

The following slides are pulled from a longer presentation provided for local, regional, state, national, and international meetings and conferences.

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Introduction and Disclaimer

- Former Director/Lead Trainer – Vision Initiative for Children – West Virginia University Eye Institute
 - Trained >1,600 individuals, 178 workshops (majority on location)
- Current Education and Outreach Coordinator – Prevent Blindness – National Center for Children’s Vision and Eye Health
- National Vision Screening Trainer for Prevent Blindness
- Vision and Eye Health Consultant to School Health Corporation and Good-Lite
- Worked in the vision and eye health space since February 15, 2001
- Lectured, trained, and consulted at more than 200 international, national, state, district, and local venues, including national webinars, and annual conferences for the:
 - National Association of School Nurses
 - National Head Start Association
 - School-Based Health Alliance
 - National Center on Early Childhood Health and Wellness
 - Office of Head Start’s National Center on Health, Behavioral Health, and Safety



Challenges With Commonly Used Tests of Visual Acuity (Eye Charts) for Optotype-Based Screening

P. Kay Nottingham Chaplin, EdD

The next two slides describe the national and international guidelines for standardized eye chart design, along with references.

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
 - Committee on Vision. (1980). Recommended standard procedures for the clinical measurement and specification of visual acuity. Report of working group 39. Assembly of Behavioral and Social Sciences, National Research Council, National Academy of Sciences, Washington, DC. *Advances in Ophthalmology*, 41:103–148.
- **1984 - International Council of Ophthalmology (ICO)**
 - Visual acuity measurement standard.
 - www.icoph.org/dynamic/attachments/resources/icovisualacuity1984.pdf
- **2003 - World Health Organization Prevention of Blindness & Deafness (WHO)**
 - Consultation on Development of Standards for Characterization of Vision Loss and Visual Functioning
 - Prevention of blindness and deafness. Consultation on development of standards for characterization of vision loss and visual functioning. Geneva: WHO;2003 (WHO/PBL/03.91).
- **2010 – American National Standards Institute, Inc.**
 - ANSI Z80.21-1992 (R2004) 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

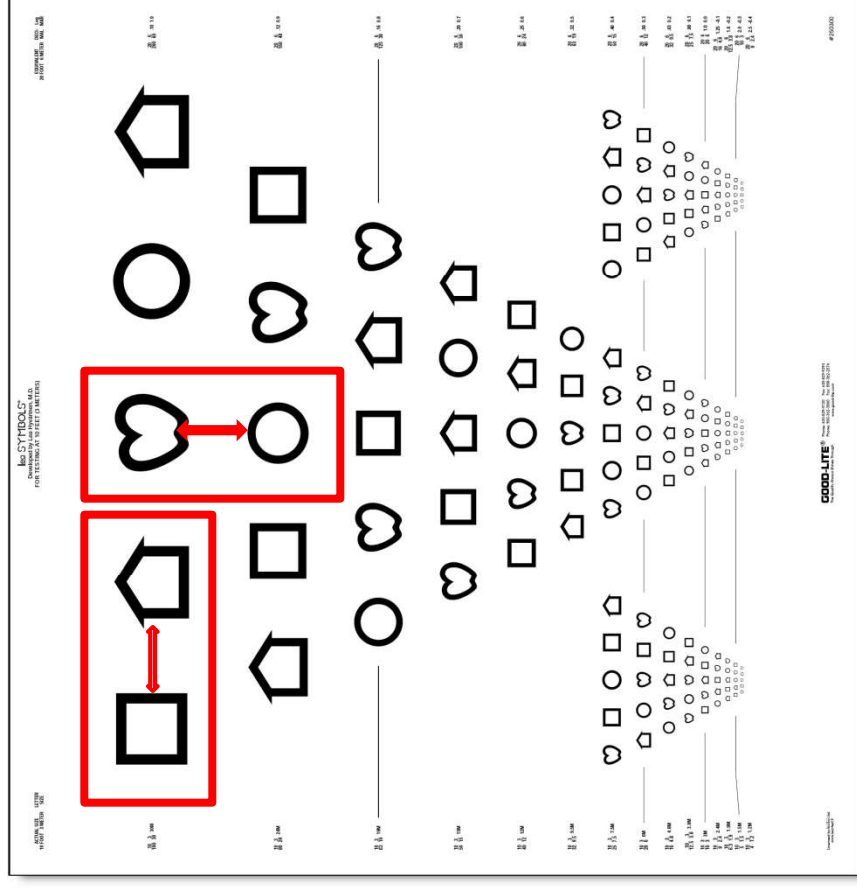
Vertical between-line spacing = height of next line down

