

Visual acuity

Why So Many Acuity Tests?

Lea Hyvärinen, MD, PhD, FAAP

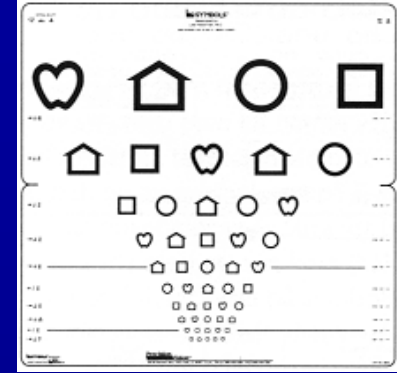
Professor h.c., Rehabilitation Sciences, University of Dortmund

Senior Lecturer, Developmental Neuropsychology, University of Helsinki

www.lea-test.fi



VA



What does visual acuity measure? - Recognition of forms.

Visual Acuity is measured as Recognition Acuity using **standard** VA charts based on **calibrated optotypes**.

Screening – surveys – assessment – follow-up

Landolt C is the **international reference optotype** for calibration.

Visual acuity values

Recognition acuity – optotype acuity, 0.1 -2.0 (6/60 – 6/3
60M cards @ 1m, VA value is 0.016 (20/1250, 6/380)

Detection acuity – small objects, ”where”function
– grating acuity ” ”

Discrimination acuity – resolving orientation of gratings

Hand movements, light perception/ projection

(no ”counting fingers”, fingers are not standardized)



WORLD HEALTH ORGANIZATION

WHO/PBL/03.91

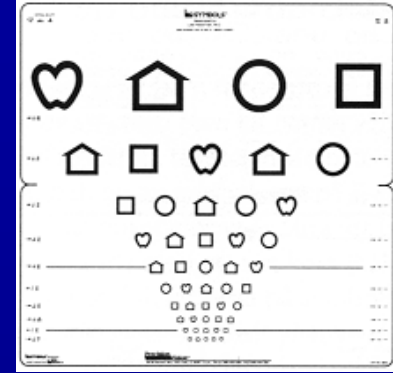
Prevention of Blindness & Deafness

**CONSULTATION
ON DEVELOPMENT OF STANDARDS
FOR CHARACTERIZATION
OF VISION LOSS
AND VISUAL FUNCTIONING**

Geneva, 4-5 September 2003



WHO/PBL/03.91



Standardized, calibrated optotypes

Logarithmic design

Distance & near VA, same optotypes

Distances 6m (**4m**) and near **40cm**; children **3m**

adjust the distance and angle to fit the needs of the child

NOT to point at the optotypes.

Second measurement using pointing to reveal
a possible difference between the values

Luminance between 80 and 160 cd/m²

Visual acuity

of children with special needs for visual functioning

- Measurement of visual acuity using optimal refractive correction that the child can use
- in standard luminance + optimal luminance
- using varying postures when needed
- Always record: **name of the test, distance used.**

Optotype tests

Line tests

Crowded tests

Single optotype tests

Letters, numbers, paediatric symbols

(Letters are difficult to design so that they would be equally recognizable.)


















Different tests for screening, surveys, assessment.

VA - line test


DISTANCE EQUIVALENTS
FOOT METER

leg SYMBOLS®
Developed by Lea Hyvärinen, M.D.
FOR TESTING AT 16 INCHES (40 CM)

LETTER SIZE DECIMAL

<p>20/400 6/120</p>		<p>6.0 M .05</p>
<p>20/320 6/96</p>		<p>6.3 M .063</p>
<p>20/250 6/75</p>		<p>5.0 M .08</p>
<p>20/200 6/60</p>		<p>4.0 M .10</p>
<p>20/160 6/48</p>		<p>3.2 M .12</p>
<p>20/125 6/36</p>		<p>2.5 M .16</p>
<p>20/100 6/30</p>		<p>2.0 M .20</p>
<p>20/80 6/24</p>		<p>1.6 M .25</p>
<p>20/63 6/18</p>		<p>1.25 M .32</p>
<p>20/50 6/15</p>		<p>1.0 M .40</p>
<p>20/40 6/12</p>		<p>.80 M .50</p>
<p>20/32 6/9.5</p>		<p>.63 M .63</p>
<p>20/25 6/7.5</p>		<p>.50 M .80</p>
<p>20/20 6/6</p>		<p>.40 M 1.0</p>
<p>20/16 6/4.8</p>		<p>.32 M 1.25</p>
<p>20/12.5 6/3.8</p>		<p>.25 M 1.6</p>
<p>20/10 6/3</p>		<p>.20 M 2.0</p>


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




























































































































































































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50% & 25% Spacing



Developed by Lea Hyvärinen, M.D.
FOR TESTING AT 16 INCHES (40 CM)

DISTANCE EQUIVALENTS FOOT METER	50% CROWDING	25% CROWDING	LETTER SIZE DECIMAL
20/400 6/120	    	    	8.0 M .05
20/320 6/95	    	    	6.3 M .063
20/250 6/75	      	     	5.0 M .08
20/200 6/60	      	     	4.0 M .10
20/180 6/48	      	     	3.2 M .12
20/125 6/36	      	     	2.5 M .16
20/100 6/30	      	     	2.0 M .20
20/80 6/24	      	     	1.6 M .25
20/63 6/19	      	     	1.25 M .32
20/50 6/15	      	     	1.0 M .40
20/40 6/12	      	     	.80 M .50
20/32 6/9.5	      	     	.63 M .63
20/25 6/7.5	      	     	.50 M .80
20/20 6/6	      	    	.40 M 1.0
20/16 6/4.8	      	    	.32 M 1.25
20/12.5 6/3.8	      	    	.25 M 1.6
20/10 6/3	      	   	.20 M 2.0

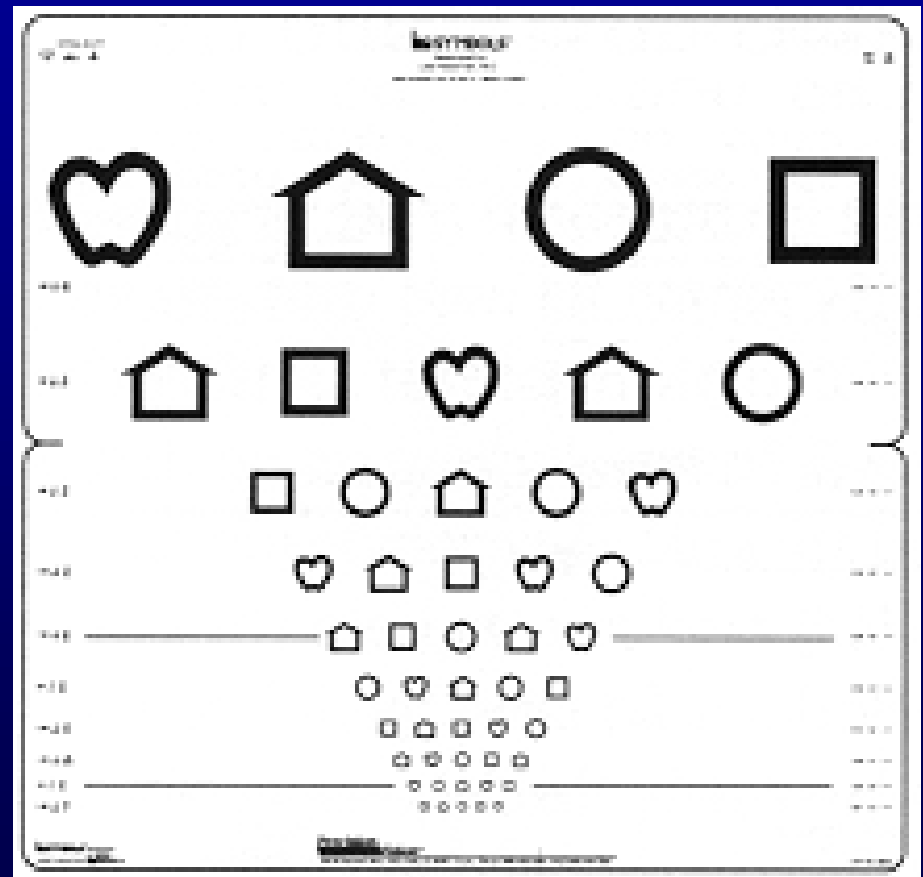
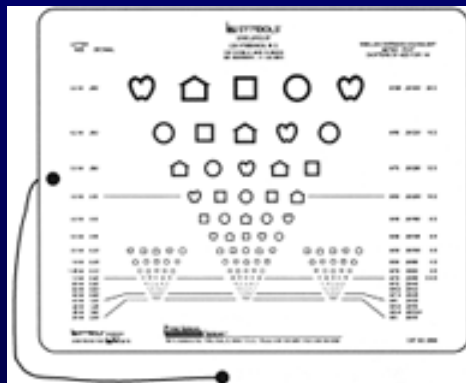
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Examined by Leo Hyvärinen, M.D.
www.leo-hyvarinen.com

