AAO Diplomate Preparation Course: Low Vision Reading Assessment
November 2018

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Low Vision Section
READING!!!

Visually demanding
Important
Low Vision Reading Assessment

• Background:
  – Assessment and management related to reading is central to low vision practice.
  – There are a range of methods for predicting successful options for reading.

• Objectives:
  – Deepen understandings of assessment options.
  – Offer a practical and systematic approach to individualized determination of optimal viewing conditions for reading.
Low Vision Reading Assessment

• Multilayered and flexible approach:
  – Review of basics plus more nuanced approaches
  – Some acknowledgement of the evidence base
    • But issues of repeatability and validity
  – Inclusion of practical clinical techniques
  – Case based practice problems

• Road map:
  – Using distance acuities
  – Using near acuities
  – Using reading speed vs. print size
Thoughtful Vision Assessment Facilitates Reading Management

Patient Visual Needs
1. History
2. Kestenbaum
3. 2x Kestenbaum
4. Critical Print Size
   a. Reciprocal
   b. “Hey, doc”
5. 2x Word Threshold
   (= acuity reserve of 2)

Device Capabilities
1. Spectacles/adds
2. Loupes
3. Simple hand-held mags
4. Stand mags
5. Near telescopes
6. Video/electronic mag

\[ \text{Feq LVD} \geq \text{Feq for 1M} \]

Feq LVD must \( \geq \) Feq for 1M to allow 1M reading.
Using **Distance Acuity** to Predict Reading Performance

- **Distance acuity** gives us some idea about how much magnification is needed for reading.

- But **distance acuity** is **not** enough to manage reading **well**.
Reading Potential by Acuity
(ICD-9-CM ranges; WHO classification; task force interp.)

Near-Normal Vision:
20/32 - 20/63

Stronger glasses give normal reading speed

Moderate Low Vision:
20/80 - 20/160

Low powered magnifiers give near-normal speed

Severe Low Vision:
20/200 to 20/400

High powered magnifiers give slowed reading
Reading Potential by Acuity

(ICD-9-CM ranges; WHO classification; task force interp.)

Profound Low Vision: 20/500 - 20/1000
Marginal reading even with strong magnifiers

Near-Blindness: 20/1250 - 20/2000
No visual reading; vision substitution needed

Total Blindness: No light perception
No visual reading; vision substitution needed
Kestenbaum’s Rule: (aka reciprocal of vision)
Using Distance VA
to Predict Magnification for Reading

Distance MAR = Add (in D) needed for 1M
\(\text{same as saying}\)
Reciprocal of DVA = Add (in D) needed for 1M

- eg. If 20/200, then +10.00 DS for 1.0 M
- eg. If 20/100, then +5.00 DS for 1.0 M
- eg. If 20/20, then +1.00 DS for 1.0 M
M Units
(developed by Louise Sloan)

• Simply meter letter sizes
  – Just like meter letters on the B-L & ETDRS charts
    • used routinely at distance in many countries (eg. 6/12 = 20/40)
    – They are the small end of the scale.

• Defined: Metric distance at which lower case letter (“x height”) would subtend 5 minutes of arc.

• Use: Able to express as Snellen fraction with metric test distance as numerator
  – eg. 0.40/0.40 M means reads 0.4 M at 40 cm
  – eg. 0.50/1.0 M means reads 1.0 M at 50 cm
M Units and Point Size
(or N notation)

- Printers’ system in which 1 point = 1/72 inch
- Measures full height from tallest ascending element to lowest descending element.
- 8 point print = 1.0 M print
  - with Times Roman print

- How big is 8 pt? 8 pt = 8/72 inches in height
  - lower case letters (x height) is about 1/2 full height for many fonts (eg. Times Roman)
  - So, M size corresponds with ½ the total letter height
  - 4/72 inches = 1.41 mm

- How big is 1.0 M? arc tan 5 minutes of arc = 1.45 mm
Basic Principles in Describing Optical Systems for Reading

• The closer print is held, the larger the angle it subtends at the eye.

• For any given print size, there is a maximum distance at which an eye (corrected for that distance) can read it.

• The “add” required is $1/\text{viewing distance (in meters)}$, for complete presbyopes.

• The “add required for 1M print” can serve as a useful metric of a pt’s visual needs for reading.
Basic Principles: What is an “Add”? 