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

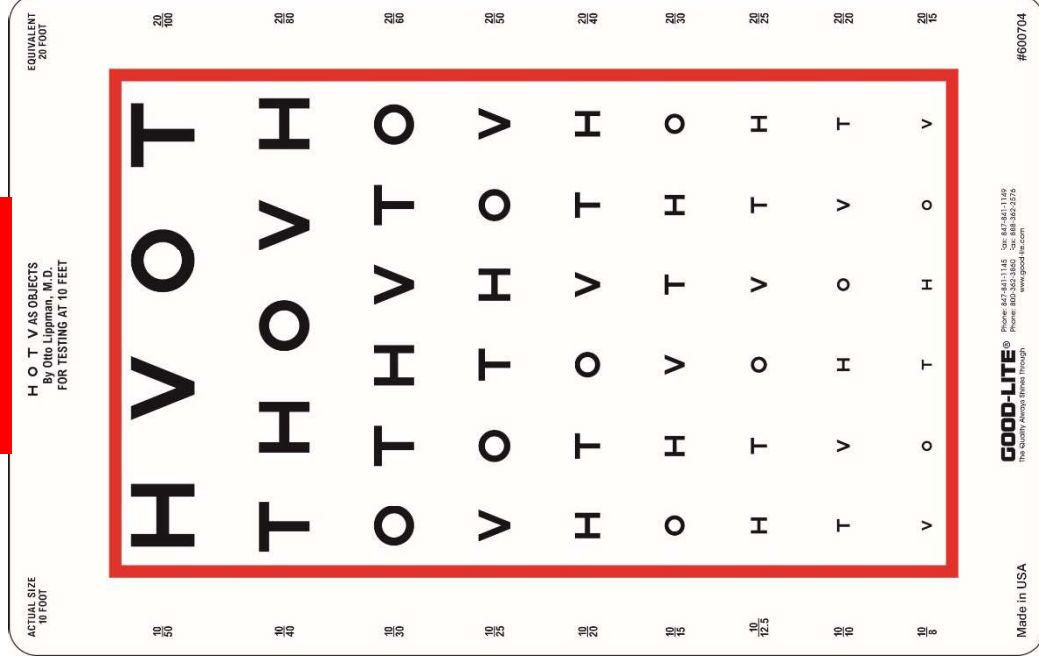
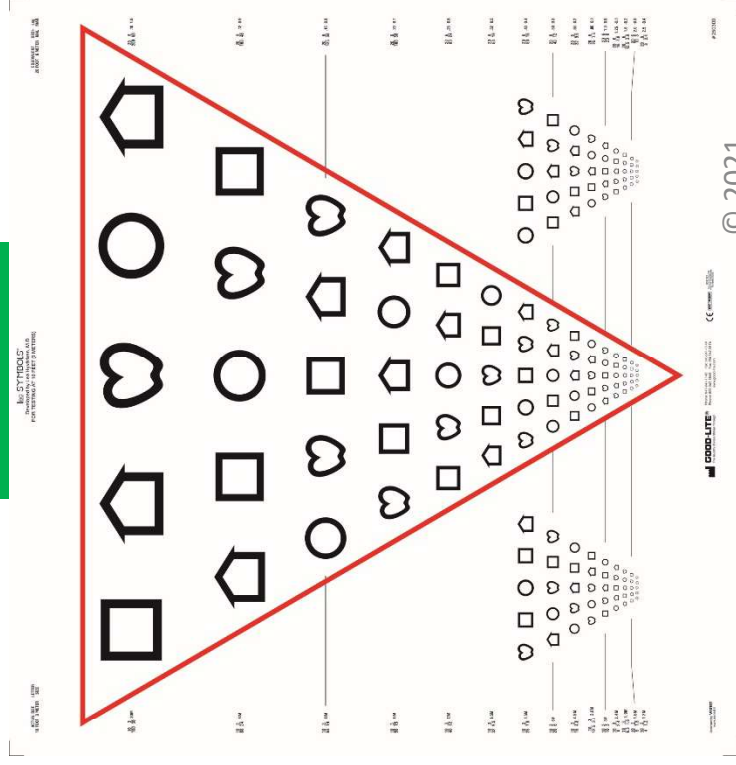