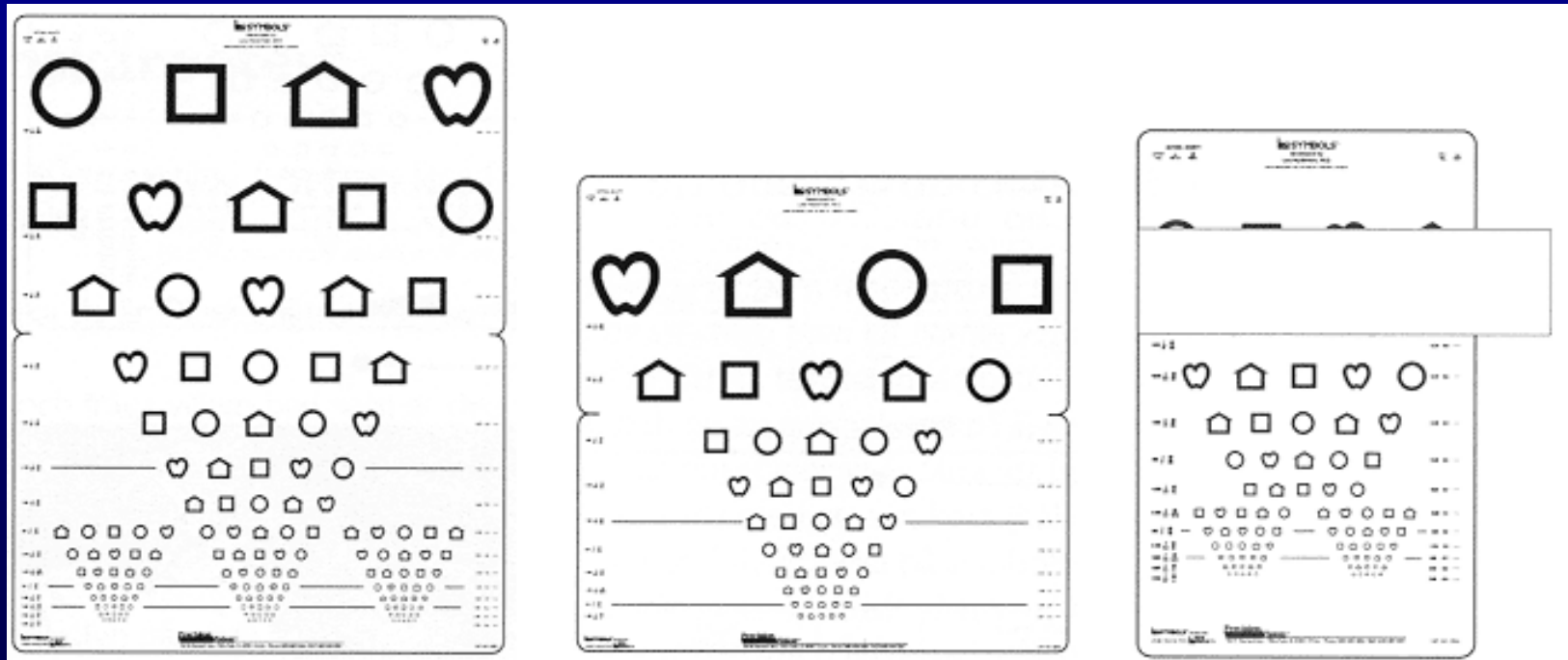
Line tests for the 3-4 year old

vision screening tests for threshold measurements



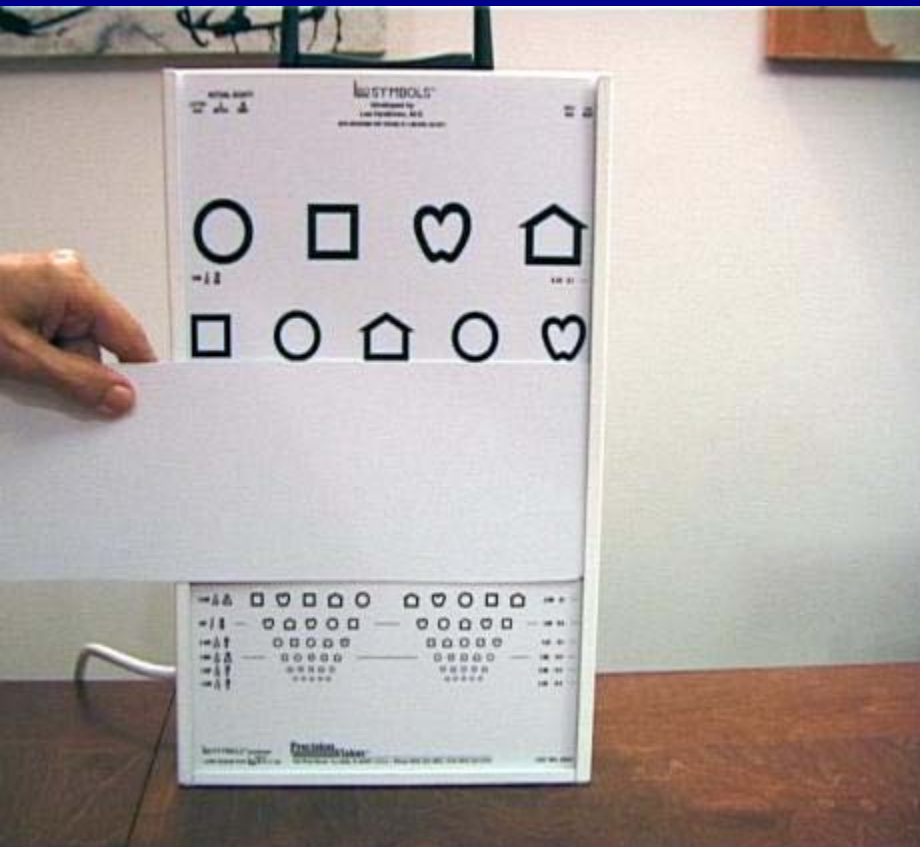
Visual acuity, line tests

standard distance tests for assessment

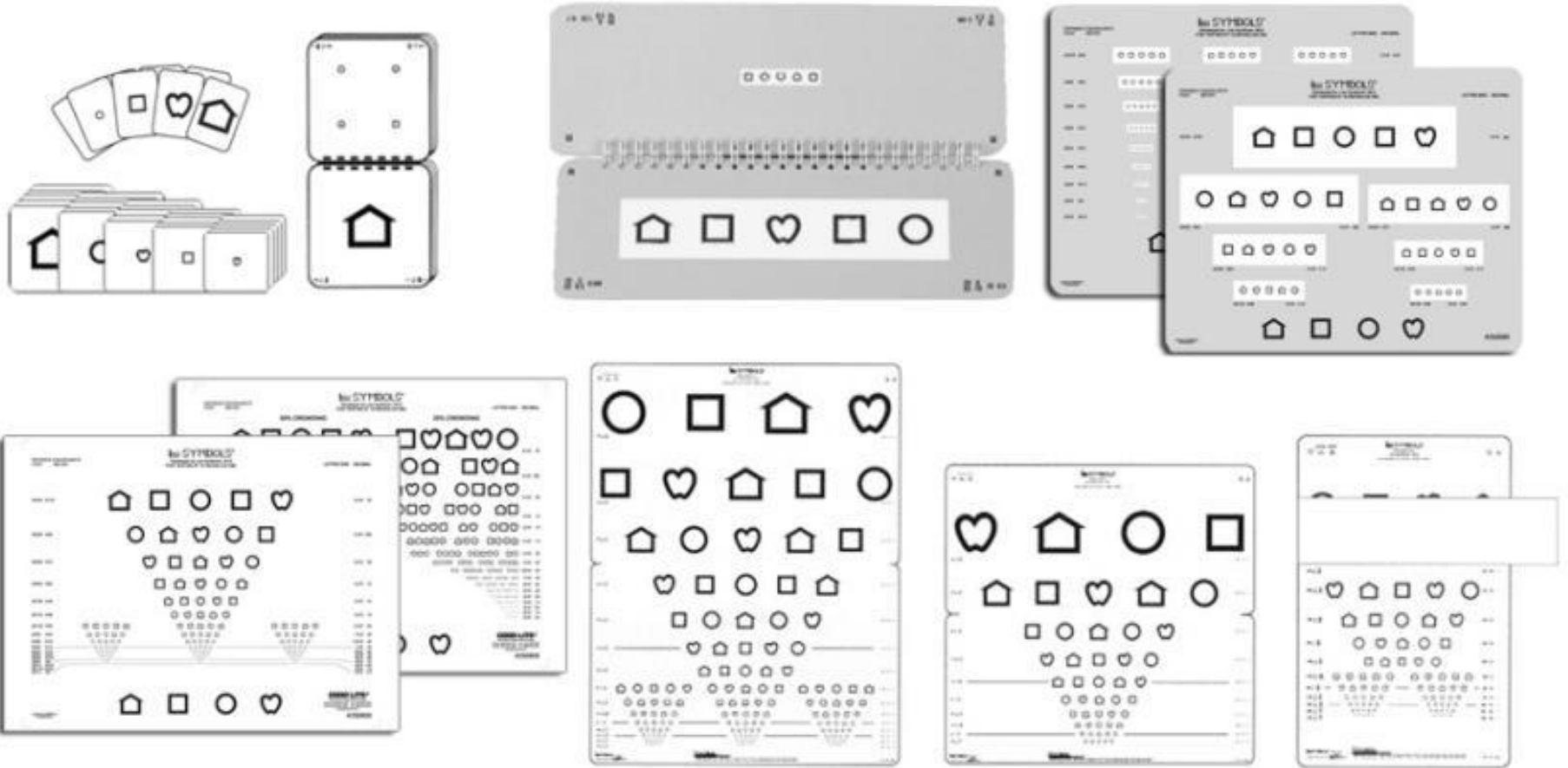


Standard luminance
level

VA charts on the small lightbox

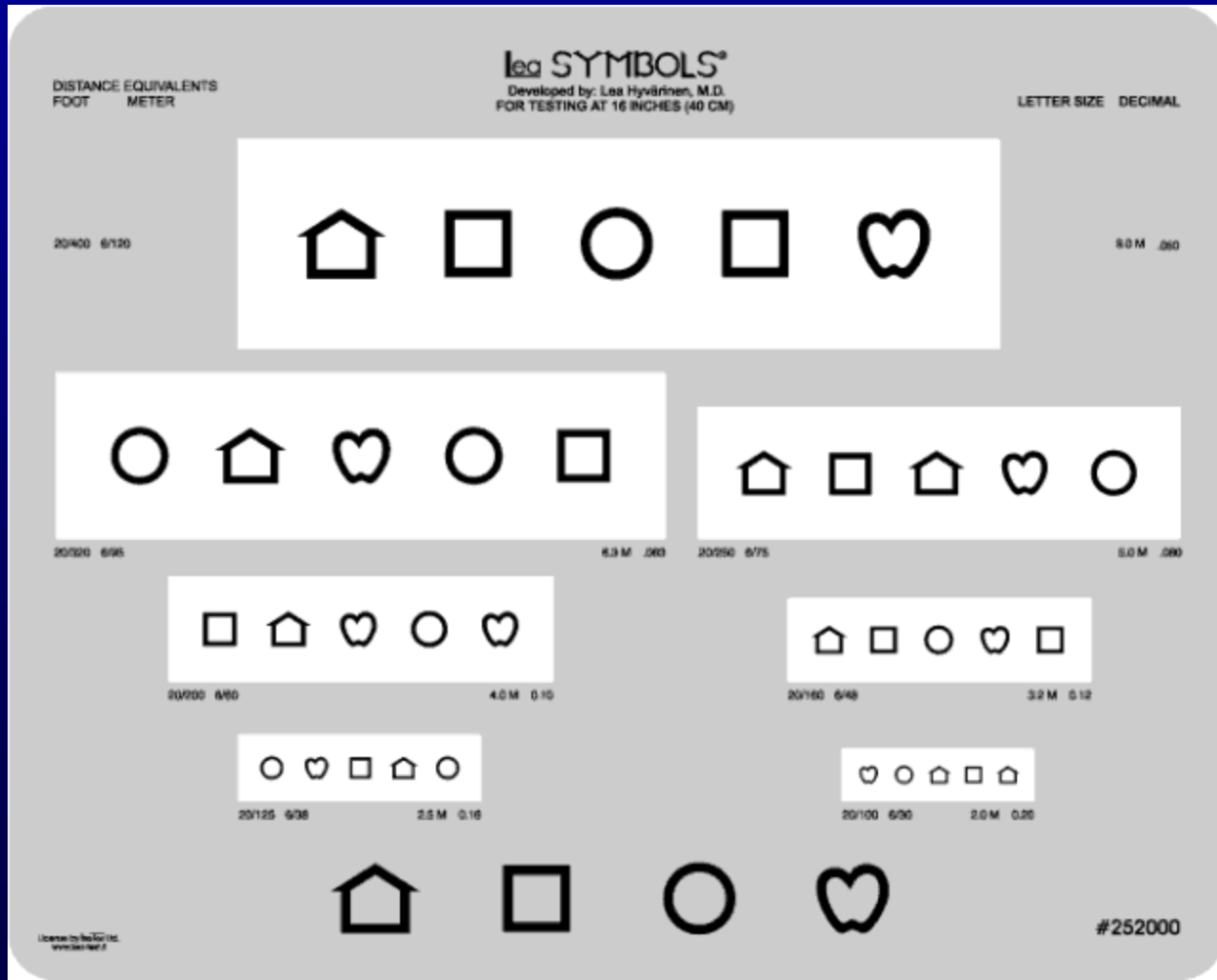


Single, line, crowded

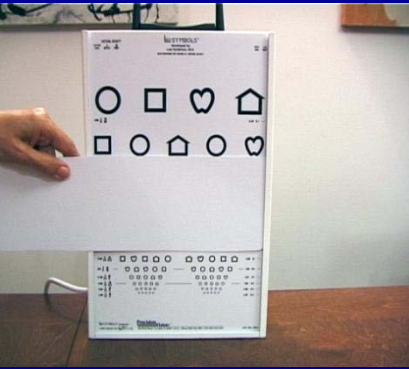


Screening Near Test

larger spaces between lines – easier for the tester, faster







Summary on optotype VA

screening, surveys, basic assessment

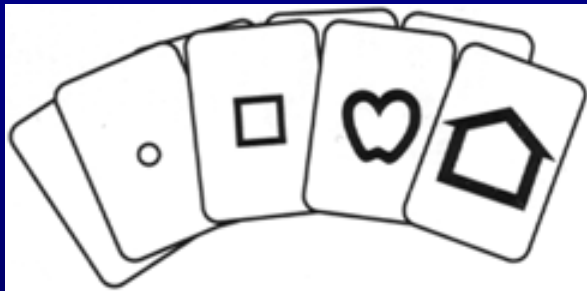


- Several visual acuities: near, distance
 - line, crowded, single
 - Technique: ask which is the first optotype on each line until error or hesitation, next ask the child to read the previous line and then following lines until at least 3 out of 5 optotypes are correctly recognised = threshold.
