Navigating the Path of Children's Vision Screening:

Visual Acuity, Instruments, & Occluders

NHSA Radio

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Contents

INTRODUCTION:

Thank you for downloading "Navigating the Path of Children's Vision: Visual acuity, Instruments, & Occluders". The information contained in this ebook applies to screening the vision of children from early childhood through high school. Our mission is to provide a resource that answers a wide range of vision screening questions and provides education relevant to the majority of children's vision screening programs.

Common early childhood vision disorders that affect at least 1 in 20 young children include amblyopia, strabismus, and significant refractive error, disorders that can lead to permanent vision impairment if not detected and treated early. Vision screening – using recommended tools, protocols, and procedures – is a cost-effective method to identify those children who should continue on for a follow-up comprehensive eye examination to determine whether vision disorders exist and treatment should occur. Early detection and timely treatment will likely result in long-term improvements in children's vision and eye health.

Head Start requires vision screening to be conducted or results to be collected from other vision screening venues, such as the child's medical home, within 45 days of enrollment into the federal program. Decisions about how vision screening occurs and which tools to use are left to local program level interpretation. This vision screening autonomy results in a wide variation of vision screening tools, protocols, and procedures.

This guide (1) describes screening the vision of typically developing young children with instruments and optotypes (letters, pictures, and numbers), (2) lists children who should bypass vision screening and go directly to eye examination, and (3) describes why a child's hand is not a preferred occluder for optotype-based screening.

This ebook does not provide information about color vision deficiency screening, stereoacuity screening, or whether or not to include near screening tests of visual acuity in your vision screening program.

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AUTHORS:

P. Kay Nottingham Chaplin, EdD, helped Geoffrey E. Bradford, MD, Pediatric Ophthalmologist at West Virginia University (WVU) Eye Institute, to create the Vision Initiative for Children (VIC), a program that trained and equipped individuals to screen the vision of preschoolers.

Between Valentine's Day 2001 and Halloween 2008, Dr. Chaplin directed the VIC program, conducted 178 workshops, and trained more than 1,600 individuals – including Head Start staff, school nurses, pediatricians, and pediatric primary care staff – to screen the vision of preschoolers. During the past 5 years Dr. Chaplin has consulted with individuals who screen the vision of children and adults, nationally and internationally, through her role as Director of Vision and Eye Health Initiatives at Good-Lite and School Health Corporation.

Dr. Chaplin is a member of the National Advisory Committee and Education Subcommittee to the National Center for Children's Vision and Eye Health at Prevent Blindness. In that role she assists in implementing recommendations of the National Expert Panel for a universal preschool vision screening strategy, developing a vision screening training and certification program, and contributing to stakeholder education.

She is also associated with two of the partners for the Year of Children's Vision (Good-Lite and School Health Corporation), along with the National Head Start Association, the National Center for Children's Vision and Eye Health at Prevent Blindness, and the American Association for Pediatric Ophthalmology and Strabismus. Supporters of this initiative include the American Academy of Optometry's Binocular Vision, Perception & Pediatric Optometry Section. The goal of YOCV is to (1) provide national guidance to staff of Head Start programs and other early childhood educators to standardize approaches to vision screening, (2) improve follow-up for eye care for children who do not pass vision screening, (3) provide family friendly educational information, and (4) consult with some of the nation's leading pediatric eye care providers to ensure best practices.

Dr. Chaplin is a member of the Healthy Tomorrows Partnership for Children Program Developmental Questionnaire Work Group, a Children's Vision Massachusetts coalition project funded by HRSA/AAP through an award to Prevent Blindness to look at screening children from birth to age 3 years.

Dr. Chaplin is also a National Vision Screening Trainer for Prevent Blindness.

Dr. Chaplin has lectured, trained, and consulted at more than 100 national, state, and local venues, including conferences for the:

- National Association of School Nurses.
- National Head Start Association.
- National Association of Pediatric Nurse Practitioners.
- Society for Physician Assistants in Pediatrics.
- National Assembly on School-Based Health Care.

As a hobby, Dr. Chaplin studies eye chart history and design.

AUTHORS:

Wendy Marsh-Tootle, OD, MS, is an Associate Professor of Optometry at the UAB School of Optometry. Dr. Marsh-Tootle also is a member of the National Expert Panel for the National Center for Children's Vision and Eye Health, housed at Prevent Blindness America.

Dr. Marsh-Tootle was principal investigator of a study, funded by the National Institutes of Health, to improve the detection of amblyopia (lazy eye) and its risk factors in primary care settings. Along with a panel of experts in pediatrics, family practice, optometry, vision science, and ophthalmology, she developed online training and showed a sustained improvement in knowledge and vision screening practices among participating primary care physicians. With collaboration from Medicaid agencies in Alabama, Illinois, and South Carolina, Dr. Marsh-Tootle showed low rates of quantitative vision screening at preschool ages, when treatment for amblyopia is most effective. She also showed that some providers achieve high rates of vision screening in real-world settings; thus, establishing the feasibility of achieving the overarching goal – to reduce the prevalence of preventable vision loss from amblyopia by improving preschool vision screening in the medical home.