Design guidelines = “ETDRS Design”

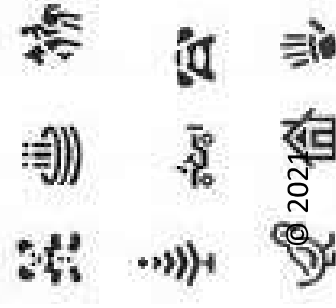
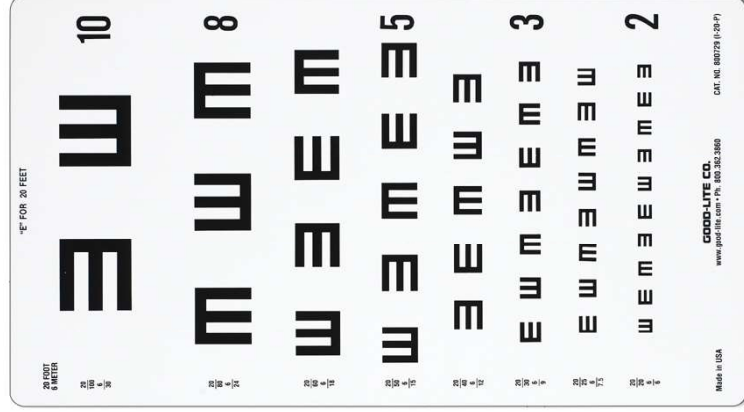
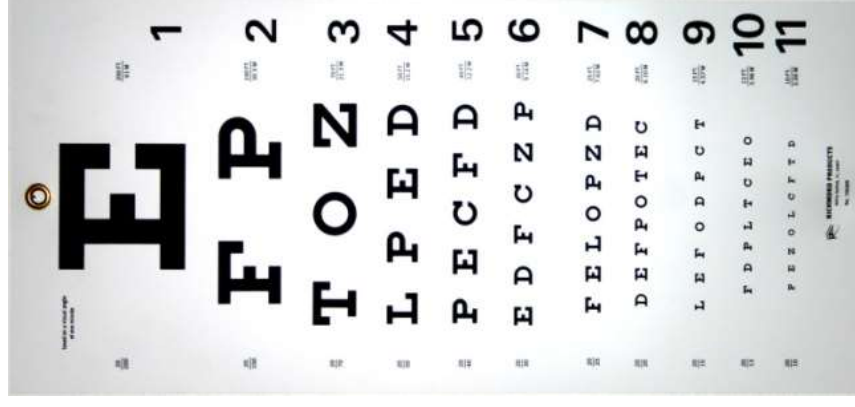
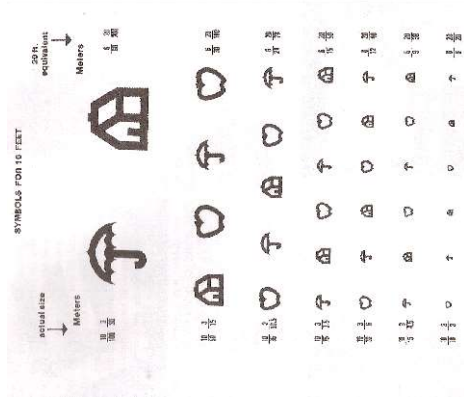
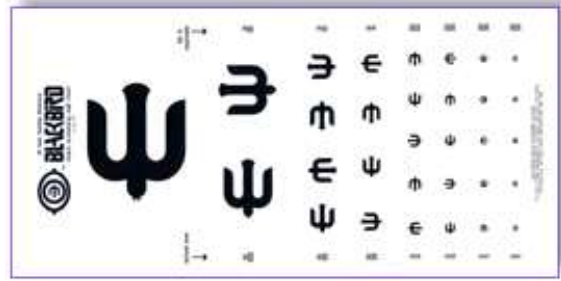
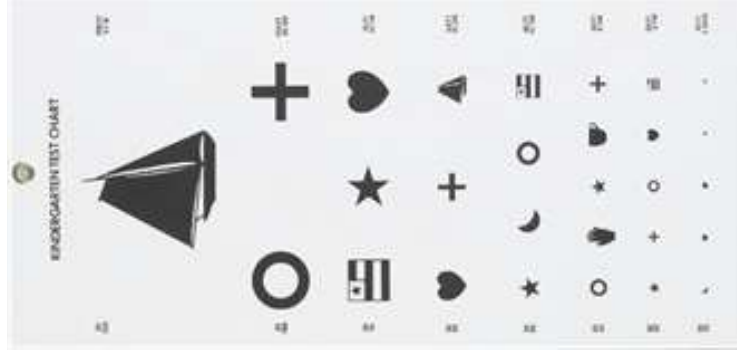
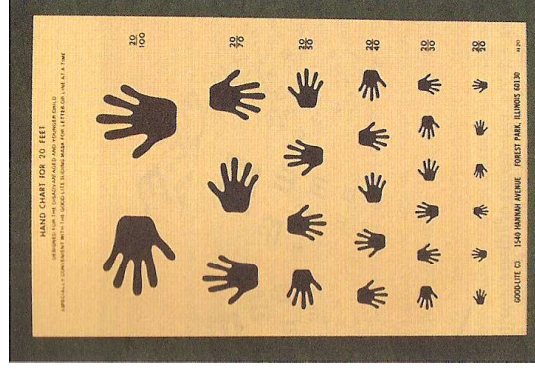
- 3 Tips for knowing whether the chart is appropriate:

1. Line outside optotypes
2. 20/32 vs. 20/30
3. 10 feet vs. 20 feet

YES

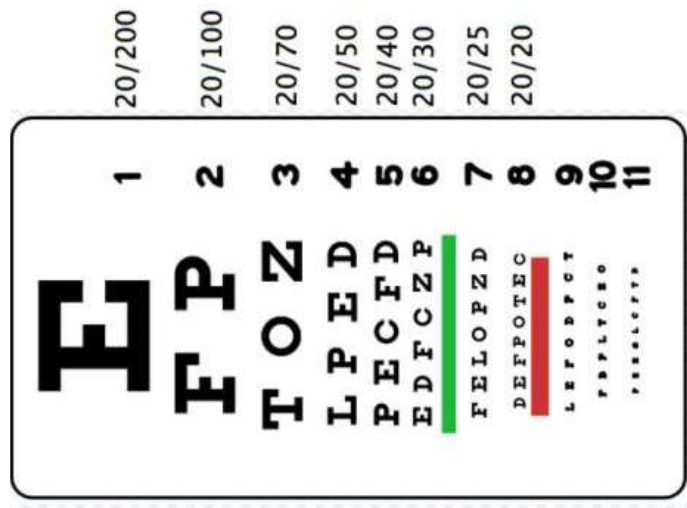


These tests of visual acuity do not fit national/international eye chart design standardization guidelines.