- Pointing helps fixation, line test without pointing.
- As a second test, try with pointing, report separately.

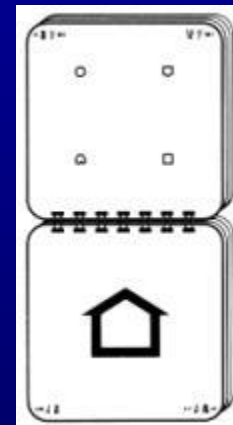
Young children
and
Children with different abilities

Single LEA Symbols tests

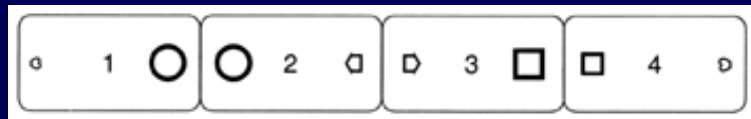
the earliest tests for measurement of VA



LEA Playing Cards



LEA Single Symbols Book



LEA DOMINO Cards
for training of amblyopic eyes



LEA Symbols Flash Cards

Concept "same" in measurement of VA

with colours



with B & W forms



$VA = m/M$

comparing concrete object
with picture



Playing Cards



Learning to match forms



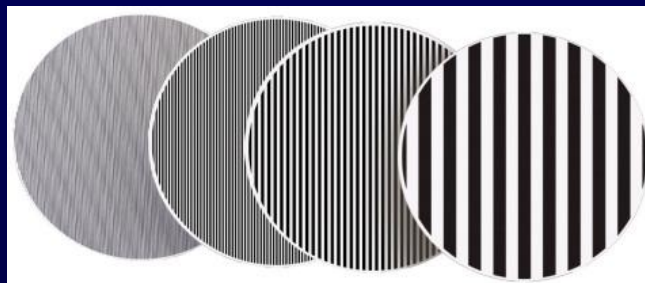
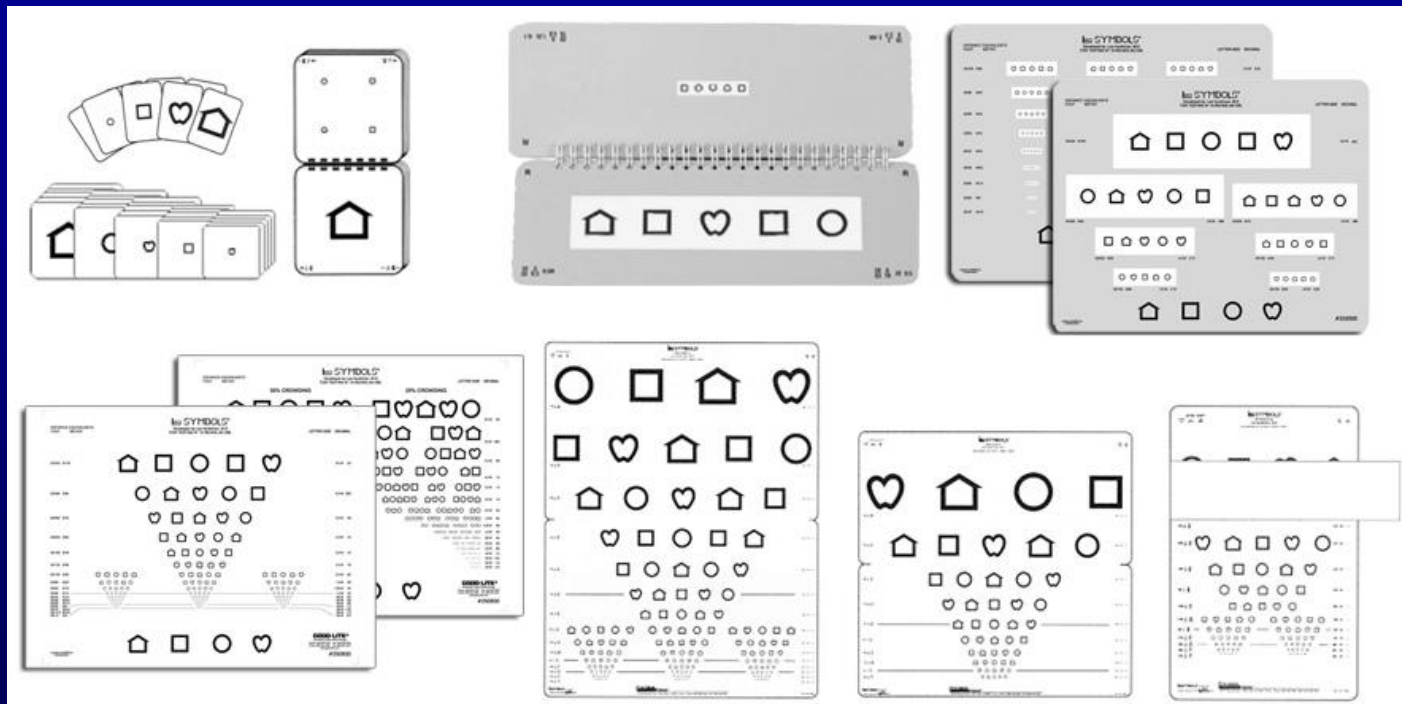
Infants with Down syndrome should have their
near correction at the age of a few WEEKS if
the error is +6.0 as in this girl or a high minus.