- With complete presbyopes, the “add” should equal the reciprocal of the viewing distance.

- With incomplete or non-presbyopes, “adds” partially or fully replace accommodation.

- In low vision, we provide “adds” to fully or partially replace accommodation, usually at closer than standard viewing distances.
Kestenbaum’s Rule: Interpreting Results

Distance MAR = Add (in D) needed for 1M

eg. 20/200 $\rightarrow$ 200/20 = 10, +10.00 DS for 1.0 M

- With a +10.00 DS add (or accommodation or uncorrected refractive), this person should read 1.0 M print at 10 cm.

- Also means that any other viewing system that is equivalent to a +10.00 DS add will do the same.

- Indeed, we should probably say Distance MAR = Equivalent power for 1.0 M
Kestenbaum’s Rule: Advantages

- correctly specifies equivalent power that puts 1 M at pt’s letter acuity threshold
- gives easy math
- scales easily for bigger or smaller print
  - eg. can just double the result for 0.5 M
- allows recognition of very high predictions
  - eg. 20/800: 40 DS, Yikes!
Kestenbaum’s Rule: Disadvantages

- underestimates, often by a lot
  - puts patients right at threshold for letter acuity
    - threshold means always struggling
    - letter acuity is easier than word acuity
  - evidence base
    - Xiong et al (Legge) IOVS Oct 2018
      - reading acuity is a better predictor than letter acuity
    - Scholz, Flom, Raasch research: chart review @ OSU
      - calculated requirements for best reading of 1M (via CPS):
        - averages 2 times greater than Kestenbaum’s rule
        - varies a lot from patient to patient
        - varies with acuity: smaller differences at poorer acuities
On average, Kestenbaum’s rule under-estimates by a factor of 2.
Using Near Testing to Predict Reading Performance

- Acuity Reserve Method
- Reading Speed vs. Letter Size
Basic Principles:
Distance VA = Near VA
If Conditions Are The Same

• As long as:
  – In focus
  – Stimulus conditions are the same
    • lighting
    • chart design
      – crowding, letters vs. words, size progression, optotype difficulty
  – No rare, weird phenomena such as:
    • pupil size ∆ isolating different optics
      – PSC effects at near are likely over-rated.
    • reduced nystagmus with convergence
Near Letter VAs: What Is The Value?

• With a fully sighted patient
  – Some evidence re. if image is in focus.

• With a low vision patient: NOT MUCH!
  – Small changes in stimulus conditions confound.
    • Lighting
      • Letter acuity often much better than word acuity.
    – Insufficient to tell if patient is in focus.
    – Insufficient re. prognosis for useful reading.
    – Insufficient re. requirements for optimal reading.
Word & Sentence Reading Charts

- Bailey Lovie Word Reading Cards
- Colenbrander Continuous Text Card (6.3M to 0.32M)
- MN READ Acuity Charts (8M to 0.13M)
- Sloan cards (10M to 1M; we use 10M only)
- Bernell Vocational Near Test (2M to 0.5M)
- MNRead Pocket Card (3.2M to 0.4 M)
- Others

Most used in our clinic for reading assessment

Most used in our clinic for device trials
Bailey Lovie Word Reading Cards

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<th>N.</th>
<th>LogMAR (VAR)</th>
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<td>80</td>
<td>1.6 (20)</td>
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<tr>
<td>8.0</td>
<td>63</td>
<td></td>
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<tr>
<td>6.3</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>5.0</td>
<td>40</td>
<td>1.3 (35)</td>
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<tr>
<td>4.0</td>
<td>32</td>
<td></td>
</tr>
<tr>
<td>3.2</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>2.5</td>
<td>20</td>
<td>1.0 (50)</td>
</tr>
<tr>
<td>2.0</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>1.6</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>1.2</td>
<td>10</td>
<td>0.7 (65)</td>
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<tr>
<td>1.0</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>0.8</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>0.6</td>
<td>4</td>
<td></td>
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<td></td>
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answers pink
securities disease
luck collection
navy dynamic additional
incredible briefly gate
veteran encouraged lane
historians gold carries membership bullets edge
managed attempting stem fine remembered crawled
stretch procedures desk outdoor fail everywhere
biological post extreme resolution wars skilled
formidable growing duty impression corners send
rose calculator beetles tiny savings illustrate
microscope held synthesis expression from permission
sudden area generally texture optical test
Bailey Lovie Word Reading Cards: Advantages & Disadvantages

- **Advantages:**
  - large range of sizes
  - logarithmic progression
  - unrelated words of 4, 7, or 10 letters

- **Disadvantages:**
  - about 10th grade level
  - not sensitive to peak reading speed
    - no one is very fast with unrelated words; thus, does not identify people capable of very fast reading
  - hard for doc to memorize to allow scoring
My father takes me to school every day in his big green car.

