Vision Screening:
Getting to the Nitty-Gritty of How to Screen… What to Use…and What to Avoid

P. Kay Nottingham Chaplin, EdD

Introduction and Disclaimer

- Former Director/Lead Trainer – Vision Initiative for Children – WVU Eye Institute
  - Trained >1,600 individuals, 178 workshops (majority on location)
- Current Director – Vision and Eye Health Initiatives at Good-Lite and Vision Screening and Eye Health Consultant for School Health Corporation
- Member – Expert Advisory Committee to the National Center for Children’s Vision and Eye Health at Prevent Blindness
- Member - Questionnaire Work Group, a Children’s Vision Massachusetts coalition project to study screening the birth to 3 population
- National Vision Screening Trainer for Prevent Blindness
- Consultant to Vision Screening Committee of the American Association for Pediatric Ophthalmology and Strabismus
- Will see “great” and “really awful” eye charts manufactured by The Good-Lite Company and marketed through Good-Lite and School Health Corporation, but focus is not to push product from the podium
  - Focus is to use power of podium to encourage appropriate and evidence-based vision screening as part of a strong Vision Health System of Care

How to Build a Strong Vision Health System of Care

http://nationalcenter.preventblindness.org/resources-2
Evaluating Your Vision Health Program

Three approaches to vision screening, depending on child age:
1. Developmental questions
2. Optotype-based (a.k.a. test of visual acuity) beginning at 3 years
3. Instrument-based beginning at 6 months

Optotype = name of shape, letter, or number to identify
Optotype-based screening measures visual acuity
Provides info about presence or absence of refractive error and pathology within the visual pathway

Instrument-based screening measures for presence of amblyopia risk factors:
- Significant refractive error
- Asymmetry of refractive error
- Asymmetry of eye alignment
- Presence of cataract

1. Vision milestone at age 8 weeks (by 6 weeks and no later than 8 weeks)
   a. Does the infant have good eye contact with parents?
   b. Does the infant already copy facial expressions?

http://nationalcenter.preventblindness.org/resources-2
Eye contact with parents is essential to developing bonding and communication.

Lack of eye contact can interfere with early emotional and general development.

• Early intervention should begin immediately.
  • The infant’s parents should receive assistance in helping the infant to develop communication through all the senses.
  • The infant should receive an eye exam from an eye doctor without delay.

2. Vision milestone at age 12 weeks
   • Enjoyable visual interaction
     a. Does the infant have a social smile?
     b. When the parent smiles at the infant, does the infant respond with a smile?
A social smile means the brain is maturing, the infant can see short distances, and the infant is making sense of an object.

A social smile boosts bonding and is one of the cornerstones of communication between infant and parent.

3. Vision milestone at age 3 to 4 months
   • Awareness of and exploration of hands
     a. Does the infant watch her hands?
     b. Does the infant bring his hands to midline and to his mouth?
     c. Does the infant hit and grasp toys hanging above her?

Awareness of hands leads to exploring the hands with the mouth, which leads to using the hands to explore the infant’s world.

Exploration with hands gives concrete information about abstract objects, including size, form, surface quality, and weight.
• This concrete information will be stored in the infant’s brain to combine with the visual concept of each object.
4. Vision milestone at age 5 to 6 months:
   • *Watching and copying goal-directed reach and learning to copy motor functions*
     a. Does the infant watch other children playing?
     b. Does the infant reach for objects?
     1) Does the infant look at the object when reaching?
     c. Are the infant's eyes straight?

   Reaching for a desired object leads to goal-directed behavior and shows desire, interest, and curiosity – critical elements for learning.

   If the infant is not reaching for objects, maybe the infant cannot see the objects.

   If the eyes appear to intermittently turn in or out at age 6 months, recommend that the infant receives an eye exam by eye doctor.

5. Vision milestone at age 7 to 10 months
   • *Recognition of familiar faces*
     a. Does the infant recognize family members before hearing their voice or seeing their smile?
     b. Does the infant look at or into the parent’s eyes?
If the infant does not recognize faces and does not look at, or into the eyes, of the parent, the infant may have “face blindness” and should be referred for a neurological assessment.

A child with “face blindness” may incorrectly be diagnosed with an autism spectrum disorder. (Google “60 Minutes” and face blindness.)