Naming symbols

monocular testing



Single, line, crowded + grating acuity



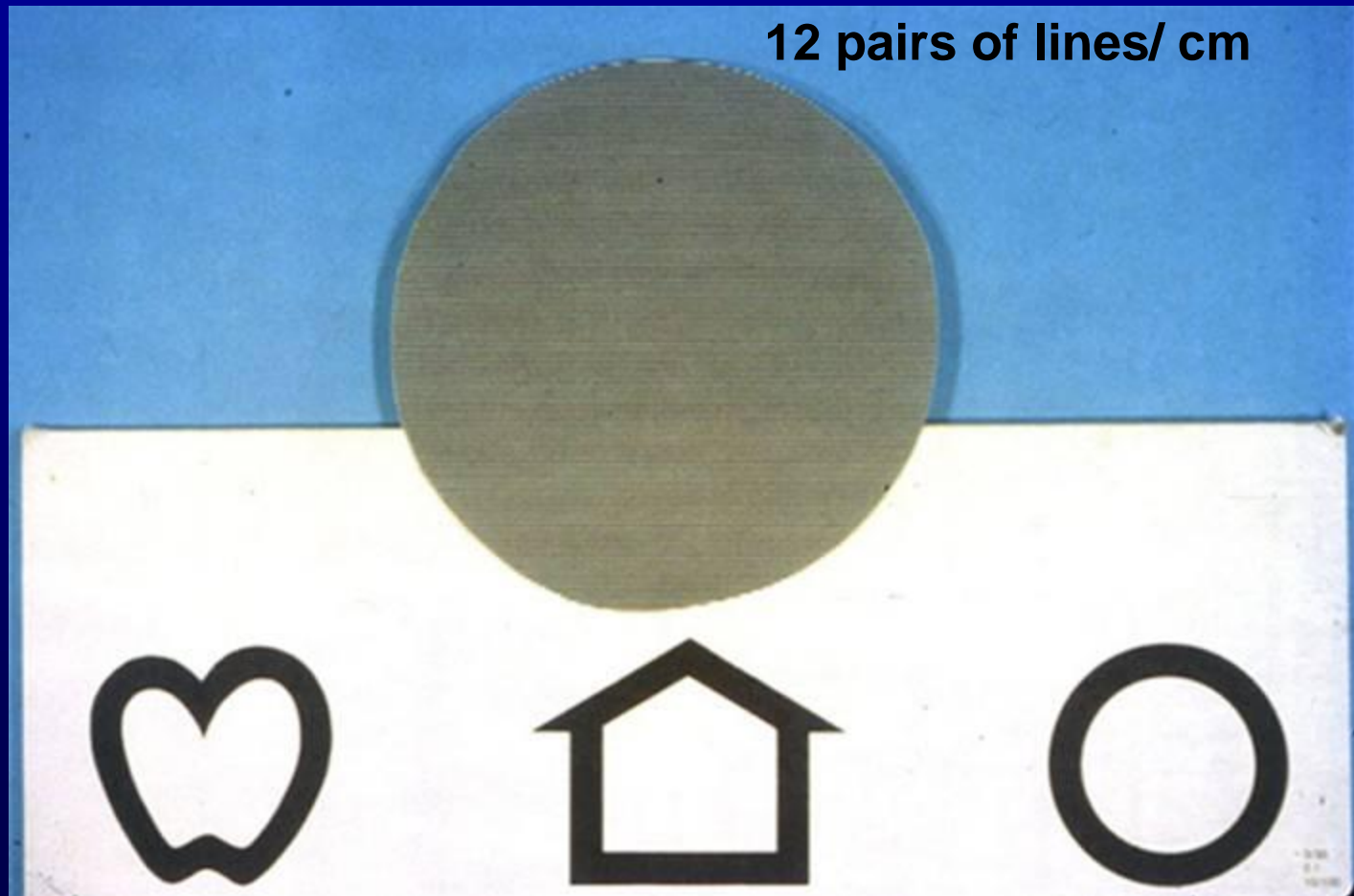
Discrimination Grating Acuity

Discrimination Grating Acuity

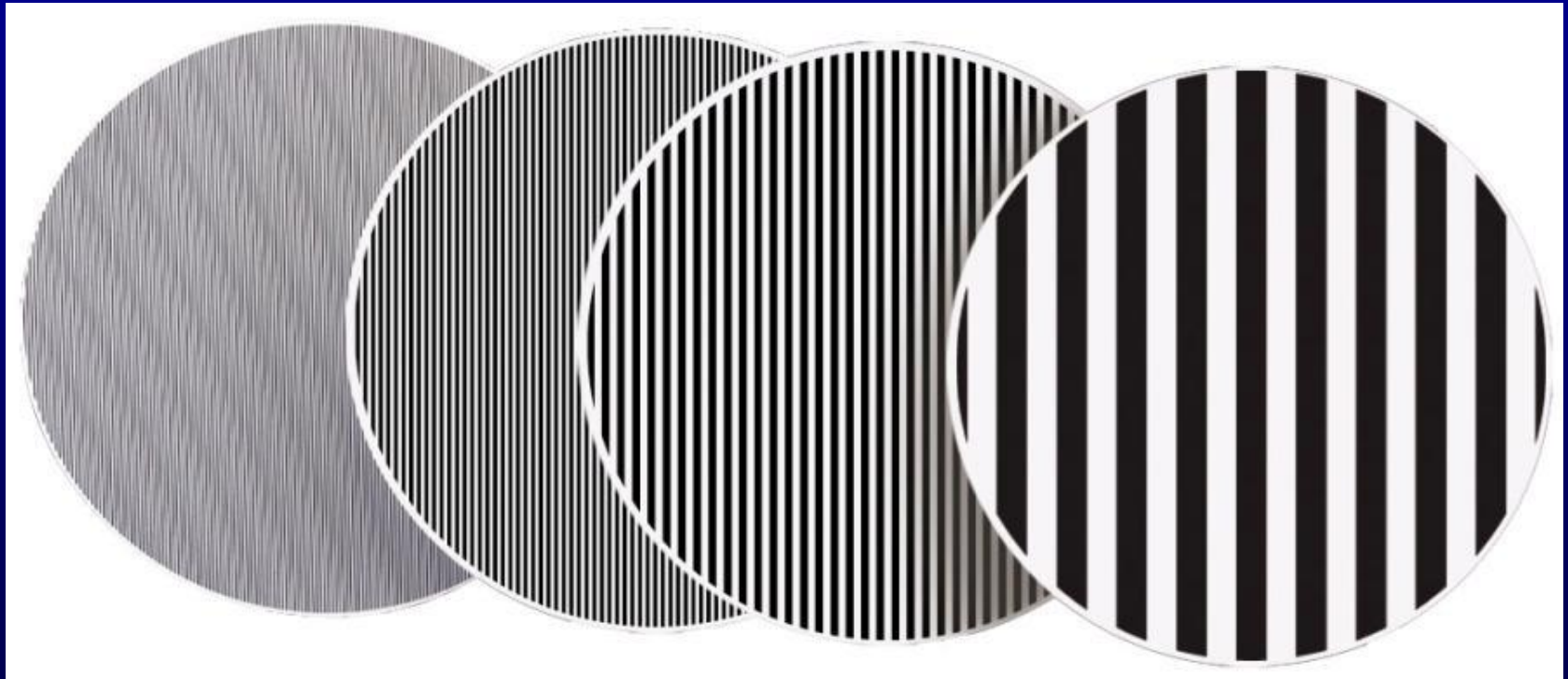


February 1983, Achromatopsia

VA 0.004 - 0.01, GrA 4 - 6cpd



LEA Grating Acuity Test



Discrimination acuity

Grating acuity values
MUST NOT
be converted
to
optotype acuity values

Grating Acuity Test



Optotype acuity VA= 0.004; 3/750, **6/1500**

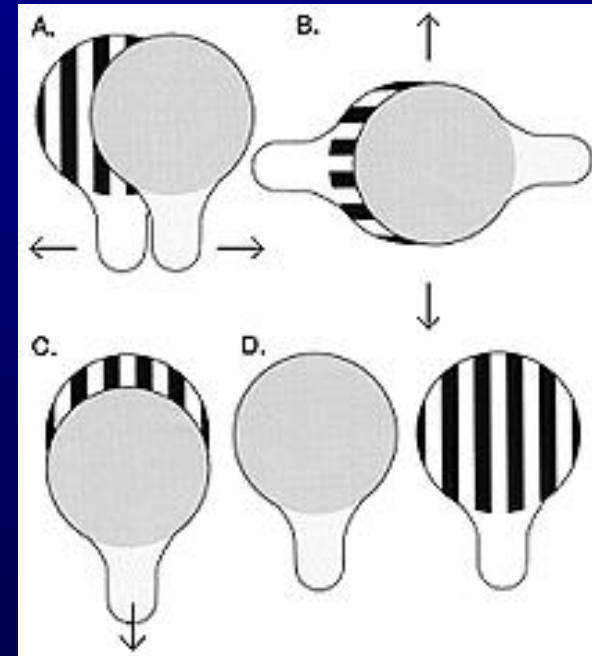
Grating acuity **4cpd**; if "converted", would be 0.12; 6/50; **30x better than the VA value**