Everyone wanted to go outside when the rain finally stopped.

They were not able to finish playing the game before dinner.

Three of my friends had never been to a circus before today.

My grandfather has a large garden with fruit and vegetables.

($165 Precision Vision)
MNRead Acuity Charts (1994)

G. Legge; Minnesota Laboratory for Low-Vision Research

- 19 sentences of about 47 letters each
- Uses high frequency words from publications for 3rd grade kids.
- Sizes range from 8 to 0.13 M (i.e. 64 to 1 pt)
- Viewing distance can be varied due to logarithmic size progression.
  - even though designers say 40cm
- Overall, well standardized and useful.
Colenbrander English Continuous Text Near Vision Card

- Letter sizes from 6.3M to .32M in Times New Roman font
- ($29.00 Precision Vision)
- Comes with cord set for 40cm, but can use at any distance.
Acuity Reserve: Uses Reading Acuity to Predict Magnification for Reading (Whittaker and Lovie-Kitchin 1993)

Acuity reserve is the ratio of actual print size being read to smallest print size that can be read.

\[
\frac{\text{actual print size being read}}{\text{threshold print size}}
\]

Example: If 4 pt print is threshold at 40 cm, reading 8 pt print at 40 cm gives acuity reserve of 2.
Acuity Reserve
(Xiong, Y, et al, IOVS Oct 2018)

- Acuity reserve for **fluent** reading
  - Median: a factor of 2

- Acuity reserve for **maximum** reading
  - Median: a factor of 3 to 4
    - But note the range on next slide

--- = non-macular disorders
--- = macular disorders

n = 58
Frequency of Various Acuity Reserves (Scholz/Raasch/Flom)

Mean Acuity Reserve = 1.6

n = 218

Mean = 0.197 log units
SD = 0.147 log units
Acuity Reserve is Lower with Worse Word Acuity (Scholz/Raasch/Flom)

Mean Diff = 0.197 logMAR

y = -0.138 x + 0.282

-0.188 0.246
-0.089 0.317
Acuity Reserve: Advantages and Disadvantages

- **Advantages:**
  - A fixed value is probably about right for many patients.
  - Useful when not able to determine critical print size.
  - Better than Kestenbaum
    - words are better choice than letters
    - does not leave patients at their threshold

- **Disadvantages:**
  - Big spread in data and varies with level of acuity
  - Not needed because individualized determination is quite doable, likely more accurate, and probably quicker than measuring threshold.
In a low vision exam:

- Don’t do near letter VA routinely.
- Wait until after refraction to assess at near.
- Assess reading properly.
- Use M units.
- Use a suitable reading card.

Do NOT rely on “rules of thumb” based on distance VA or reading threshold to predict requirements for reading, unless you must (eg. before pt arrives, learning to read).

- Kestenbaum’s rule
- Acuity Reserve

Useful, but usually can do better.
Why Not Measure Directly?

Reading Speed vs. Letter Size method

The Gold Standard?
Purposes of Reading Speed vs. Letter Size Method

• Establish prognosis for useful reading
  – Is sustained visual reading possible?
  – Is brief visual reading possible?