Threshold vs. Critical Line

• Threshold screening
  ➢ Move down chart until child cannot correctly identify majority of optotypes

• Critical line screening
  ➢ Use only line child needs to pass according to child’s age

Single, Surrounded LEA Symbols

• Research supports using single, LEA Symbols optotypes surrounded with bars for children ages 3 to 5 years at 5 feet

Importance of Appropriate Tools

• “Visual acuity scores can be significantly affected by the chart design.” (p. 1248)

• Excluding optotype size, “each visual acuity level on a test chart should present an essentially equivalent task.” (p. 740)

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.
  • 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

• 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

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Similar recommendations across guidelines

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

Design guidelines = “ETDRS chart”
Tips:
- Line outside optotypes
- 20/32 vs. 20/30
- 10 feet vs. 20 feet

Do the following eye charts fit national/international eye chart design guidelines? Yes or No?

<table>
<thead>
<tr>
<th>Guidelines</th>
<th>Allen Pictures</th>
<th>Light House</th>
<th>“Sailboat”, “Lighthouse”, or “House, Apple, Umbrella”</th>
<th>Tumbling E</th>
<th>HOTV</th>
<th>LEA Symbols</th>
<th>Sloan Letters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optotypes should be approximately equal in legibility</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Horizontal between-optotype spacing = 1 optotype width</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Vertical between-line spacing = height of last line drawn</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>0.1 log unit geometric progression of optotype sizes</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Optotypes per line</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Optotypes black on white background</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

Similar mean visual acuity values when compared with the Landolt C international reference (------ = not included in study).

Options for Pediatric Eye Charts

LEA Symbols
- Only pediatric eye chart with optotypes that blur equally at threshold
- Culturally neutral
- Children call optotypes what they want
  - i.e., Square may be an iPad
  - Circle may be hula-hoop

HOTV


Screening Distance
- Young children: 10 feet from chart to child’s eyes
- New, standardized charts will be at 10 feet
- 10/xx on left side of chart with 20/xx on right side
NO - “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

NO - “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


Want “Proportional” Spacing

• a.k.a. ETDRS chart
• a.k.a. logMAR chart

Occluders – Younger Children <10 Years

Fun Frames – Frosted
Sunflowers

Instrument-Based Screening

Welch Allyn SureLight
Welch Allyn Spot Vision Screener
Plusoptix S12
Instrument-Based Screening

- Instruments
  - Require minimal child response or interaction
- Titmus is a machine and not an instrument


Titmus Examples

Letters

LEA Symbols

Current Recommendations

<table>
<thead>
<tr>
<th>Child Ages for Optotypes and Instruments</th>
<th>OPTOTYPE</th>
<th>INSTRUMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preverbal children</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Preiterate children</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>6 months to 3 years</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>3 to 5 years</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>&gt;5 years</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

Instrument-Based Screening

- Most experts believe cannot convert instrument measurement to visual acuity
- If use instruments, have test of visual acuity as back-up
  - Forgot to charge battery
  - Device malfunctions
  - Cannot achieve a reading
- Head Start children in Vision in Preschoolers Study
- Could “nearly always” participate in instrument-based screening if unable to participate in optotype-based screening, and vice versa

Pointing from 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.”

Can just anyone screen vision?

- World Health Organization recommends “regular training” for screeners because “... the skill of the tester affects very significantly the validity and variability of the outcome.”
Matching Variation

- Place individual cards on floor in front of child.
- Ask child to step on the card that matches your symbol.

No Need to 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

Children Who Should Bypass Vision Screening and Go Directly to Eye Exam

- Down Syndrome, prematurity, juvenile idiopathic arthritis, and neurofibromatosis.¹
- A family history of amblyopia, strabismus, retinoblastoma, congenital cataracts, or congenital glaucoma.¹
- Developmental delays, intellectual disabilities, neurodevelopmental conditions, and/or behavioral issues that render them untestable.
- Low birth weight, prolonged supplemental oxygen, or grades III or IV intraventricular hemorrhage.² ³
- Retinopathy of prematurity.² ³
- Whose mothers smoked or used drugs or alcohol during pregnancy.² ³
- Whose mothers had rubella, toxoplasmosis, venereal disease, herpes, cytomegalovirus, or human immunodeficiency virus during pregnancy.² ³
- Whose mothers experienced difficult or assisted labor, which may be associated with fetal distress or low Apgar scores.² ³
- Known or suspected central nervous system dysfunction evidenced by developmental delay, cerebral palsy, dysmorphic features, seizures, or hydrocephalus.² ³
- On the autism spectrum.⁴

References:


Referral Criteria

- Ages 3-5 years:
  - Majority of optotypes on 20/40 line
  - Or 2-line difference between eyes even if difference is in passing lines (i.e., 20/25 and 20/40)
- Ages 6 years and older
  - Majority of optotypes on 20/30 (20/32) line
  - Or 2-line difference between eyes even if difference is in passing lines (i.e., 20/20 and 20/32)

Referral Criteria from:
- American Academy of Pediatrics
- American Association of Orthoptists
- American Association for Pediatric Ophthalmology and Strabismus
- American Academy of Ophthalmology

Referral Criteria

- American Association for Pediatric Ophthalmology and Strabismus

- Ages 3 years:
  - Majority of optotypes on 20/50 line

- Ages 4 years:
  - Majority of optotypes on 20/40 line

- Ages 5 years and older:
  - Majority of optotypes on 20/32 (or 20/30) line
  - Or 2-line difference between eyes even if difference is in passing lines (e.g., 20/25 and 20/40)

Keep track of “untestable” children.

Untestable children were 2x as likely to have vision problems than those who passed vision screening.

If you have reason to believe that the child may perform better on another day, consider rescreening the child within 6 months.

Otherwise, refer untestable children for an eye exam with eye care professional skilled in treating young children and adolescents.


Color Vision Deficiency Screening? Why? When?

- Color deficiencies cannot be corrected
- Important for teachers and parents to know
- Early childhood curriculum heavily color-coded
- Johnny may get into trouble for not sitting on the red circle in circle time because he does not see a red circle
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Blog on Good-Lite website
https://www.good-lite.com

Category: Color Vision
AAPOS Vision screening Kits SUCCEED at AAP Conference
Read more...

Terry Waggoner, OD, and T. J. Waggoner Included in Wall Street Journal on Color Deficiencies
Good-Lite Friends Terry Waggoner, OD, well-known vision expert who developed the Color Vision Testing Male Color Screening kit, and T. J. Waggoner, of TestingColorBlind.com, were included in a November 6, 2012, online Wall Street Journal article about color deficiencies. Next to know the information they contributed

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Stereoacuity (Muscle Balance)

PASS 2

Stereoacuity levels: 480 sec arc for 3 and 4 yo; 240 sec arc for 5 yo and older, blank, demo

Stereo Butterfly

Stereoacuity levels:
- Wings (upper) = 2,000
- Antenna = 1,100
- Wings (lower) = 1,000
- Abdomen = 600

Why Not Random Dot E?

- Did not go to 2nd VIP phase
- Elise Ciner, OD, stereoacuity expert with VIP:
  - High untestability rate compared with Stereo Smile (PASS II)
  - Concerns with 50 cm vs. 40 cm (16 in.) screening distance
  - Unclear whether 550 sec arc stereo level is sensitive enough to detect visual conditions

Personal Communication 1/19/11 and 2/21/11
Stereo Smile II

- Analysis of VIP Study data found:
  - Testability of Stereo Smile II ages 3 to 5 years – 99%
  - Preschool children “unable” to complete stereoacuity testing – 5.75 times more likely to have vision disorder – should be referred
  - Preschool children who could complete demonstration card only with no measurable stereopsis – 16.2 times more likely to have a vision disorder – should be referred

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Vision Screening Tips and Review

- If child strongly resists your covering one eye and does NOT resist your covering the other eye: One eye may be preferred for vision; the other eye may have amblyopia.

What to do?
- Test second eye first
- Return to first eye

If this does not work?
- Refer to an eye care professional for comprehensive eye exam

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Take-Home Message . . .

- Instruments = options for detecting amblyopia risk factors
Take-Home Message . . .

Do not fit national/international eye chart design guidelines:

Take-Home Message . . .

• Line outside optotypes
• 20/32 vs. 20/30
• 10 feet vs. 20 feet

Take-Home Message:

LEA Symbols

HOTV
Take-Home Message . . .

• Research supports using single, LEA Symbols optotypes surrounded with bars for children ages 3 to 5 years at 5 feet

• No pointing and holding pointer at optotype.

• If you must show child optotype to identify, point to optotype and immediately remove pointer.


RESOURCES:

➢ Year of Children’s Vision

➢ http://nationalcenter.preventblindness.org/year-childrens-vision

➢ Archived vision screening webinars in Resources

➢ National Center for Children’s Vision & Eye Health

➢ http://nationalcenter.preventblindness.org/
Identify 3 mistakes in image:
1. Pointing at optotype
2. Incorrect chart
3. Holding occluder incorrectly

Thank You for Your Time and Attention!

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