Detection Grating Acuity

Detection Grating Acuity



Teller Acuity Cards



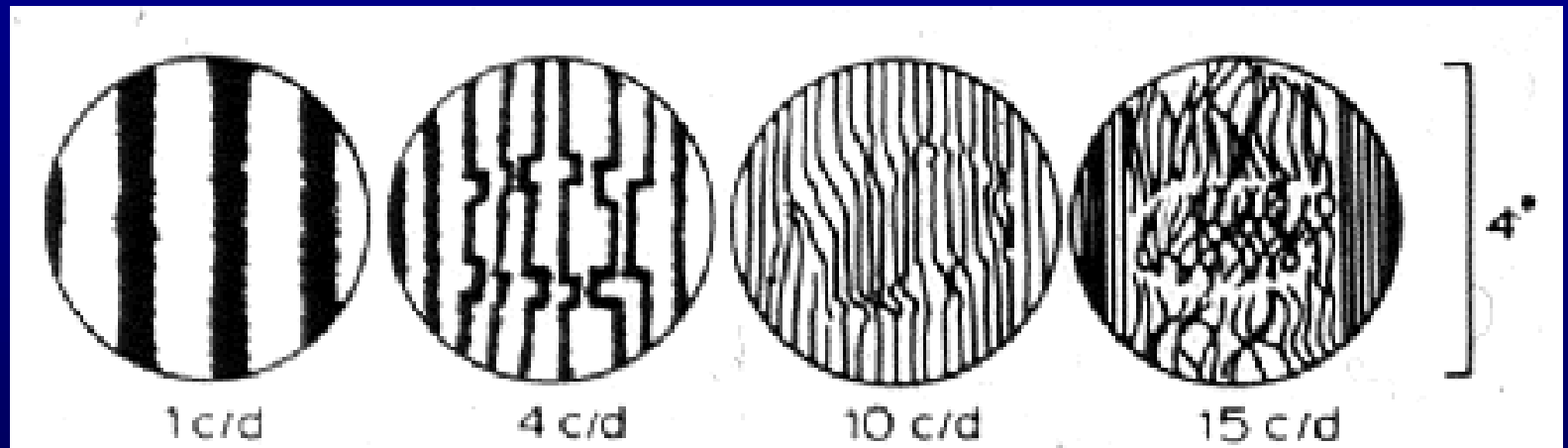
Lea Gratings

Grating Acuity

as detection acuity

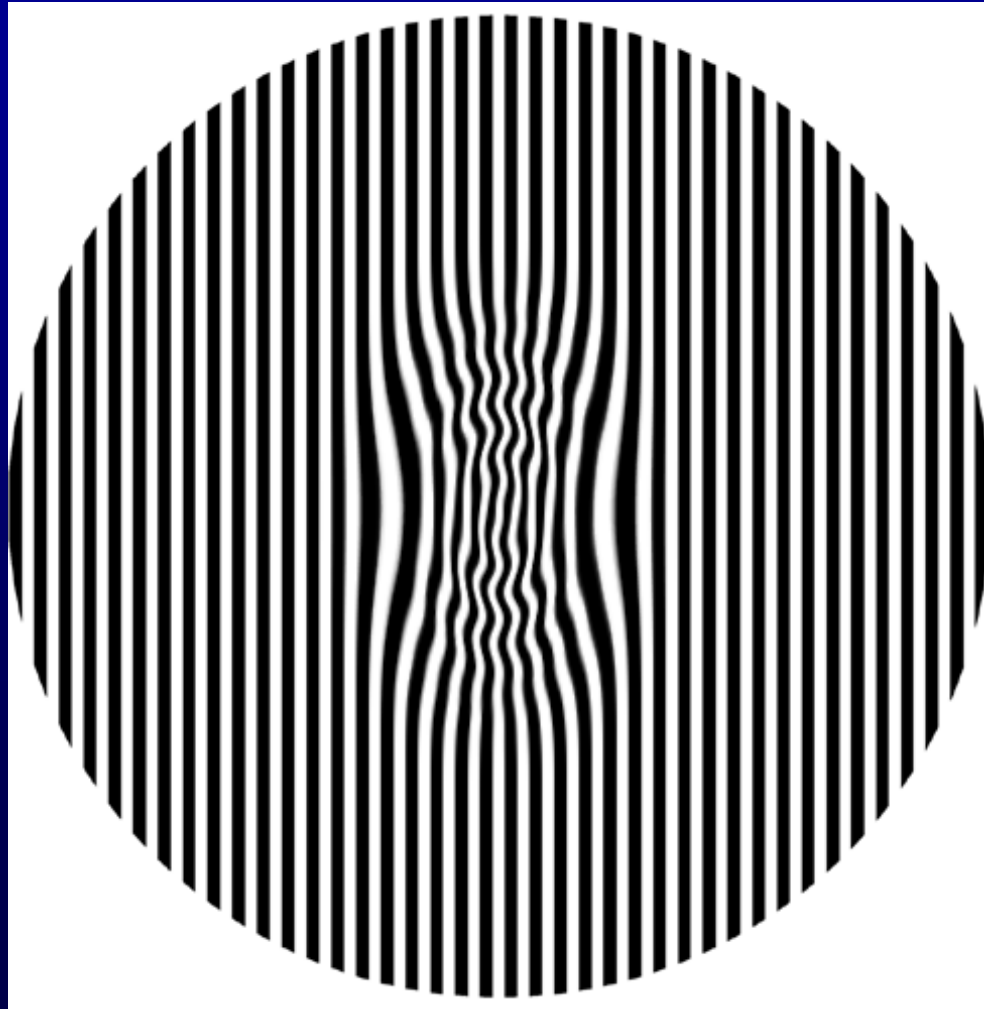


Grating acuity



Detection test

Distortion of central image



Difficult-to-test infants and children

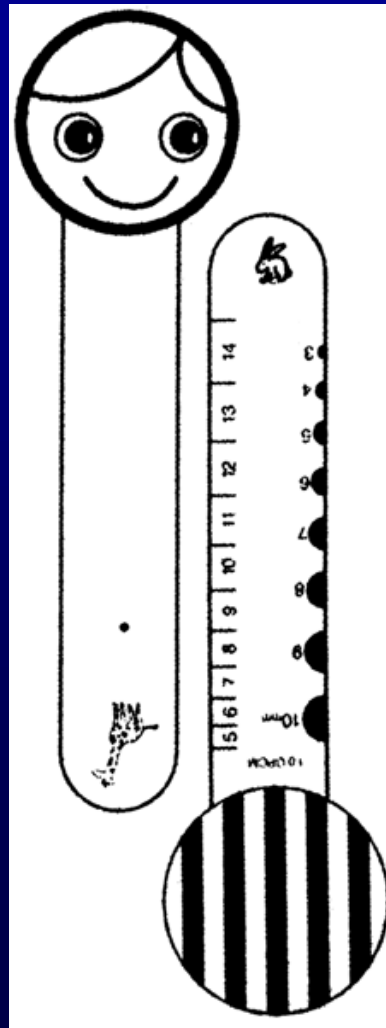
Detection acuity, small objects

- The size of the object
- The background/ contrast
- The distance
- Doctor can calculate the size of the object as angular size.