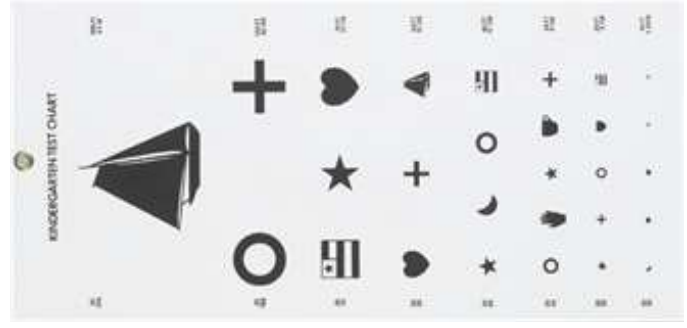


Challenges With 5 Commonly Used Eye Charts

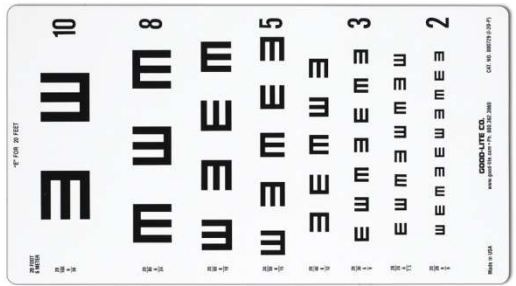
Snellen Letters



Kindergarten Test Chart



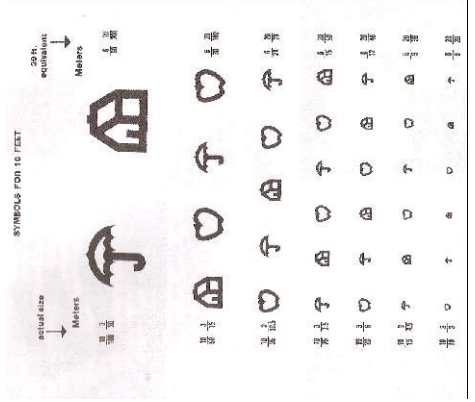
Tumbling E



Allen Pictures

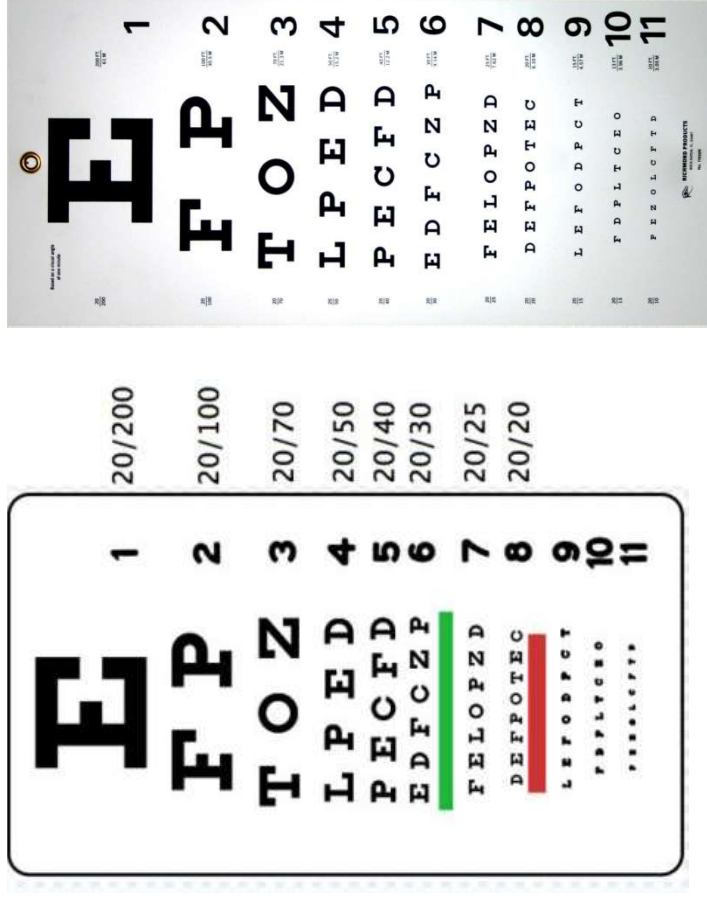


Lighthouse or “House, Apple, Umbrella”



3 Challenges With “Snellen Chart”

- Does not meet national/international eye chart design guidelines
- Is not standardized
- Some letters easier than others to identify



Kaiser, P. K. (2009). Prospective evaluation of visual acuity assessment: A comparison of Snellen versus ETDRS charts in clinical practice (An AOS thesis). *Transactions of the American Ophthalmological Society*, 107, 311-324.

“Sailboat” Chart Lacks Scientific Evidence

- Does not meet national/international eye chart design guidelines
- Some optotypes in black “blobs”
- Optotypes of different sizes on same line



20/30 line



- Found 3 studies
 - Only 1 looked at visual acuity, but with colored optotypes = not same chart.
 - Deemed “too complicated” for 3- and 4-yr-olds.
 - Only 1 study pertained to current chart and the goal was to determine whether children liked the chart.

Fink, W. H. (1944). An evaluation of visual acuity symbols. *Transactions of the American Ophthalmological Society*, 42, 49-99.

Lippmann, O. Vision screening of young children. (1971). *American Journal of Public Health*, 61(8), 1586-1601.

Savitz, R. A., Reed R. B., & Valadian I. (1964). Vision screening of the preschool child: report of a study. US Department of Health, Education, and Welfare. Welfare Administration. Children's Bureau. Washington, DC: US Government Printing Office.