Dr. Marsh-Tootle participates in studies conducted through the Pediatric Eye Disease Investigator Group to determine better methods to treat amblyopia and myopia. These studies have allowed practitioners to prescribe fewer hours of patching and to offer eye drops as an equally effective treatment for amblyopia, as well as to establish the importance of wearing glasses as an important first step in the treatment of strabismus and amblyopia.

In her spare time, Dr. Marsh-Tootle is an active member of VOSH (Volunteers for Optometric Service to Humanity) International.

AUTHORS:

Geoffrey E Bradford, MS, MD, is a professor of Ophthalmology and Pediatrics at West Virginia University. He is in clinical practice and specializes in pediatric eye diseases, trains residents in ophthalmology and pediatrics, and, along with Dr Chaplin, has a research interest in developing ways to enhance early childhood vision screening.

Dr. Bradford founded the West Virginia Vision Initiative for Children in 2001 in which he and Dr Chaplin worked to train, equip, and support vision screeners across the state from Head Start, school nursing, practices in Pediatrics and Family Medicine, and preschool groups.

Dr. Bradford serves on the Section of Ophthalmology Executive Committee for the AAP and is the next Chair of the Vision Screening Committee of the American Association for Pediatric Ophthalmology and Strabismus.

In his spare time, Dr. Bradford enjoys time with his family, travel, wine tasting, chocolate, and relaxing on the deck!

The authors wish to acknowledge and thank the following individuals for reviewing this document or for their assistance and time in answering questions about instrument-based screening:

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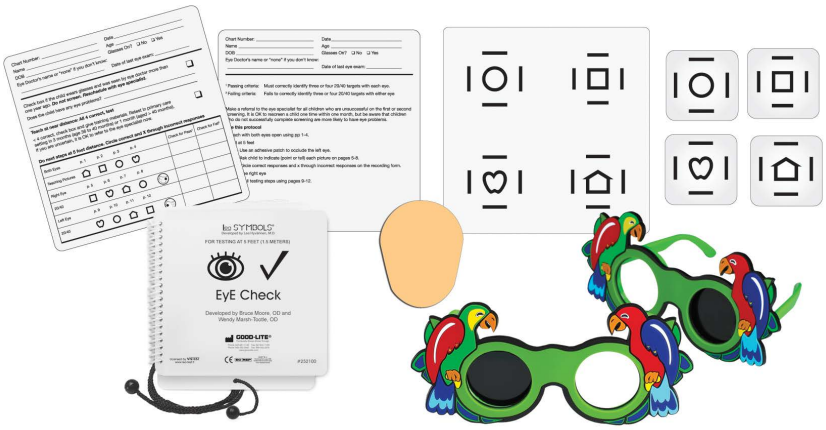
SECTION 1

Optotype-Based Screening & Instrument-Based Screening: How Do They Differ And What Do They Measure?

Jean E. Ramsey, MD, MPH, in her September 2014 NHSA Radio spot with Yasmina Vinci, National Head Start Association Executive Director, talked about using tests of visual acuity and instruments to detect vision problems in young children that could lead to permanent vision loss if not detected and treated early. The two types of screening are referred to as optotype-based or instrument-based.



WHAT IS THE DIFFERENCE BETWEEN INSTRUMENT-BASED AND OPTOTYPE-BASED VISION SCREENING?

Optotype-based screening refers to tests of visual acuity that use pictures, symbols, numbers, or letters, such as eye charts with full lines; flipbooks with single, crowded optotypes; flipbooks with full lines of optotypes for critical line screening (the line the child should pass according to the child's age), iPad apps, and screening software. The child's task in optotype-based screening is to identify the optotypes on the test of visual acuity.

In this e-Book, "tests of visual acuity" includes both standard threshold charts (those with several lines of optotypes decreasing in size on one chart) and flipbooks or other formats with single, isolated optotypes surrounded with bars.

Tests of visual acuity measure the clearness or clarity of vision at the brain level. Optotype-based screening provides visual acuity values, such as 20/20.

Instrument-based screening refers to photoscreeners or portable, handheld autorefractors that, typically, provide instantaneous results suggesting that the child passed the screening or should be referred for an eye exam. Instruments are often called "devices", "automated screening instruments", "automated vision screening devices", or similar terms. The child's task in instrument-based screening is to look at the device; no response is required.

Instruments do not measure visual acuity. Most of the currently commercially available instruments assess for the presence of amblyopia risk factors, such as:

- Significant refractive errors (hyperopia, myopia, and astigmatism),
- Asymmetry of the refractive error from one eye to the other (anisometropia),
- Misalignment of the eyes (strabismus), and the
- Presence of media opacities (cataract).[1]

Let's look at a scenario to help clarify this difference. Vision screening results on a child using an instrument indicate that this child may have an eye condition that can cause defocused and blurred vision. However, vision screening results using a test of visual acuity on this same child show that vision and eye function are actually normal.