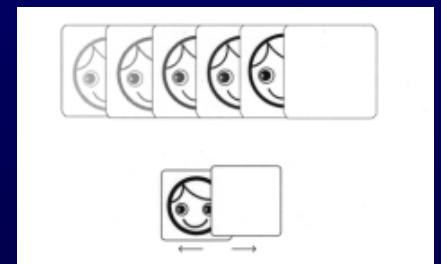
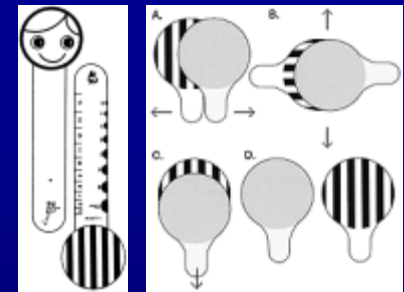
Fixation test

Robert Fantz' face picture
Small fixation targets for
the 4-year screening.



Clinical examination

gives the foundation for the assessment of visual functioning



Hiding Heidi test

Photo: Miguel G. Alvares, MD Brazil

Hiding Heidi

low contrast pictures for assessment of communication distance



Facial expressions are fast moving low contrast shadows.
Copying smiling face = must have been seen, then copied.

Figure-in-motion, Pepi-test



Near correction, head support



Pepi-test, copy from www.lea-test.fi

Never mention what you saw moving on the screen!!
You can ask "Should I play it again?"

Difficult communication situations



Student responds reliably to questions that are recorded.

Oculomotor problems

Slow and inexact accommodation >> Puzzle board as a tactile key card



Cover above and below the line to be read.
Use the LEA Puzzle board as the key card.



Transdisciplinary assessment

Educational Assistant

helping VI teacher to test in an optometrist's office



Poor visual acuity

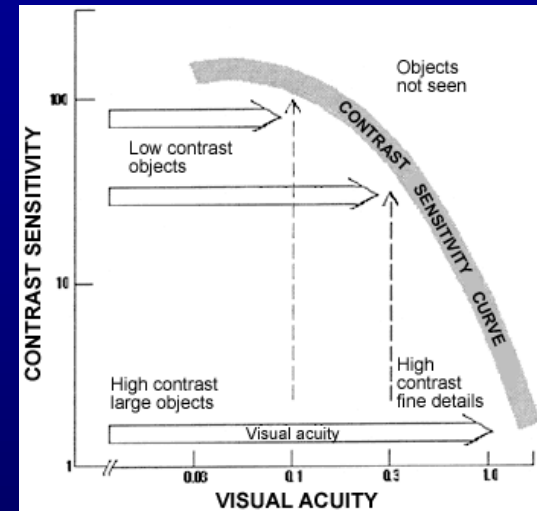
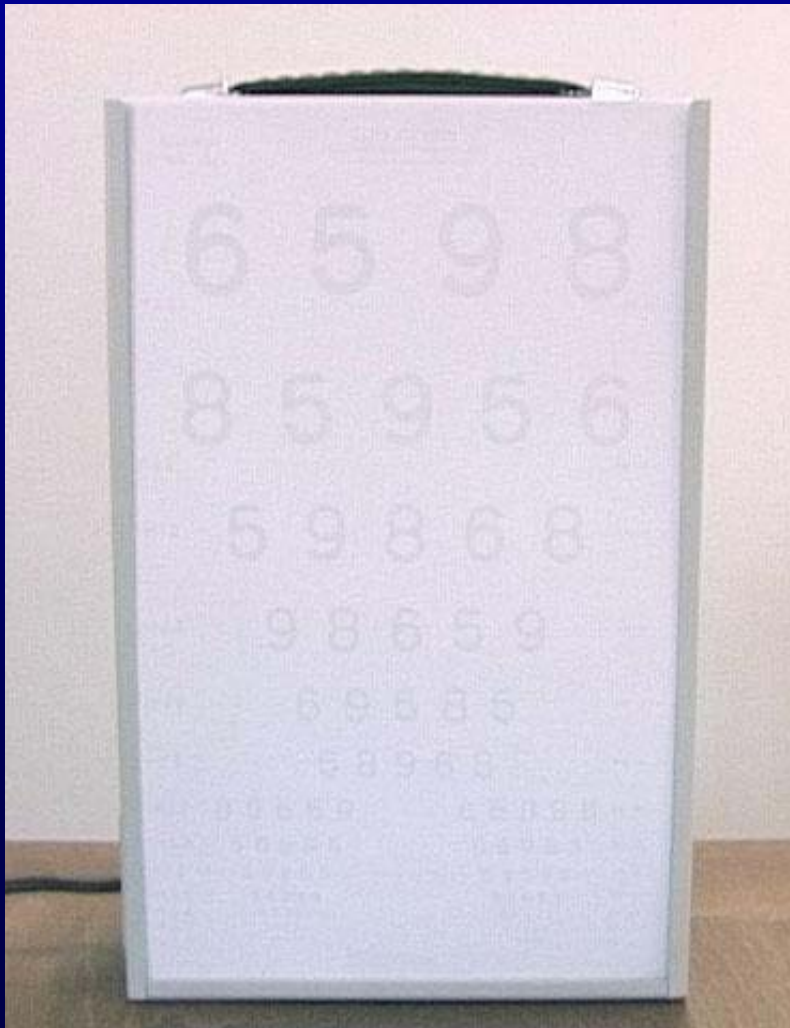
Xmas decorations & UV light



Low contrast VA

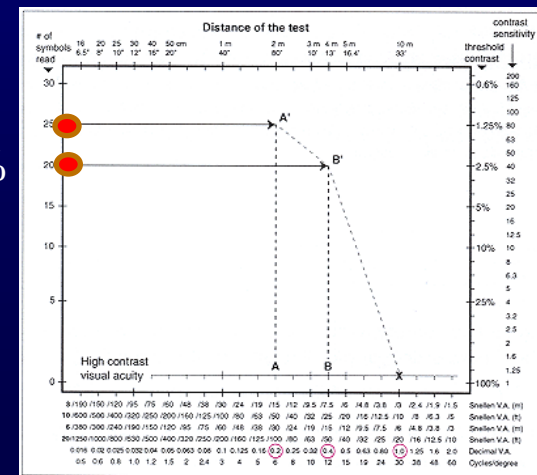
Translucent low contrast test

at 2.5% contrast on the small lightbox



95 %
contrast

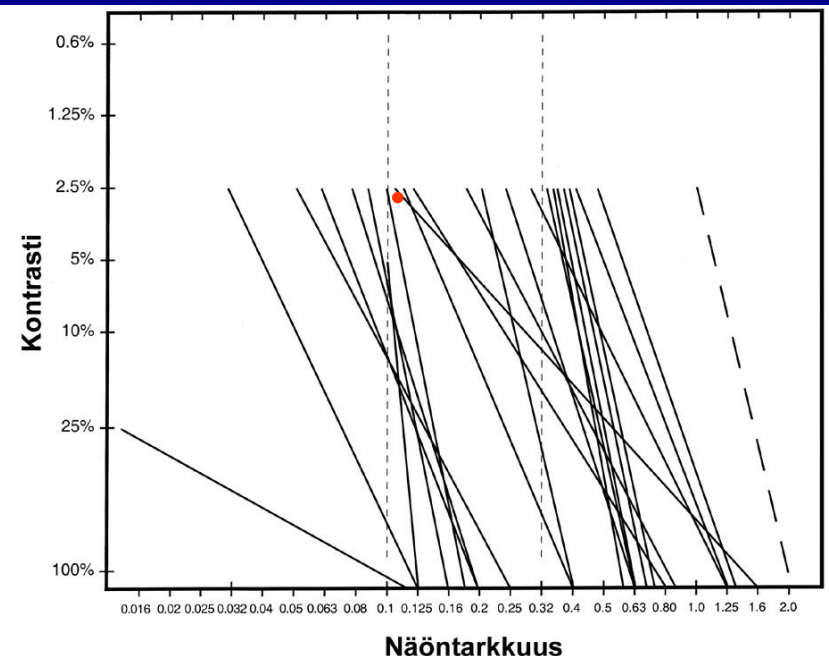
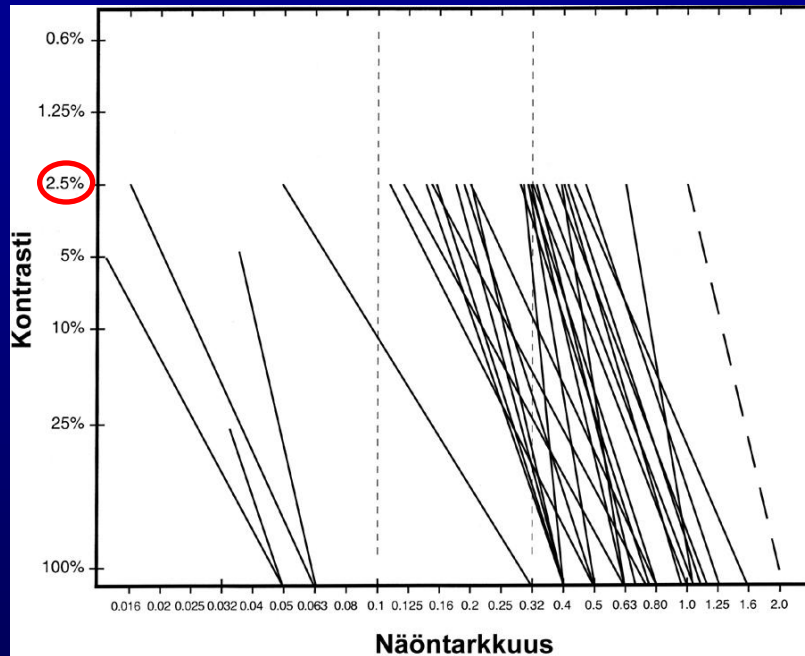
1%
2.5%