• Establish how to achieve best reading
  – How much magnification?
  – What lighting conditions & how critical?
  – Binocularity: which is better…1 or 2 eyes?
  – Other factors: underlining, etc.
Key Features:
Reading Speed vs. Letter Size Method

Four key features: important for all pts

1. Peak reading speed (PRS) (aka MRS)
2. Critical print size (CPS)
3. Threshold print size (TPS)
4. Lighting needs and criticality

Two bonus features: important for some pts

1. Interoccular factors
2. Non-visual factors
Clinical Protocol: Reading Speed vs. Letter Size Method

1. **Use continuous text w/ wide range of print sizes**
2. **Set adjustable lamp to suit basic pt preference**
   - Often about two feet from page
3. **For presbyopes: provide a known add**
   - Usually in the range of +3.00 to +5.00
   - Incorporate any significant change in Rx
4. **Give reading card to pt**
   - Advise on proper test distance only if way off
5. **Advise to read aloud from largest print**
6. **Listen carefully to reading**
   - Note speed and errors (presence or absence and types).
   - If doing very well, can interrupt to move to next smaller.
   - Don’t be distracted by attention to measuring test distance.
Clinical Protocol: Reading Speed vs. Letter Size Method

7. **Document:**
   - peak speed
   - CPS = critical print size (numerator & denominator)
   - TPS = threshold print size (numerator & denominator)

8. **Calculate equivalent power (Feq) for 1.0 M**
   - by taking reciprocal of CPS or
   - by using “Hey doc” method = (add)(letter size)

9. **Refine lighting and assess its criticality**

10. **Check for major binocularity issues, if needed**

11. **Repeat 1-7 with a stronger add**
    - to refine observations
Reading Speed vs. Letter Size: Listening to the Function

Simulated data for fully sighted @ 40 cm

= 20/20
Reading Speed vs. Letter Size: Key Feature #1 = Peak Speed

Simulated data for fully sighted @ 40 cm
Reading Speed vs. Letter Size: Key Feature #1 = Peak Speed

- Peak Speed = fastest speeds attained with sufficiently large print

- For normals, it is the height of a long fairly flat plateau for intermediate sizes
  - ignore minor deviations along plateau
  - avg oral reading w/fully sighted = about 200 to 250 wpm

- Non-visual factors also affect Peak Speed
  - literacy, motivation, confidence, speech, etc.
Peak Reading Speed for Low Vision Readers

Reading Speed (WPM)

 normal

albinism

AMD with scotomas

@ 40 cm

Letter size in M units
Peak Reading Speed for Low Vision Readers

- Sometimes normal or near normal.
  - eg. in albinism or congenital nystagmus
  - curve just shifted to the right

- Often reduced or greatly reduced.
  - eg. with central scotomas
  - eg. only tiny spared central island of vision
  - eg. greatly reduced acuity or contrast vision
The shape of the function

- Normal or near-normal: most common
  - i.e. long flat plateau with slight roll off when too big and steep decline when too small

- Much flatter: sometimes
  - Why?

- Much steeper: sometimes
  - Why?
Peak Reading Speed vs. Distance VA: OSU chart review (J. Scholz 2017)

- 32% “fast” or “very fast”
- 36.5% “moderate”
- 25% “slow” or “very slow”
- faster with better VAs
Peak Reading Speed for Low Vision Readers

• Does Dist Letter VA predict PRS? (Legge Psychophysics of Reading XII 1992)
  – Only modest correlation = 0.3 to 0.5
  – Acuity accts for only 9 to 25% of variance in observed peak speeds.

• Does VF predict peak reading speed?
  – Only if can’t see enough letters at a time
    • at least 4 to 5 letters with scrolled text
    • at least ~3 to the left & ~15 to right with static text
  – So, problems occur if scotomas or edge of peripheral visual field is at or near fixation
Peak Reading Speed for Low Vision Readers

• Our testing often creates “best case” scenario.

  – We offer great viewing conditions.
    • High contrast print, optimized lighting, big field of view, reasonable viewing distances, etc.
    • Optical low vision devices will usually be worse since they limit field of view, require alignment, etc.

  • An exception: video magnification may produce faster reading since contrast can be enhanced.
Peak Reading Speed for Low Vision Readers

- Clinical significance:
  - PRS predicts fastest they should be able to read with best low vision devices.
    - rarely will pt read faster with a magnifier
  - PRS predicts how realistic it may be to have ambitious visual reading goals.
    - eg. if slow, sustained reading is unlikely
Peak Reading Speed for Low Vision Readers

- What reading speeds are needed by pts?
  - Whittaker and Lovie-Kitchin OVS 1993, 1994
    - “High fluent” reading requires 160 wpm
      • eg. reading novels
    - “Spot”/“survival” reading requires 40 wpm
      • eg. reading price tags, bills, letters

- Fast PRS = “good news”
- Slow PRS = “bad news”
Peak Reading Speed for Low Vision Readers