Overarching Challenge With “Sailboat” Chart: Lacks

Scientific Evidence

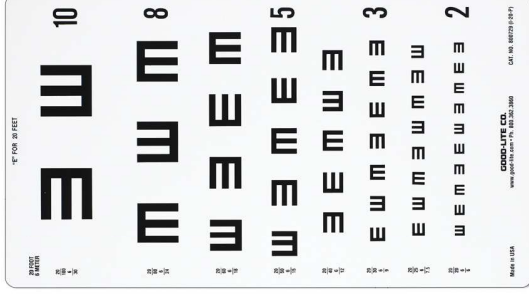
- **Not on recommended list of eye charts 2016 joint guidelines from:**
 - American Academy of Pediatrics
 - American Association of Certified Orthoptists
 - American Association for Pediatric Ophthalmology and Strabismus
 - American Academy of Ophthalmology
- Chart’s history and developer unknown
- Earliest photograph: August 1935 American Optical Company catalog

Donahue, S. P., Baker, C. N., & AAP Committee on Practice and Ambulatory Medicine, AAP Section on Ophthalmology, American Association of Certified Orthoptists, American Association for Pediatric Ophthalmology and Strabismus, American Academy of Ophthalmology (2016). Procedures for the evaluation of the visual system by pediatricians. *Pediatrics*, 137(1), e20153597.

<http://pediatrics.aappublications.org/content/pediatrics/early/2015/12/07/peds.2015-3597.full.pdf>

2 Challenges With Tumbling E

1. Children's orientation and direction challenges with directional optotypes
 - a. Emerging cognitive skill
 - b. Up/down emerges before left/right
 - c. Usually in place by ages 8 or 10 years
 - d. Measuring cognitive skills prior to ages 8 or 10 years
2. Potential ability to guess optotype at threshold by looking at solid line or 3 open lines



Elkind, D. (1961). Children's conceptions of right and left: Piaget replication study IV. *The Journal of Genetic Psychology*, 99, 269-276.

Hyvärinen, L., Näsänen, R., & Laurinen, P. (1980). New visual acuity test for pre-school children. *Acta Ophthalmologica (Copenhagen)*, 58(4), 507-11.

“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)

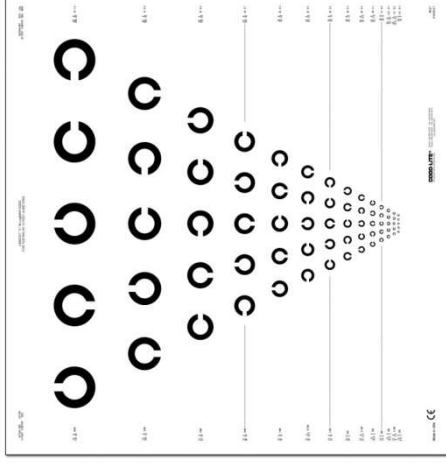
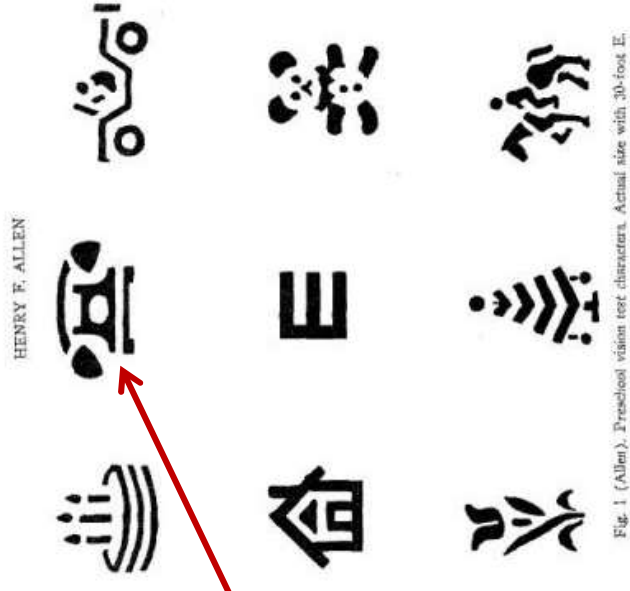


Otto Lippmann, M.D., was born in Germany (1900)

Lippmann, O. (1974). Choice of preschool vision test. *The Eye, Ear, Nose and Throat Monthly*, 53(5), 68-73.