Contrast sensitivity

50 children with motor problems

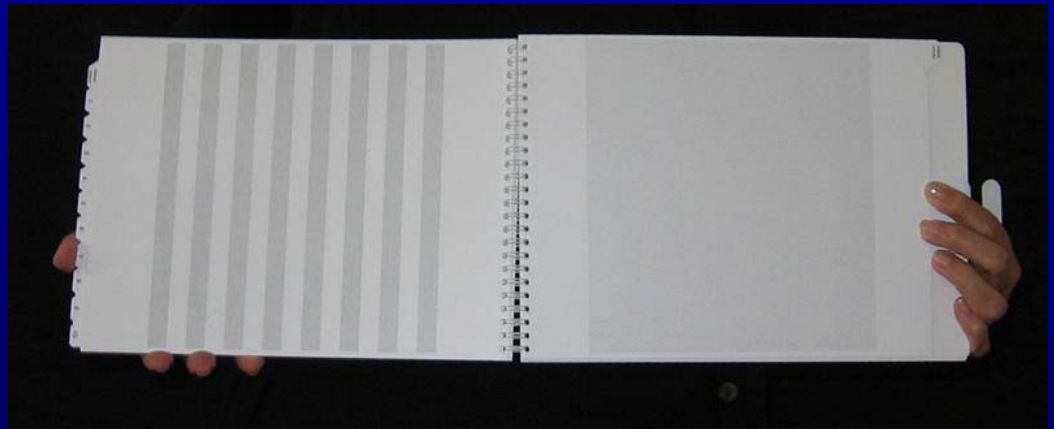
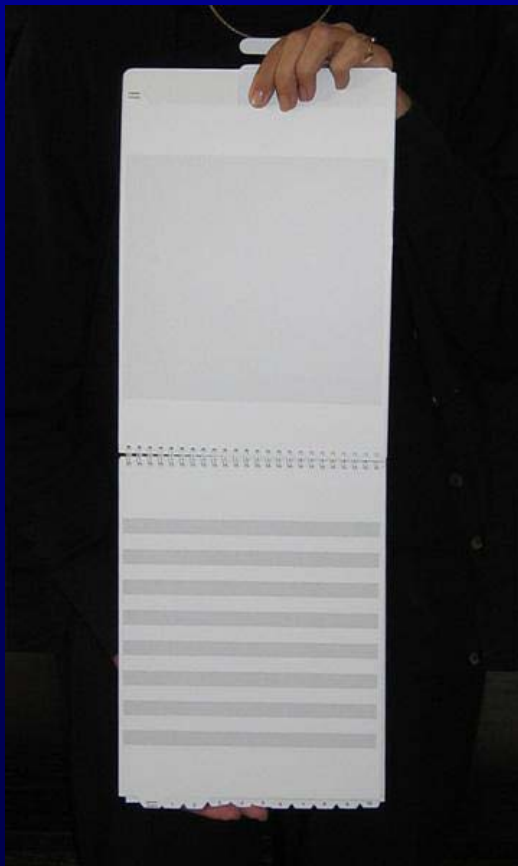
2.5%



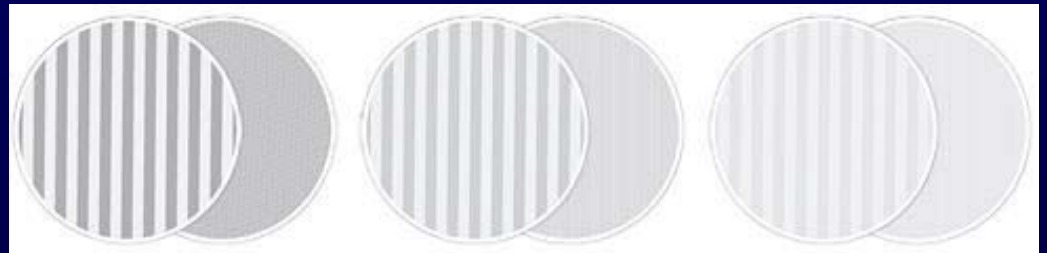
Declination of the slope varies, mostly close to normal: $\frac{1}{2}$ of the high contrast VA
 The student with the highest visual acuity 1.6, 6/4, had at 2.5% only 0.1(+2), 6/60(+2)
 10% of students with severe CP did not see the 2.5% contrast test.

Low Contrast Grating Tests

Cambridge Low Contrast Gratings

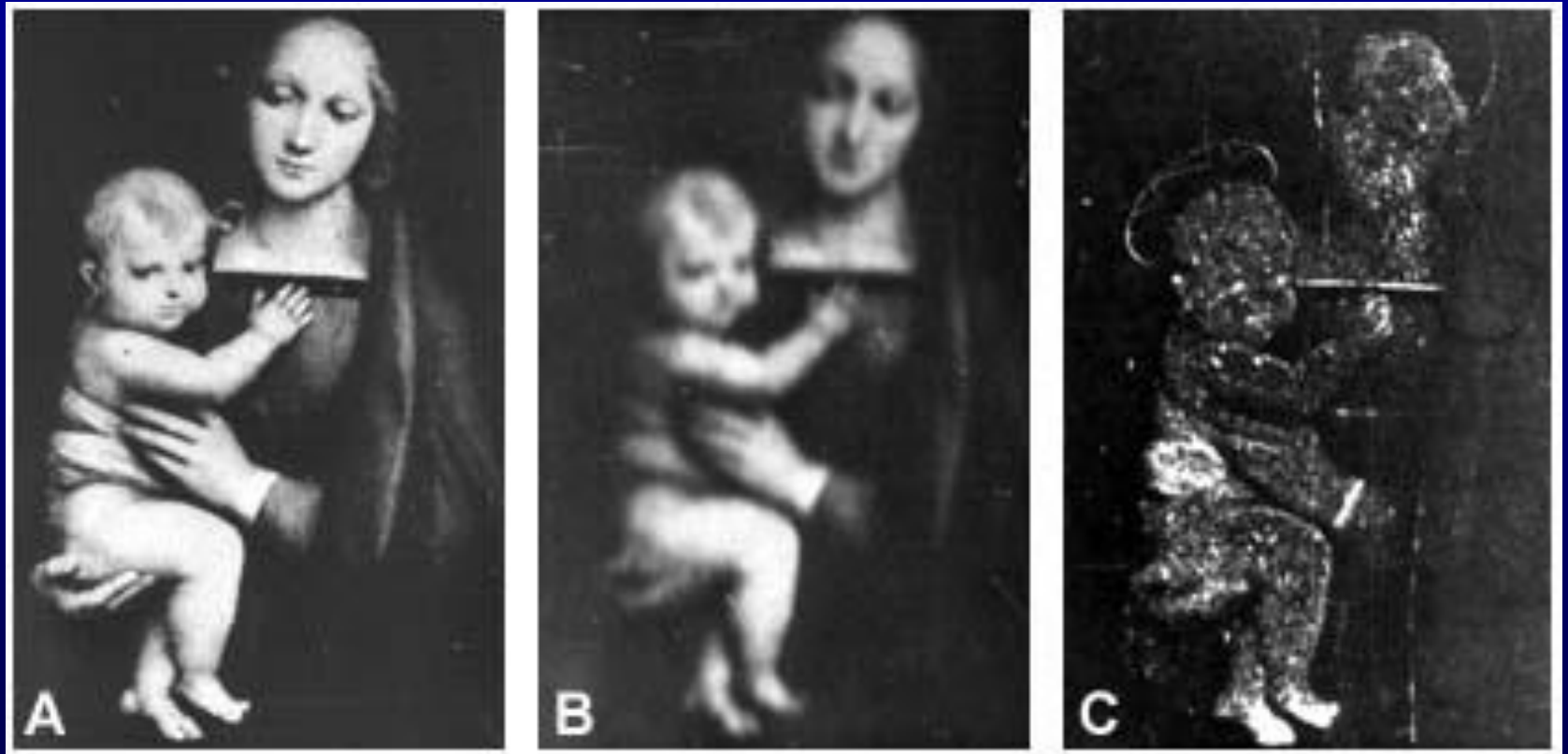


LEA Low Contrast Grating Acuity Test



Low contrast information & image quality

Lamberto Maffei 1981



Visual information for perception of round forms and in communication is NOT transferred by fine lines (high GrA & VA) but broad lines (low VA) at low contrast.