Because instruments detect eye conditions that can lead to poor vision but do not actually measure visual acuity, most experts in the field of vision screening believe that instrument-based screening results cannot be directly translated to a specific Snellen notation, such as 20/20.

Optotype-based screening requires a child's attentiveness and responses; instrument-based screening does not need as much cooperation from the child. Some of you have asked whether vision screening machines that use cards or slides, and require child responses to measure vision, are instruments. These machines that require child responses are not included in the

"instrument" category for this discussion.

WHY MIGHT I WANT TO SCREEN VISION WITH AN INSTRUMENT?

Instrument-based screening is quick, requires minimal cooperation of the child, and is especially useful in preverbal and preliterate children, according to the 2012 Instrument-Based Pediatric Vision Screening Policy Statement from the American Academy of Pediatrics, the American Academy of Ophthalmology, the American Association for Pediatric Ophthalmology and Strabismus (AAPOS), and the American Association of Certified Orthoptists.[2]

This instrument-based policy statement is geared toward the medical home and does not provide a recommendation for mass screening. Table 1 provides suggested ages for tests of visual acuity or instruments.[2]

Table 1: Child ages for optotypes and instruments

AGE	OPTOTYPE	INSTRUMENT
Preverbal children		✓
Preliterate children		✓
6 months to 3 years		✓
3 to 5 years	✓	✓
>5 years	✓	

The American Academy of Ophthalmology[3] recommends bypassing vision screening and moving directly to referrals for comprehensive eye examinations by eye care professionals skilled in working with children for:

- Children with certain medical conditions, such as Down Syndrome, prematurity, juvenile idiopathic arthritis, and neurofibromatosis;
- Children with a family history of amblyopia, strabismus, retinoblastoma, congenital cataracts, or congenital glaucoma;
- Children with learning disabilities to rule out the presence of ocular comorbidities; and
- Children with developmental delays, intellectual disabilities, neuropsychological conditions, and/or behavioral issues that render them untestable.

The American Optometric Association[4-5] includes the following high risk factors as reasons for direct referral for a comprehensive eye exam:

- Low birth weight, prolonged supplemental oxygen, or grades III or IV intraventicular hemorrhage;
- Retinopathy of prematurity;
- Maternal smoking during pregnancy;
- Maternal use of drugs or alcohol during pregnancy;
- Maternal infection during pregnancy, including rubella, toxoplasmosis, venereal disease, herpes, cytomegalovirus, and human immunodeficiency virus;
- Difficult or assisted labor, which may be associated with fetal distress or low Apgar scores; and
- Known or suspected central nervous system dysfunction evidenced by developmental delay, cerebral palsy, dysmorphic features, seizures, or hydrocephalus.

Additionally, functional diagnoses such as autism are associated with visual problems, including subnormal visual acuity, refractive errors, and strabismus.[6] You may want to include children on the autism spectrum on your list of children who should bypass vision screening and go to directly to comprehensive eye examination.

Guidelines also exist for those healthy, asymptomatic, typically developing children on your vision screening roster. For example:

- Rescreen or refer children who were "untestable" during vision screening.
- The Vision in Preschoolers (VIP) study found that children who were untestable were at least twice as likely to have vision problems than children who passed vision screening. Vision problems included amblyopia, strabismus, significant refractive error, and unexplained low visual acuity.[7]
- When you rescreen children's vision, one recommended schedule is to rescreen within 6 months.[3]

- When you refer a young child, and have choices among eye care professionals in your community, help ensure that parents/caregivers arrange appointments with an eye care professional who specializes in the care and treatment of young children.

HOW DO INSTRUMENTS DIFFER?

Three devices you will commonly see on the market for instrument-based vision screening are:

- Welch Allyn SureSight
- Welch Allyn Spot Vision Screener
- Plusoptix S12C

Welch Allyn Suresight

Welch Allyn Spot Vision Screener

Plusoptix S12C

*The instruments listed here are examples and do not represent an exhaustive list of commercially available products or endorsements of effectiveness of one product over another.

The three instruments described in this section differ in (1) whether they screen monocularly or binocularly, (2) the distance from the child at which they screen, (3) appropriate referral criteria, and (4) purchase cost.

Monocular and Binocular Screening:

It is easy to assume that screening monocularly would miss detecting eye alignment and strabismus because such a device reads only one eye at a time. This is not necessarily true.

"Claims for instruments that they do a better job of detecting strabismus because they test both eyes simultaneously are not necessarily correct," said Lynn Cyert, PhD, OD, Vision in Preschoolers (VIP) Study Group member representing the Oklahoma Northeastern State University College of Optometry, one of the five clinical sites in the Vision in Preschoolers study (personal communication, February 17, 2014).

"Instruments or VA (visual acuity) tests that test monocularly do a very good job of detecting strabismus, presumably because in most cases strabismus is associated either with decreased visual acuity in one or both eyes or is associated with a high refractive error in one or both eyes." Dr. Cyert said. "So it is not necessary to test binocularly to screen for strabismus, even though monocular tests do not DIRECTLY test for strabismus."