• Clinical measurement:
  – Quantitative:
    • Could be useful.
    • We rarely do this.
  – Qualitative:
    • We use adjectives to describe.
      – Very fast, Fast, Moderate, Slow, Very slow
Reading Speed vs. Letter Size:
Key Feature #2 = Critical Print Size

Simulated data @ 40 cm
Reading Speed vs. Letter Size:
Key Feature #2 = Critical Print Size

albinism @ 40 cm

AMD w/ scotomas
Reading Speed vs. Letter Size: Key Feature #2 = Critical Print Size

- Reading Speed (WPM) vs. Letter size in M units
- Albinism @ 40 cm
- AMD w/ scotomas

Key points:
- Letter size at 0.8, 1.2, and 2.0 M units
- Graph indicates critical print size for optimal reading speed
Critical Print Size

- For a given distance, CPS is the smallest letter size read at peak speed BEFORE a significant slowing or beginning of errors.

- Expressed as acuity fraction
  - Test distance / letter size
    - listen carefully for “last good reading”
  - Examples from last slide:
    - CPS = 0.40 / 0.8 “normal”
    - CPS = 0.40 / 1.6 albinism
    - CPS = 0.40 / 2.0 AMD with scotoma
Critical Print Size for Low Vision Readers

- **Clinical significance:**

- CPS allows predictions of the smallest sizes that should be easily read at other distances.
  - Example:
    - If CPS equals 0.40 / 2 M, then expect CPS also equals 0.20 / 1 M.
    - This means that at 20 cm (with appropriate add or accommodation) 1 M (8 pt) should be easily readable.
Using CPS to Predict Feq Needed: Approach #1 = Similar Triangles

- Similar Triangles Method
  - i.e. setting fractions equal
- \[ \frac{\text{Test Distance 1}}{\text{Print size 1}} = \frac{\text{Test Distance 2}}{\text{Print size 2}} \]

CPS gives you Test Distance 1 & Print Size 1

- Feq associated w/any distance = \(1/\text{Test Distance}\)
Predicting Feq Needed

- Similar Triangles Method
  - i.e. setting fractions equal

\[
\frac{\text{Test Distance 1}}{\text{Print size 1}} = \frac{\text{Test Distance 2}}{\text{Print size 2}}
\]

Based on CPS

- If given a new print size goal, you can solve for the needed test distance.
- If given a new test distance requirement, you can solve for the print size needed.
- If given the Feq of a reading system, you can solve for print size needed.
  - Substitute the reciprocal of the Feq as the test distance and solve for print size needed.
Review: Acuity Equivalence at Different Distances

- Near acuities at different near distances should be equivalent
  - if in focus (via add/accomm.) & same task

<table>
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<tr>
<th></th>
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<th>Expected @ 20 cm</th>
<th>Expected @ 10 cm</th>
<th>Expected @ 5 cm</th>
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<tbody>
<tr>
<td>Pt #1</td>
<td>0.40 / 4 M</td>
<td>0.20 /</td>
<td>0.10 /</td>
<td>0.05 /</td>
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<tr>
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<td>0.40 / 8 M</td>
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**Review: Acuity Equivalence at Different Distances**

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</thead>
<tbody>
<tr>
<td>+2.50 add</td>
<td>+5.00 add</td>
<td>+10.00 add</td>
<td>+20.00 add</td>
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<table>
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<tr>
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<td>0.20 / 4 M</td>
<td>0.10 / 2 M</td>
<td>0.05 / 1 M</td>
</tr>
</tbody>
</table>
Critical Print Size: Calculating What is Needed for 1 M

- Useful to assume that 1.0 M print is the goal.
  - If 1.0 M is not goal, we can correct for this later.

- We then need to know the farthest test distance (f) at which 1.0 M can be easily read.