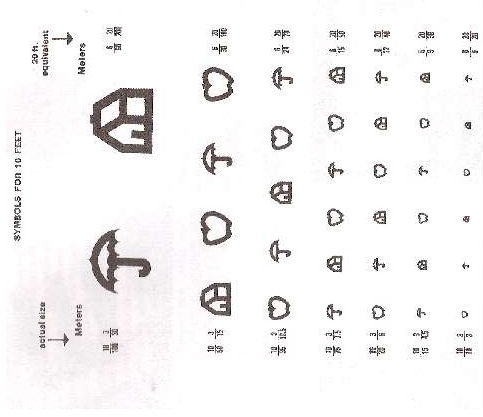
3 Challenges With Allen Pictures

1. Asking young children to create a “whole” picture from “parts”
2. Cultural bias
3. Calibrated against Snellen 30-ft E, not Landolt C (international standard)



Lighthouse Chart

- Not on 2016 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



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

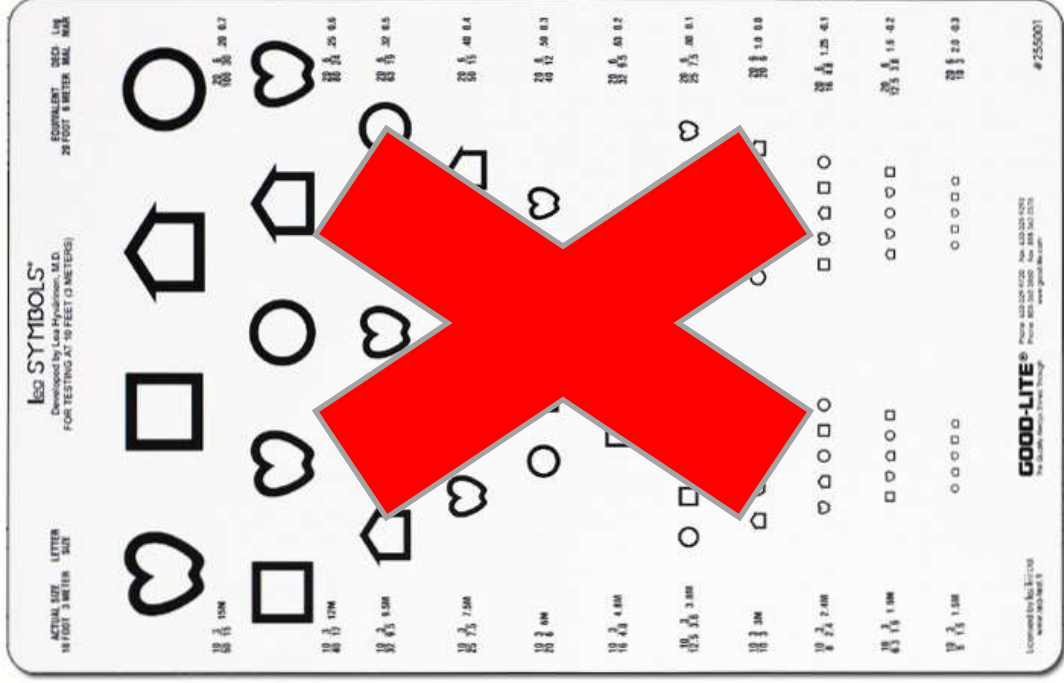
Candy, T. R., Mishoulam, S. R., Nosofsky, R. M., & Dobson, V. (2011). Adult discrimination performance for pediatric acuity test optotypes. *Investigative Ophthalmology & Visual Science*, 52(7), 4307-4313.
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3175947/pdf/z7g4307.pdf>

Donahue, S. P., Baker, C. N., & AAP Committee on Practice and Ambulatory Medicine, AAP Section on Ophthalmology, American Association of Certified Orthoptists, American Association for Pediatric Ophthalmology and Strabismus, American Academy of Ophthalmology (2016). Procedures for the evaluation of the visual system by pediatricians. *Pediatrics*, 137(1), e20153597. Retrieved from

<http://pediatrics.aappublications.org/content/pediatrics/early/2015/12/07/peds.2015-3597.full.pdf>