Screening Distance:

The screening distance for Plusoptix and Welch Allyn Spot Vision Screener is around 3 feet. The distance for the Welch Allyn SureSight is 14 inches. Table 2 illustrates screening distance and conditions measured:

Table 2: Instrument screening distances and conditions measured

INSTRUMENT	DISTANCE	1 EYE AT A TIME	BOTH EYES AT SAME TIME	REFRACTIVE ERRORS	EYE ALIGNMENT	ANISCORIA
Welch Allyn Spot Vision Screener	About 3 feet		✓	✓	✓	✓
Plusoptix S12	3.3 feet		✓	✓	✓	✓
Welch Allyn SureSight	14 inches	✓		✓	Indirectly	

Referral Criteria:

The sensitivity and specificity of your device for detecting vision disorders will depend on the referral criteria for your device.[2] Before moving forward, let us review sensitivity and specificity.

- Sensitivity refers to the percentage of children with a vision disorder who were correctly identified and were referred for an eye exam.
- Specificity is the percentage of children without a vision disorder who appropriately passed.

If *sensitivity* is 80%, the screening test:

- Correctly identified and referred 80 of 100 children with a vision disorder, and
- Failed to identify and refer 20 of 100 children with a vision disorder.
- The 20 children passed the vision screening although they had a vision disorder. This is also known as under-referring.

If *specificity* is 80%, the screening test:

- Correctly passed 80 of 100 children without a vision disorder, and
- Incorrectly referred 20 of 100 children without a vision disorder.
- The 20 children did not pass the vision screening even though they did not have a vision disorder. This scenario is also known as over-referring.

It is important to remember, Dr. Cyert said, that "health screening over-refers some of the people who do not have the target condition and misses some of the people in the screening who have the targeted condition."

Some instruments contain preprogrammed referral criteria thresholds. When you select referral criteria, you are basically determining whether you want to over- or under-refer children for eye exams. Changing referral criteria often results in a trade-off between sensitivity and specificity. High sensitivity risks excessive over-referrals. High specificity risks under-referring children with vision disorders.[2]

You can select appropriate referral criteria for your instruments by consulting with pediatric optometrists or ophthalmologists in your area or reviewing guidelines from AAPOS (Table 3) for detecting amblyopia risk factors.[9] The criteria in Table 3 are similar to those established for preschoolers in the VIP Study.[10]

Table 3: AAPOS instrument-based setting guidelines

Amblyopia Risk Factors Targeted With Instrument-Based Vision Screening From the American Association for Pediatric Ophthalmology and Strabismus				
Age in Months	Astigmatism	Hyperopia	Anisometropia	Myopia
12-30	>2.0 D	>4.5 D	>2.5 D	>-3.5 D
31-48	>2.0 D	>4.0 D	>2.0 D	>-3.0 D
>48	>1.5 D	>3.5 D	>1.5 D	>-1.5 D

D = Diopters (a measurement of refractive error)

If you use the Welch Allyn SureSight, ensure the device is calibrated every 18 months, always set in "child mode" when being used with children before age 7 years, and updated to Version 2.25, which matches Vision In Preschoolers Study screening criteria.[10-11] A printout of vision screening results will display your software version. SureSight software Version 2.25 includes referral criteria (0.90 specificity) that align with the recommendations of the National Expert Panel to the National Center for Children's Vision and Eye Health at Prevent Blindness.

If you have access to eye exam results, compare the eye exam results with your vision screening results to ensure appropriate referral rates and use of updated, age-appropriate criteria. If you believe this comparison suggests you may be referring too many children, adjust your referral criteria. It is a balancing act, if you will, between over- and under-referring children. Your local ophthalmologists and optometrists can help you with this decision.

Purchase Cost:

The three instruments described in this section cost around $4,000 to $8,000.

Welch Allyn Suresight

PediaVision Spot

Plusoptix S12C

SHOULD I USE AN INSTRUMENT OR A TEST OF VISUAL ACUITY?

The following information can help you with this decision:

- ✓ The University of Iowa found in a recent study that children as young as 1 to 3 years could be screened using an instrument.[12]
- ✓ The 2012 Instrument-Based Pediatric Vision Screening Policy Statement provides recommendations for the medical home but not for mass screening.[2] This document:
  - States that photoscreeners and handheld autorefractors may be electively performed with children ages **6 months to 3 years** to permit earlier detection of disorders that could lead to amblyopia.
  - States that photoscreeners and handheld autorefractors may be electively performed with older children who are unable or unwilling to participate in optotype-based screening.
  - Recommends photoscreeners and handheld autorefractors as an alternative to tests of visual acuity for children ages **3 through 5 years**.
  - States that tests of visual acuity to assess amblyopia in children ages **3 to 5 years** remains a viable practice.
  - States that tests of visual acuity are more efficient and less expensive for children aged **6 years and older**.
- ✓ Instrument-based screening has not been shown to be superior or inferior to tests of visual acuity in children ages 3 to 5 years.[10-11]

Daniel E. Neely, MD, Pediatric Ophthalmologist, Professor of Ophthalmology at the Indiana University School of Medicine, and past Chair of the AAPOS Vision Screening Committee, provided this summary:[1]

- Instrument-based screening has advantages in children **under the age of 3 years**.
- Children ages **3 to 5 years** can be screened with equal efficacy with either an instrument or a test of visual acuity.
- Children ages **5 years and older** should be screened with an acuity chart to document the visual acuity of each eye.