- i.e. test distance / letter size = f / 1 = f

- (BTW: Ian Bailey calls this “f” Equivalent Viewing Distance (or EVD) for 1 M.)
Predicting Feq Needed

• Similar Triangles Method
  – i.e. setting fractions equal)

\[ \frac{\text{Test Distance 1}}{\text{Print size 1}} = \frac{\text{Test Distance 2}}{\text{Print size 2}} \]

based on CPS

• If given a new print size goal, you can solve for the needed test distance.
• If given a new test distance requirement, you can solve for the print size needed.
• If given the Feq of a reading system, you can solve for print size needed.
  – Substitute the reciprocal of the Feq as the test distance and solve for print size needed.
Predicting Feq Needed: Approach #2 = “Hey, Doc” Method

- **Making it intuitive:**
  - Feq for 1 M = (add)(letter size)

- **Example:**
  - A patient for whom 2 M is smallest print before slowing might ask: “Hey doc, how much stronger should my bifocal be to read print two times smaller?”

- **Doctor:** “Duh, two times stronger!”
"Hey, Doc" Method

Q: What equivalent powered system would be needed to see 1.0 M just as well as at CPS?

A: A power that is proportionately stronger by the same amount that the print size at CPS was bigger than 1.0.
“Hey, Doc” Method is Just Simple  
Re-Arranging of Similar Triangles  
Method: Leads to Easy Math

\[ \text{F}_{eq} \text{ for 1M} = \frac{\text{letter size}}{\text{test distance}} = (\text{add}) \ (\text{letter size}) \]

Note: Pt must be in focus for the viewing distance

– via add and/or
– via accommodation and/or
– uncorrected refractive error.

For clinic, know reciprocals of basic integers:
2, 3, 4, 5, 6, 8, 10

Chairside we substitute reciprocal of numerator so we can multiply in our heads
“Hey, Doc” Method for Feq for 1M: Basic Examples

• **Example: CPS = 0.40 / 2 M**
  – Feq for 1 M = (add)(letter size) = (+2.50) (2 M)
  – Feq for 1 M = +5.00 DS

• **Example: CPS = 0.33 / 4 M**
  – Feq for 1 M = (add)(letter size) = (+3.00) (4 M)
  – Feq for 1 M = +12.00 DS
“Hey, Doc” Method for Other Predictions

- “Hey, Doc” Method
- \((\text{Feq}_1)(\text{Print in M units}_1) = (\text{Feq}_2)(\text{Print in M units}_2)\)

Eg. If CPS = .4/4 M,

\((2.5)(4) = (10)(1)\) \text{ Needs } +10 \text{ for } 1 \text{ M}

If same pt now uses +5.00 instead,
can say \((10)(1) = (5)(x)\) and \(x = 2\text{M}\) \text{ Will read } 2 \text{ M}

Note: Feq and Print size are inversely proportional.
Summary: Two Methods for Calculating Feq for 1 M

1. Similar triangles

2. “Hey, Doc”

Same thing; different math.
1. Peak reading speed
   - Best case scenario for reading efficiency or fluency

2. Critical print size: (CPS)
   - Point beyond which reading speed drops significantly
   - Indicates minimum size for maximum speed
   - Allows prediction of power of optical system required

3. Threshold print size:
   - Normals: 0.2 to 0.3 log units (about factor of 2) smaller than CPS
   - Low vision: separation between CPS and threshold is often nearly normal but can be much larger

4. Lighting needs and criticality

1. Binocularity check
2. Non-visual factors check
Reading Speed vs. Letter Size:
Key Feature #3 = Threshold Print Size

@ 40 cm
albinism
AMD w/ scotomas
In reality: we don’t measure threshold at zero wpm

@ 40 cm

albinism

AMD w/ scotomas
Threshold Print Size

- **Smallest print size read correctly or almost correctly.**
  - eg. 0.40 / 0.8 M thresh
  - pretty loosely defined
  - but doesn’t matter much (I often don’t measure!)

- **Application:**
  - Can set an absolute floor for Feq.
    - (add)(letter size @ threshold) = Feq guaranteed to make patient struggle w/ 1.0 M print.
  - Can be used for Acuity Reserve calculations.
    - But use CPS instead whenever possible.
Reading Speed vs. Letter Size: Key Feature #4 = Lighting

• Determine optimal lighting and its criticality.
  – Select initial lighting level based on hx.
    • Usually with bulb about 2 or 3 ft away.
  – Assess peak speed, CPS, and threshold.
  – Refine lighting:
    • Pt views print near CPS size.
    • Give 2AFC with these options:
      – Overhead only
      – Lamp at 3 feet
      – Lamp at 1 foot

  “Which is better?”
  “How much better?”
Reading Speed vs. Letter Size: Key Feature #4 = Lighting

• Don’t forget!!