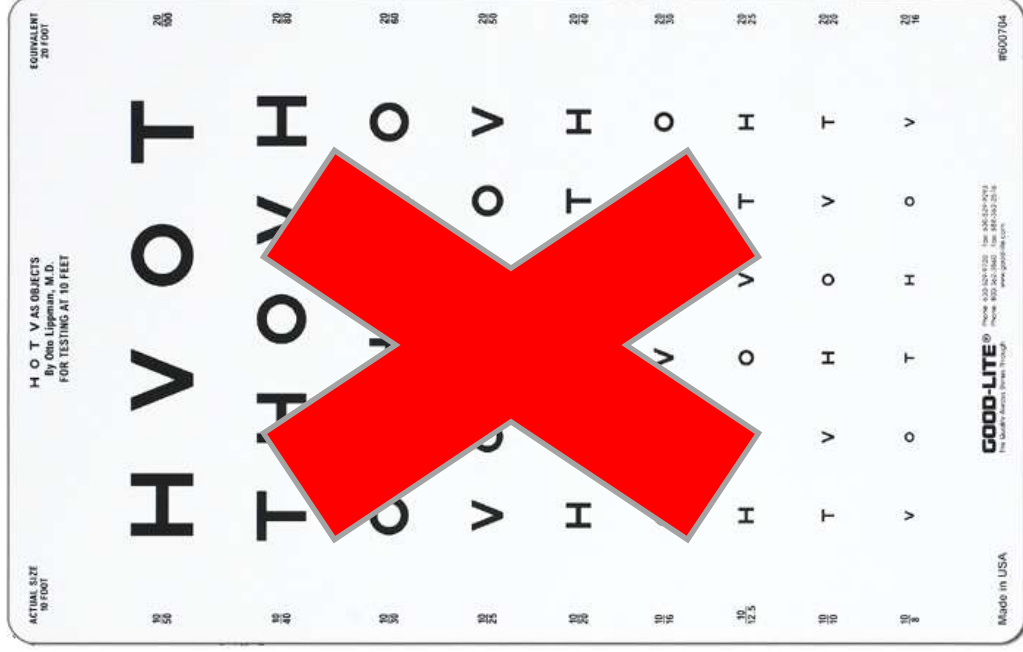
“Linear-Spaced” Eye Charts

- 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



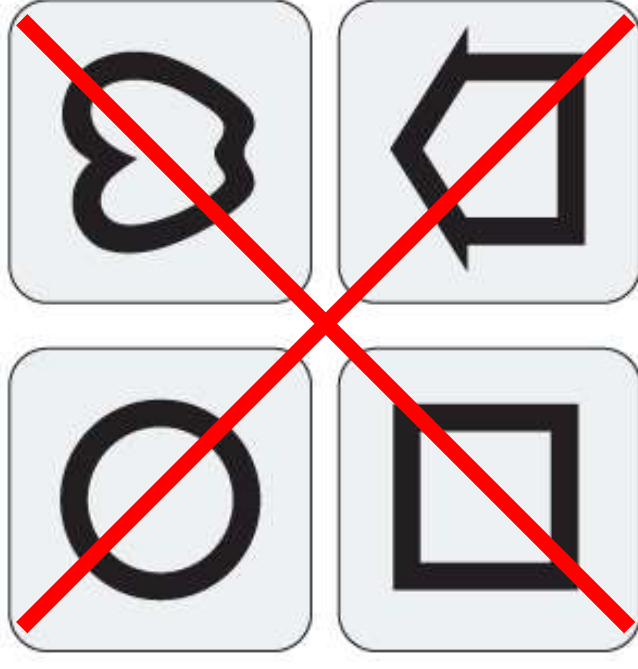
“Wide-Spaced” Eye Charts

- 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 Optotypes or Flashcards Without Surround Bars for Typically Developing Children

- Visual acuity results, on average, 3 lines worse on charts with lines vs. single, non-crowded optotypes
 - For example, 20/32 with single, isolated optotype and 20/80 with line chart



Youngson, R. M. (1975). Anomaly in visual acuity testing in children. *British Journal of Ophthalmology*, 59(3), 168-170. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1017375/pdf/brjopthal00255-0057.pdf>

Hilton, A. F., & Stanley, J. C. (1972). Pitfalls in testing children's vision by the Sheridan Gardiner single optotype method. *British Journal of Ophthalmology*, 56(2), 135-139.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1208699/pdf/brjopthal00290-0063.pdf>