IF I CHOOSE TO USE AN INSTRUMENT, SHOULD I ALSO HAVE A TEST OF VISUAL ACUITY IN MY TOOL BOX?

If you choose to use an instrument as your primary vision screening tool, you will want an age-appropriate, evidence-based, and scientifically valid test of visual acuity (discussed in Section 2) as a backup in case:

- You forgot to charge the battery and an electrical outlet is inaccessible in your screening area,
- The device malfunctions,
- You cannot achieve a reading with the instrument, or
- A child is untestable with the instrument.

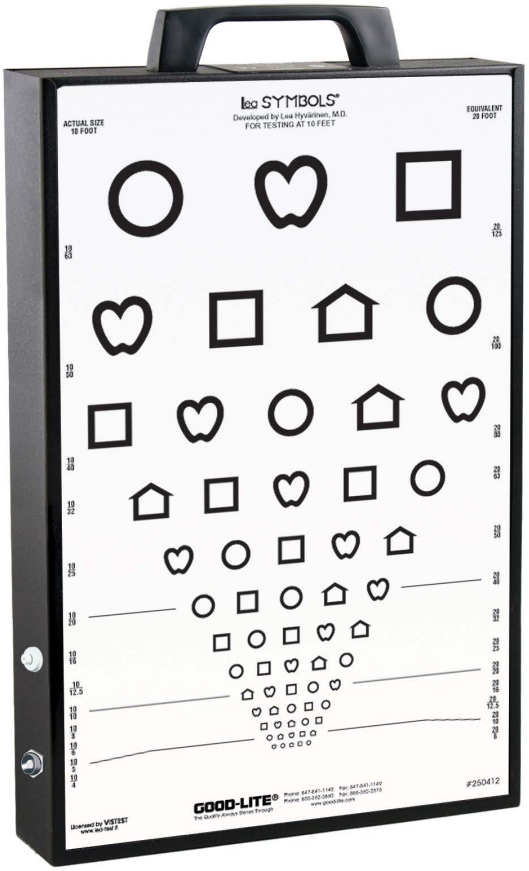
The Vision in Preschoolers Study found that children who were unable to participate in vision screening with a handheld autorefractor were nearly always able to participate in vision screening with a test of visual acuity. Children who were unable to participate in vision screening with a test of visual acuity were nearly always able to participate in vision screening with a handheld autorefractor.[7]

The take-home message is this: The decision to use an instrument or a test of visual acuity as your primary vision screening tool depends on your preference, your screening environment, what you want to measure, and your budget. If you choose an instrument, add an age-appropriate, evidence-based, and scientifically validated test of visual acuity as a backup in your vision screening toolbox.

SECTION 2

Two Optimal Optotypes To Detect Vision Disorders In Young Children

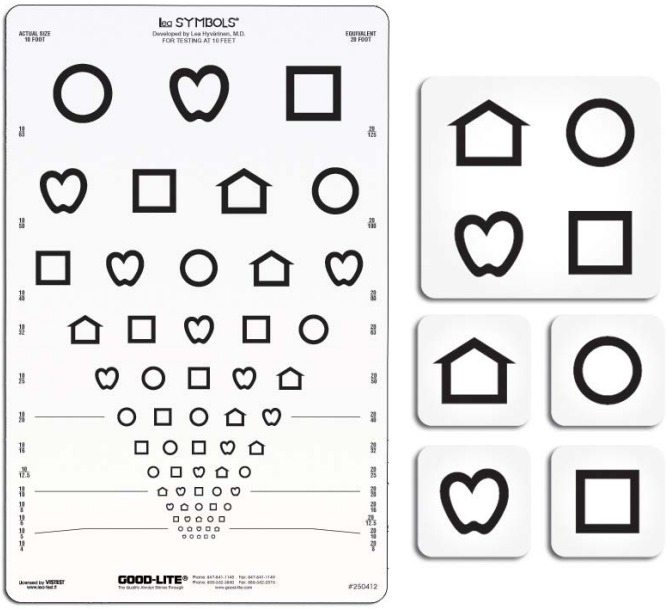
As Jean E. Ramsey, MD, MPH, Pediatric Ophthalmologist, stated in her September 2014 NHSA Radio spot with Yasmina Vinci, National Head Start Association Executive Director, we want to ensure that our young children have the best vision possible to grow and develop. Yet, according to Dr. Ramsey, 3% to 5% of our young children have vision problems . . . vision problems that can lead to permanent visual impairment if not detected and treated early.



HOW DO I DETECT VISION PROBLEMS EARLY?