• Document:
  – OH = overhead only
  – L3’ = lamp @ 3 ft
  – L2’ = lamp @ 2 ft
  – L1’ = lamp @ 1 ft

  – Examples:
    • L1’ >> L2’
    • L2’ > OH
    • OH > L3’

• Avoid glare: eg. No light shining on pt eyes

Remember the inverse square law…
Reading Speed vs. Letter Size:
Bonus Feature #1 = Interocular Factors

- **Perform as indicated:**
  - if the two eyes are within about 2 lines of each other
    - skip this if worse eye is MUCH worse
  - if you suspect problems

- **Determine if bi-ocularity helps or hinders significantly.**
  - Listen to reading speed & accuracy as you occlude each eye.
  - Which is the better eye for reading?
  - What is effect of occluding worse eye?
    - Helps? Hinders? No diff?
Some Pts Read Best Binocularly

- For fully sighted people, binocularity is no benefit for reading.

- Some low vision patients read better binocularly
  - aka interocular facilitation
  - Why? Complementary scotomas (eg. donut and hole)

- Issue: Strong optical magnifiers require monocular use.
  - So may read more slowly than they did on reading assessment OU.
  - Need to know which eye pt should use.
    - Sometimes ambiguous: similar VAs but diff CS or scotomas
    - Sometimes handedness or orthopedic factors confound

- A strategy: Bias toward electronic magnification (eg. CCTV) since they allow binocularity.
Some patients have a hard time ignoring image from the worse eye.

- aka. interocular interference or rivalry
- Not well understood
- Can occur with small/moderate acuity differences OD vs OS, esp. if contrast vision is better in eye with worse VA.
- Often occurs with disconjugate nystagmus.

Management = occlusion

- opaque vs. translucent
- complete vs. regional
- permanent vs. temporary

Scotch tape
Reading Speed vs. Letter Size: Bonus Feature #2 = Non-visual Factors

- **Literacy:** never learned or lost skills
  - types of errors can be revealing
  - listen for pts who say
    “I never was much of a reader”

- **Emotional factors**
  - self-conscious
  - anxious

- **Other factors**
  - aphasia, hearing impaired, dramatic types +
Reading Speed vs. Letter Size

1. Peak reading speed
   - Best case scenario for reading efficiency or fluency

2. Critical print size: (CPS)
   - Point beyond which significant drop in speed occurs
   - Indicates minimum size for maximum speed
   - Allows prediction of power of optical system required

3. Threshold print size:
   - Normals: 0.2 to 0.3 log units (about factor of 2) smaller than CPS
   - Low vision: separation between CPS and threshold is often nearly normal but can be much larger

4. Lighting needs and criticality

   1. Binocularity check
      - If similar VAs & may need to go monocular w/devices, or interference suspected.

   2. Non-visual factors check
      - If literacy or motivation is questionable
Documenting Reading Assessment

Stimulus Conditions #1
- Effective ADD + 3.00 D

Test Conditions
- Habitual Rx
- No Rx
- BVA
- Trial Frame
- Other

Reading Assessment (per line)
- Peak Reading Speed: Fast
- Lighting: 1ft
- Critical Print Size: .33 / 4 M
- Subjective Critical Print Size: .33 / 2 M
- Threshold Print Size
- Equivalent Power for 1M Print + 12.00 D
Documenting Reading Assessment: Re-test

Stimulus Conditions #2
Effective ADD + 6.00 D

Test Conditions
- Habitual Rx
- No Rx
- BVA
- Trial Frame
- Other

Peak Reading Speed: Fast
Lighting: 1ft

Critical Print Size: 0.17 / 2 M
Subjective Critical Print Size: 0.17 / 1 M
Threshold Print Size
Equivalent Power for 1M Print + 12.00 D
Documenting Reading Assessment: Other Aspects of Performance

<table>
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<th>Best Lighting</th>
<th>2ft</th>
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<tr>
<td>Other Limit to Speed</td>
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<td>Interocular Effects</td>
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**Reading Notes**
Patient Visual Needs for Reading: Feq for 1M

1. History

2. Kestenbaum

3. 2x Kestenbaum

4. Critical Print Size
   a. Reciprocal
   b. “Hey, doc”

5. 2x Word Reading Threshold
   (= acuity reserve of 2)