Visual Acuity

Detection acuity: objects, gratings

Grating discrimination acuity

Optotype recognition acuities

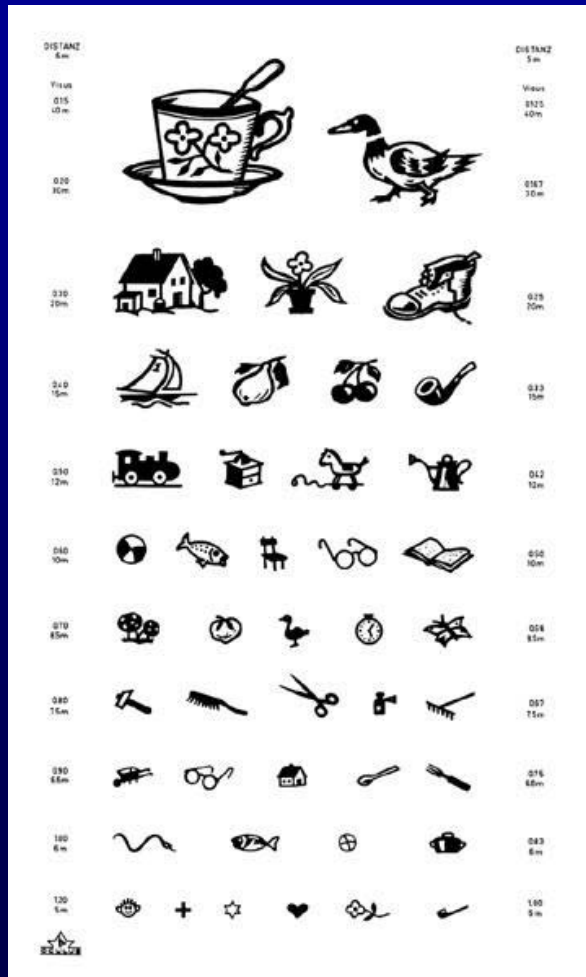
near & distance

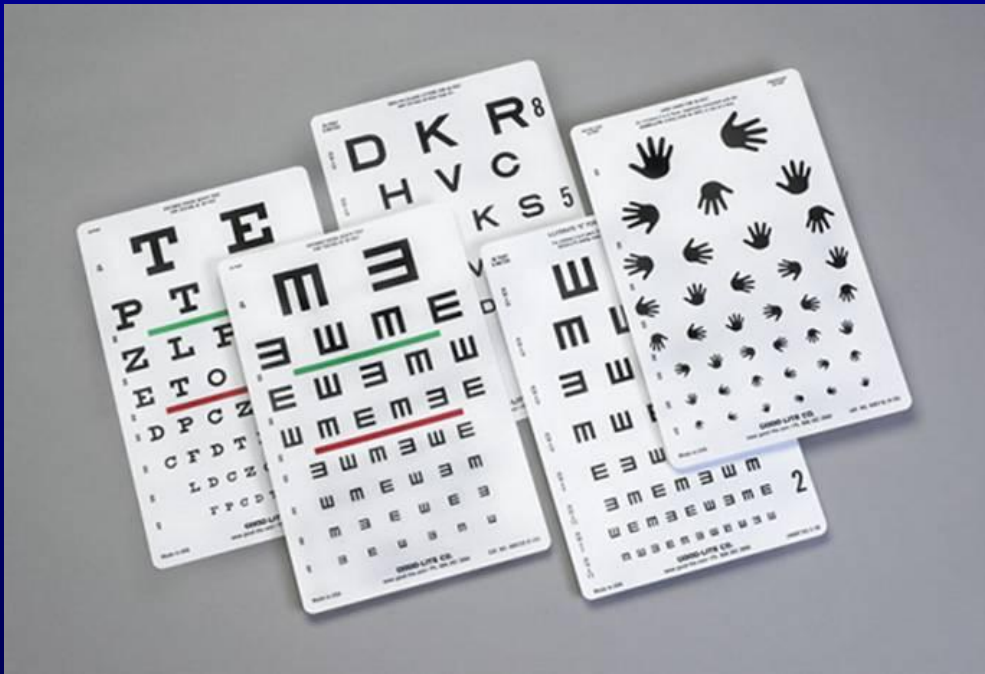
Line, crowded, single

Low contrast tests

Non-calibrated tests

Old non-calibrated tests 1976





Letters cannot be drawn so that they would be equally recognizable. In the best letter test, ETDRS with the Sloan letters there are 3 groups of letters with different recognizability: S, O, C the hardest, Z the easiest.

Visual Acuity Tests

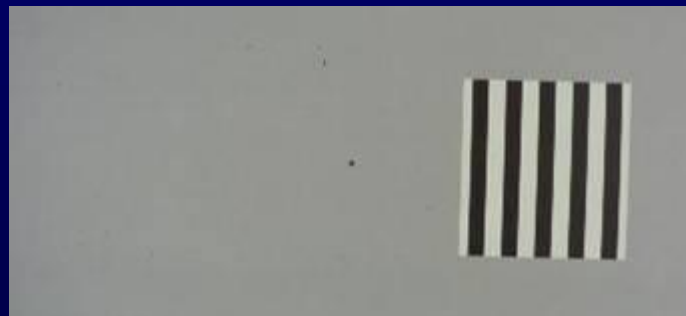
non-calibrated with the reference optotype, Landolt C



Kay Pictures

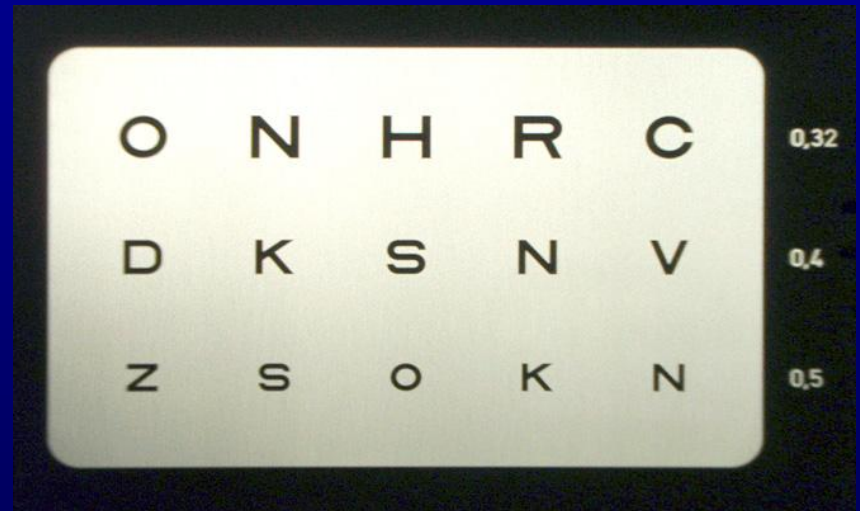
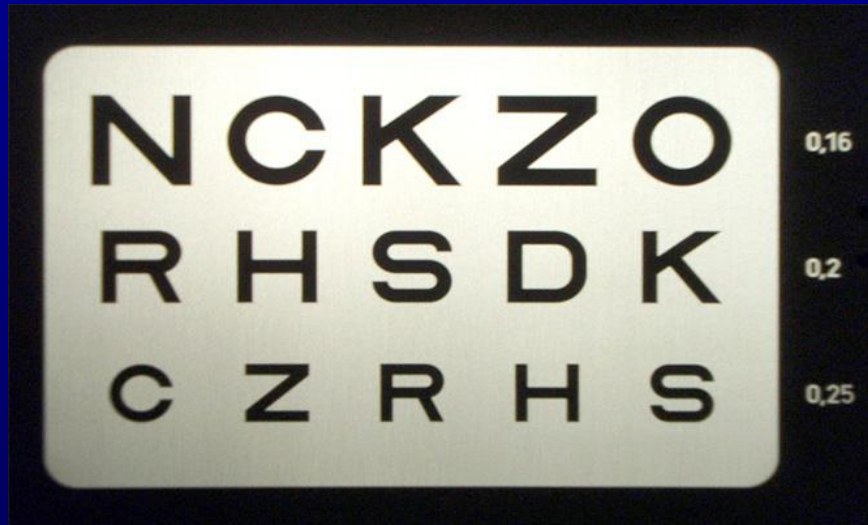


Keeler LogMAR, HOTV



Grating Acuity Cards do NOT measure recognition acuity, are not a VA but a GrA test

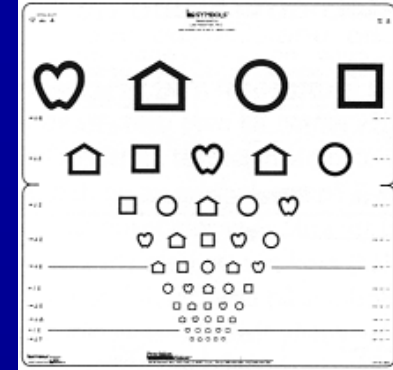
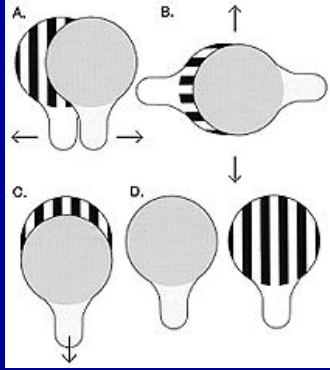
VA tests on projectors and computer screens



Spacing irregular, optotypes vary, luminanc level varies.
There are very few computer based tests with correct lay-out
and with correct sets of ideal optotypes.

Why So Many Acuity Tests?

- Different calibrated tests measure different functions
 - line, tightly crowded, single optotype tests
 - near and distance vision; high and low contrast
 - different communication techniques
- Grating acuity tests, discrimination tasks, image quality?
- Tests that measure other visual functions
 - Cardiff vanishing pictures, detection + recognition
 - Detection tests, objects and gratings
- Non-calibrated picture tests with varying optotypes exist as long as they are purchased.



Visual acuity

Why So Many Acuity Tests?

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www.lea-test.fi