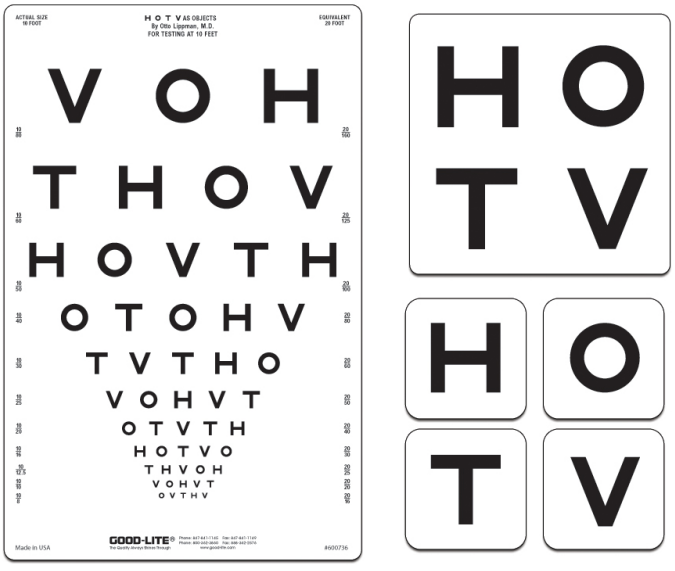
You cannot rely on merely looking at a child to detect whether or not that child has a vision problem, according to information Dr. Ramsey provided in the NHSA Radio spot.

Dr. Ramsey suggested screening children's vision with age- and developmentally appropriate, evidence-based, and scientifically validated tools to detect vision disorders. Proper vision screening can help to identify a child who should be referred for an eye exam. The eye care professional will then examine the child, provide a diagnosis if a vision disorder is detected, and develop a treatment plan. The combination of a vision screen and an eye exam will detect vision problems early so that treatment can begin to improve vision and prevent permanent visual impairment.



For visual acuity screening, Dr. Ramsey recommended using LEA Symbols and HOTV letters as appropriate "optotypes" for tests of visual acuity. Optotype is the name of the shape, letter, or number to identify on a test of visual acuity.

Various professional organizations also support LEA Symbols and HOTV optotypes, including the American Academy of Pediatrics,[1] the American Association of Ophthalmology,[1-2] the American Association for Pediatric Ophthalmology and Strabismus (AAPOS),[1] the American Association of Certified Orthoptists,[1] Prevent Blindness[3], and the American Optometric Association.[4] AAPOS developed a basic vision screening kit featuring LEA Symbols for young children and Sloan Letters for older children.



WHAT ARE THE BENEFITS OF THE LEA SYMBOL OPTOTYPES?

- ✓ LEA Symbols are culturally neutral. Children choose a name for what they believe the optotype represents. For example, the circle could be a hula-hoop or the square could be an iPad.
- ✓ LEA Symbols blur equally at threshold, or at the line where children experience difficulty distinguishing one optotype from another.[5-6] When the optotypes blur, they tend to resemble circles. This encourages the child to keep responding, rather than "shutting down" and allows the tester to obtain a valid acuity estimate.
- ✓ LEA Symbols can be used with children as young as 3 years of age, and come in formats that are specially designed for young children.
- ✓ Older children can be tested with Sloan Letters in chart format.

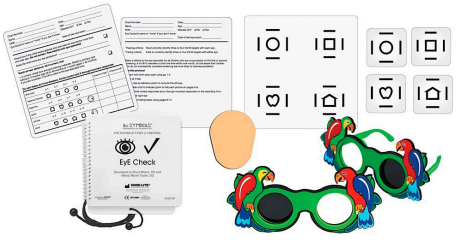
WHAT TEST OF VISUAL ACUITY SHOULD I INCLUDE IN MY TOOLBOX?

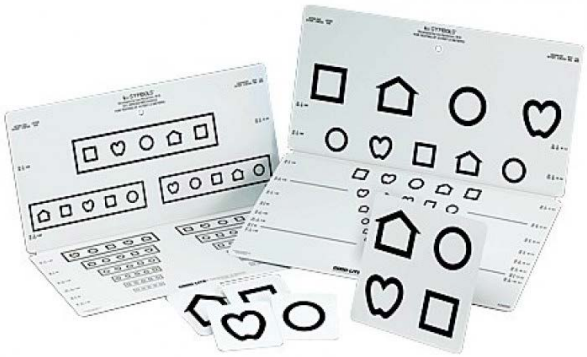
Research supports simplified tests of visual acuity for children aged 3 to 5 years, that use single, surrounded LEA Symbols at a 5-foot testing distance, such as the test designed for the Vision in Preschoolers (VIP) Study to help engage children's participation in vision screening.[7-8] The VIP Study 5-foot test of visual acuity also aligns with recommendations of the National Expert Panel to the National Center for Children's Vision and Eye Health at Prevent Blindness.

Each optotype in the VIP test is surrounded by a bar on all four sides which helps to assess how well the child sees in the real world as accurately as possible.