See separate handout for expanded version.
Case 1

History: 65 yo POHS OU, s/p trauma OS
Reads 16 pt print with +4.00 D add w/effort

Data: OD 20/80, OS NLP; no Δ Rx
+2.50 add .4 / 5 M cps
 .4/ 2 M threshold
mod @ peak; L1’>>L2’

Calculate Feq for 1M by each of 6 methods
Case 1: answers

1. History:

2. Kestenbaum:

3. 2x Kestenbaum:

4. Critical Print Size
   - Reciprocal of CPS:
   - “Hey, doc”:

5. 2x Reading Acuity (reserve of 2):
Case 1: answers

1. History: at least 8 D
2. Kestenbaum: 4 D
3. 2x Kestenbaum: 8 D
4. Critical Print Size
   - Reciprocal of CPS: 12.50 D
   - “Hey, doc”: 12.50 D
5. 2x Reading Acuity (reserve of 2):
   “Hey, Doc” on thresh x 2; 2 x 2.5 x 2 = 10 D
Case 2

History: 85 yo AMD OU
Unable to read presently

Data: OD 20/200, OS 20/500; no Δ Rx
+3.00 add .33 / 8 M cps (lgr)
.33/ 3.2 M threshold
mod @ peak; L1’>L2’

Calculate Feq for 1M by each of 6 methods
Case 2: answers

1. History: unable
2. Kestenbaum: 10 D
3. 2x Kestenbaum: 20 D
4. Critical Print Size
   - Reciprocal of CPS: 24 D
   - “Hey, doc”: 24 D
5. 2x Reading Acuity (reserve of 2): 20 D
   i.e. $2 \times 3 \times 3.2 = 20$
Case 3

History: 85 yo AMD OU
reads 32 pt on phone @ 33 cm
c/o LP books tough with his mag

Data: OD 20/60, OS 20/80; no Δ Rx
logCS OD 1.28, OS 1.36
PRS = moderate
+3.00 add .33 / 4 M cps (& scps)
            .33/ 1.6 M threshold
prefers very strong light; high criticality
reads best with OS occluded
Case 3: answers

1. History: 12 D (phone); > 8 D (books)
2. Kestenbaum: 3 D
3. 2x Kestenbaum: 6 D
4. Critical Print Size
   – Reciprocal of CPS: 12 D
   – “Hey, doc”: 12 D
5. 2x Reading Acuity (reserve of 2): 10 D
   i.e. 3 x 1.6 x 2 = 10
Deciding Among Methods

Use all the data you have to serve pts best.

1. **History**: useful, if reliable historian
2. **Kestenbaum**: gives minimum
3. **2x Kestenbaum**: gives estimate
4. **Critical Print Size**: usually best estimate
   - Reciprocal of CPS or “Hey, doc”
5. **2x Reading Acuity (reserve of 2)**: if hard to ascertain CPS (eg. very slow speed)
Predicting Reading Performance with Low Vision Devices

• Based on Feq for 1M, we know what pt needs.

• If we provide an optical system of that power, the patient should read 1M.

• Our usual goal:

  Feq for 1M = Feq of low vision device (i.e. Feq LVD)

(If goal is larger or smaller, we can adjust estimate.)
Predicting Reading Performance with Low Vision Devices

- We need to be able to predict how much improvement in resolving ability to expect when we change optical systems for patients.

  Resolving ability is directly related to Feq of LVD. Print size read is inversely related to Feq of LVD.

- Eg. With +5.00 add, reads print 1/2 size read with +2.50 add.

  *(Reading materials must be at the focal length of lenses.)*
Putting it all Together!

Patient Visual Needs
1. History
2. Kestenbaum
3. 2x Kestenbaum
4. Critical Print Size
   a. Reciprocal
   b. “Hey, doc”
5. 2x Word Threshold
   (= acuity reserve of 2)

Low Vision Device Capabilities
1. Spectacles/adds
2. Loupes
3. Simple hand-held mags
4. Stand mags
5. Near telescopes
6. Video/electronic mag

\[
\text{Feq LVD} \geq \text{Feq for 1M}
\]

Feq LVD must \(\geq\) Feq for 1M to allow 1M reading.
Thank you! It’s an honor.

Roanne E. Flom, OD, FAAO, Dipl.
Low Vision Section