ARE YOU TESTS EVIDENCE BASED?
THE “SAILBOAT” CHART IS NOT

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Disclaimer
- Former Director/Lead Trainer – Vision Initiative for Children - West Virginia University Eye Institute
  - Trained >1,600 individuals, 178 workshops
- Current Director – Vision and Eye Health Initiatives for The Good-Lite Company and School Health Corporation
- Counselor to the West Virginia Lions Sight Conservation Foundation and President of local Lion’s club
- Will see “good” and “bad” eye charts manufactured by The Good-Lite Company and marketed through The Good-Lite Company and School Health Corporation, but focus is not to push product from the podium

Other manufacturers/suppliers of eye charts:
- Richmond Products
  - 505-275-2406
  - www.richmondproducts.com
- Bernell
  - 574-559-2070
  - www.bernell.com
- MacGill Discount School Nurse Supplies
  - 800-333-2841
  - www.macgill.com
- Henry Schein
  - 800-472-4346
  - www.henryschein.com

Learning Objectives
1. Describe why the “Sailboat” and “Snellen” eye charts fail to meet five national and international eye chart design guidelines.
2. Describe why pointing at optotypes could miss amblyopia
3. Describe an evidence-based way to save time when screening
Today’s Topics

1. National and international eye chart design standardization guidelines
2. Challenges with commonly used eye charts, including “Snellen” charts
3. Appropriate, evidence-based optotypes
4. Eye chart designs to avoid
5. Screening tips

Importance of Standardized Eye Charts

- Test task should be same throughout chart.
- Optotype size should be sole factor affecting visual acuity test task.

- Standardized eye charts meeting national and international eye chart design guidelines offer equal test task.
- Many commonly used eye charts do not.

National and International Distance Visual Acuity Eye Chart Recommendations

- 1980 - National Academy of Sciences-National Research Council (NAS-NRC)
  - Recommended Standard Procedures for the Clinical Measurement and Specification of Visual Acuity

- 1984 - International Council of Ophthalmology (ICO)
  - Visual acuity measurement standard.  
National and International Distance Visual Acuity Eye Chart Recommendations

- 2003 - World Health Organization Prevention of Blindness & Deafness (WHO)
  - Consultation on Development of Standards for Characterization of Vision Loss and Visual Functioning

- 2010 – American National Standards Institute, Inc.
    - Approved May 27, 2010
  - Performance standard for the optical design of optotypes used in clinical visual acuity measurement systems

Optotypes approximately equal in legibility

Horizontal between-optotype spacing = 1 optotype width

Vertical between-line spacing = height of next line down

Geometric progression of optotype sizes of 0.1 log units (logMAR, ETDRS)

5 optotypes per line

Optotypes black on white background with luminance between 80 cd/m² and 160 cd/m²

Similar recommendations across guidelines

Importance of 5 Optotypes Per Line

- Smaller lines as move down chart
- More letters to read on non-standardized chart
- 5 optotypes per line = identifying majority is same throughout chart


Do the following eye charts fit national/international eye chart design guidelines? Yes or No?
Challenges With Common Eye Charts

- **Allen Figures**
- **Lighthouse or “House, Apple, Umbrella”**
- **Snellen Letters**
- **Kindergarten Test Chart**
- **Tumbling E**

Challenges with “Snellen Charts”

- Do not meet national/international eye chart design guidelines
- Are not standardized

“Sailboat” Chart Lacks Scientific Evidence

- Does not meet national/international eye chart design guidelines
- Optotypes of different sizes on same line
- Some optotypes in black “blobs”
- Found only 3 studies
  - Only 1 looked at visual acuity, but with colored optotypes
  - Only 1 study pertains to current chart and the goal was to determine whether children liked the chart
  - Deemed “too complicated” for 3- and 4-yr-olds

Overarching Challenge with “Sailboat” Chart: Lacks Scientific Evidence

- Not on recommended list of eye charts in 2003-Policy Statement from:
  - American Academy of Pediatrics
  - American Association of Certified Orthoptists
  - American Association for Pediatric Ophthalmology and Strabismus
  - American Academy of Ophthalmology
- Chart’s history and developer unknown
- Earliest photograph: August 1935 American Optical Company catalog

References:


2 Challenges with Tumbling E

1. Children’s orientation and direction challenges with directional optotypes
   a. Emerging cognitive skill
   b. Upland emerges before leftright
   c. Usually in place by age 8

2. Ability to guess optotype at threshold


“Since horizontal direction sense develops later than vertical direction sense, recognition of horizontally pointing E’s by younger children is particularly unreliable. Test symbols, not depending on the direction sense, improve testability, testing time and visual acuity scores.” (p. 70)

Challenges to Allen Pictures

1. Asking young children to make a “whole” picture from “parts”
2. Cultural bias
3. Calibrated against Snellen 30-ft E, not Landolt C (international standard)
4. Dr. Allen: “The test is not intended to replace existing tests like the illiterate E and the Sjögren hand. It is recognized that the latter tests are undoubtedly superior and better standardized for children who can use them.”