Screening vision with a single, isolated optotype (without crowding bars or other optotypes) can miss detecting some vision disorders, such as amblyopia. A single, isolated optotype is easier to identify, which is not what you want to occur during vision screening, no matter how much you want the child to pass your vision screening.

Using a single, isolated optotype will overestimate the chart acuity. A single, isolated optotype will also produce an inaccurately high visual acuity score. For example, two studies comparing visual acuity results using single, isolated optotypes with visual acuity results using charts of full lines found that the scores were, on average, three lines better with the single letter compared with charts.[9-10] This means that visual acuity could be 20/32 with a single, isolated optotype and 20/80 on a line chart.



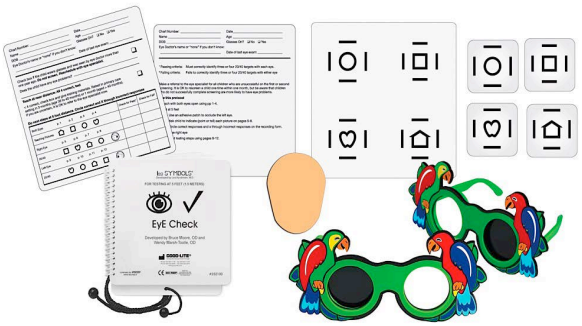


The reason for this large difference is explained by the "crowding effect", which is a reduction in acuity when optotypes are presented with neighboring optotypes, such as a line or a chart of letters or pictures.[11-12] Simply put, single optotypes are too easy to identify.

In the VIP study, nurses and lay screeners detected more children with strabismus and amblyopia using the VIP Study 5-foot test of visual acuity with single, surrounded LEA Symbols optotypes than they did with a test showing a line of optotypes surrounded by a rectangular box at a 10-foot screening distance.[7-8] Strabismus is defined as turned or misaligned eyes. Amblyopia is defined as "lazy eye" or preventable loss of vision at the brain level because of defocused, misaligned, or obscured images.

Lay screeners in the VIP study found 79% of children with strabismus and 87% of children with amblyopia with the VIP 5-foot test. However, when using a line of optotypes surrounded by a rectangular box at a 10-foot screening distance, lay screeners detected only 39% of preschool-aged children with strabismus and 56% of children with amblyopia.[7-8]

You may hear the term "simplified screening format" for tests of visual acuity that use single, surrounded LEA Symbols optotypes.



An example of a tool using a simplified screening format is the EyE Check Screener with LEA Symbols. This screening test uses the critical elements of the VIP test, including the surround bars around the optotype and the 5-foot screening distance. Focus groups, including pediatricians and office staff, suggested that acuity tests calibrated for a 5-foot testing distance would work well in pediatric primary care settings.[13]

Another example is EyeSpy 20/20™, a software video game that uses single, surrounded LEA Symbols optotypes. EyeSpy 20/20™ is typically conducted at 10-feet, but has the capability to use at 5 feet.

If your state or local guidelines call for full eye charts and screening conducted at 10-feet and you want to switch to a simplified screening format that uses a single, surrounded LEA Symbols optotype, you will want to ensure your eye charts are standardized in the interim.

WHY SHOULD FULL EYE CHARTS BE STANDARDIZED & HOW DO I KNOW THE DIFFERENCE BETWEEN A STANDARDIZED AND NON-STANDARDIZED FORMAT?

If you use a "regular" eye chart with multiple lines as a test of visual acuity, you want to ensure that the chart is in a standardized format, as recommended in national and international guidelines for eye chart design.[14-17]

The design of an eye chart can significantly affect visual acuity scores, according to Ian Bailey, OD, MS, FBCO, FAAO, Professor of Optometry and Vision Science, Berkeley School of Optometry, University of California, Berkeley.[18] Excluding the size of the optotype, "each visual acuity level on a test chart should present an essentially equivalent task".[19 (p. 740)] Standardized eye charts provide this equal visual acuity test task during vision screening.

Let's look at an example. In vision screening, visual acuity is defined as the last line where the majority of optotypes are correctly identified. On some eye charts the number of optotypes increases as the line size decreases. This means that, as the child moves down the chart, the child is tasked to identify more optotypes . . . on smaller lines. The number of optotypes to correctly identify increases as the number of optotypes on a line increases. Is this visual acuity test task equal? The answer is . . . no.