Lighthouse Chart

- Optotypes easy to guess
- Poor visual acuity results when compared with international Landolt C standard.

Not on list of charts recommended by:
- American Academy of Pediatrics
- American Association of Certified Orthoptists
- American Association for Pediatric Ophthalmology and Strabismus
- American Academy of Ophthalmology


Pediatric Eye Charts

LEA Symbols

HOTV

LEA Symbols and HOTV Letters

- Vision in Preschoolers:
  - No significant differences in sensitivity (finding children with vision disorder) for either test for either age
  - LEA Symbols optotypes easier for 3yo children to identify

- Hered et al.:
  - Testability rates did not differ significantly between LEA Symbols and HOTV charts
  - Testability rate for 3yo children was significantly higher with LEA Symbols (92% of 777 children) than HOTV (85% of 777 children)


LEA Symbols and HOTV Letters

- Candy et al. (2011) looked at discriminability of optotypes within the same test to determine whether some optotypes of same size were easier than others to identify
  - LEA Symbols, LEA Numbers, Tumbling E, and Landolt C were similar to each other in ability to identify
  - Validated blur factor of LEA Symbols
  - HOTV, Allen Figures, and Lighthouse tests had significant differences in similarity or discriminability of optotypes
  - HOTV, Allen Figures, and Lighthouse could be improved in how well visual acuities matched visual acuities with the reference optotype, Landolt C.

What Does This Mean?

- “... differences in acuity estimates resulting from basic differences in optotype design and combination are likely to have a significant impact on children’s performance” p. 4312.
LEA Symbols

- Only pediatric eye chart with optotypes that blur equally at threshold
- Culturally neutral
- Children call optotypes what they want

Beware of . . .

“Linear-Spaced” Eye Charts

- 100% spacing between optotypes (1 optotype width)
- Unequal spacing BETWEEN lines – not geometric progression of 0.1 log (logMAR)
- Arbitrary and non-standardized between-line spacing

“Wide-Spaced” Eye Charts

- Between-optotype spacing >100%
- Unequal spacing BETWEEN lines – not geometric progression of 0.1 log (logMAR)
- Between-line spacing is arbitrary
- Basically contains lines of single optotypes
No Single Symbols or Flashcards

- Unless child has disabilities and cannot do full lines
- And want idea of what child can see
- Youngson (1975) found:
  - Visual acuity scores of 30 children with amblyopia were, on average, 3 lines worse on chart with lines vs. single optotypes

Want “Proportional” Spacing

- a.k.a. ETDRS
- a.k.a. logMAR

Pointing: World Health Organization

- Pointing to each optotype to help children know where they are on the chart is permissible.
  - True or False?
- 1.8 “Line-by-line isolation or pointing may be used, but not letter by letter.”

Children Need Not Read Each Optotype on Every Line

- World Health Organization (2003) says:
  - May be less tedious for children to read 1st optotype on left-side of chart until missing one and then moving up a line and reading entire line
- Camparini et al. found: ETDRS-Fast (reading 1 letter per row until a mistake is made) yields accurate results compared with standard method of reading each optotype on every line.
  - Also – significantly reduced test time
1 Way to Prevent Peeking ...

Many vision screening charts are available. Does one chart fit all children? Is one better than another?

Take Home Message . . .

- Want:
  - Optotypes approximately equal in legibility and discriminability
  - Horizontal between-optotype spacing = 1 optotype width
  - Vertical between-line spacing = height of next line down
  - Geometric progression of line sizes of 0.1 log units (logMAR, ETDRS format [V shape])
  - Black optotypes on white background
  - 5 optotypes per line
  - Maximum 10-feet testing distance for preschoolers
Take-Home Message:
Do not fit national/international eye chart design guidelines:

In Conclusion . . .
- LEA Symbols
- Sloan Letters