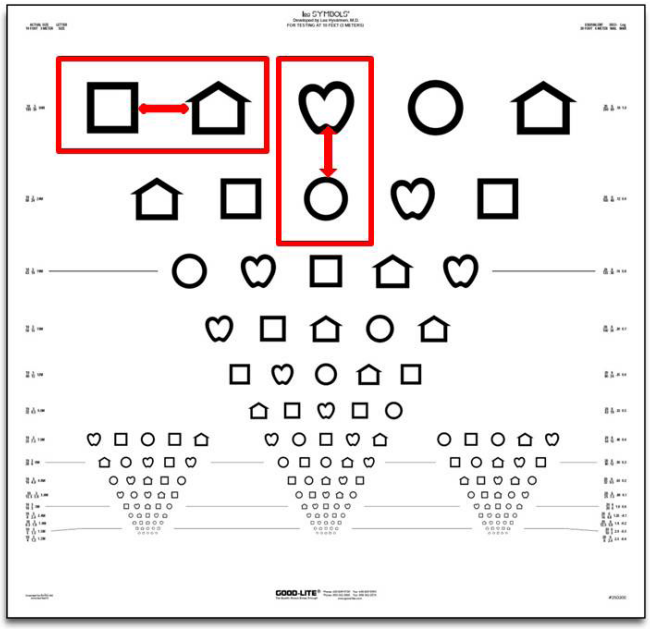
WHAT MAKES AN EYE CHART STANDARDIZED?

Four national and international guidelines exist with six similar recommendations to help ensure that eye charts are standardized.[14-17]

The recommendations are:

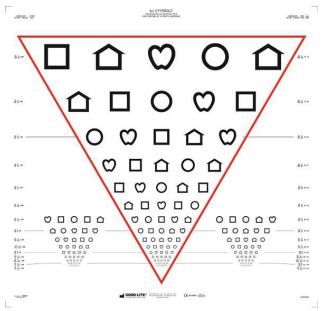
1. Optotypes should be of approximate equal legibility. One optotype should not be easier to identify than another on the same line.
2. Each line on an eye chart should have the same number of optotypes. Identifying correctly the majority of optotypes on a line will be consistent throughout the chart.
3. Horizontal spacing between optotypes on a line should be equal to the width of the optotypes on that line. Specific optotype spacing helps to ensure that the visual task of identifying optotypes is consistent throughout the chart.
4. Vertical spacing between lines should be the height of the optotypes on the next line down. Uniform spacing ratios help to ensure that the visual task is equal on all lines.
5. The size of the optotypes should progress geometrically up or down the chart by 0.1 log units. You will likely see 20/32 instead of 20/30 on charts that meet this guideline.
6. Optotypes should be black on a white background under good lighting conditions.[14-17]

If you drew a line around the outside of optotypes on a standardized eye chart, the shape of the line would resemble an inverted pyramid or triangle instead of a box or a rectangle. Eye charts meeting spacing requirements will likely be described as "proportional" or "proportionally spaced" in product catalogs and on e-commerce web sites.

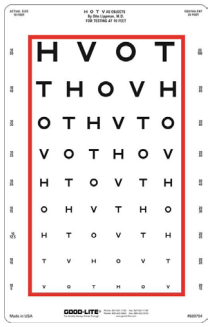


Some of you may be asking how the visual acuity test task can be equal when some eye charts have fewer than five optotypes on the top two lines. The answer to that question is: The top two lines on some charts have fewer optotypes to accommodate the size of the chart. Think about a 9 x 14 chart that slides into the grooves of an ESV1200 illuminated cabinet. The chart meets standardization guidelines overall and you, the screener, are more concerned about how the typically developing child performs on the lines from 20/50 down. If a child cannot identify the majority of optotypes on the first two lines, you have an automatic referral.

YES



NO



The national and international guidelines pertain to "regular" or "threshold" eye charts, where children identify optotypes from the top of the chart downward until they can no longer correctly identify the majority of optotypes. Most of the guidelines, such as optotypes of approximate equal legibility, same number of optotypes, and appropriate horizontal spacing between optotypes also apply to "critical line" tests of visual acuity. In this type of test, the child must correctly identify the majority of optotypes on a line matching the child's age.

WHAT CAN HAPPEN IF I USE A NON-STANDARDIZED EYE CHART?

Let's answer this question from your perspective as a school nurse, a Head Start or early childhood program staff person, or anyone who screens vision. If a child does not pass vision screening conducted with a non-standardized eye chart, it is likely that the visual acuity measurement will differ when the child is later examined by an eye care professional using a standardized eye chart.[20] In fact, the child could pass the visual acuity part of the exam. At least five problems can occur with this scenario:

1. The over-referral rate of children with normal vision increases.
2. The eye care professional may question the appropriateness of future referrals.
3. The child's parent(s) takes time away from work or household duties for an unnecessary appointment with an eye care professional.
4. Children who actually have vision problems may be under-referred.
5. Over-referrals of children with normal vision increases health care costs.[17]

The take-home message is this: To help children have the best vision possible to grow and develop, your task is to do the best job you can when screening vision. Whatever test of visual acuity you use, ensure you use age-appropriate, evidence-based, and scientifically validated tools.

SECTION 3

The Choice Of Occluder Matters

Jean E. Ramsey, MD, MPH, in her September 2014 NHSA Radio spot with Yasmina Vinci, National Head Start Association Executive Director, talked about ensuring that children's eyes are covered (occluded) appropriately during vision screening to ensure no peeking.

WHY IS FULLY OCCUDING ONE EYE WHEN SCREENING THE OTHER EYE IMPORTANT?

The answer to this question is: If a child peeks to use both eyes to identify an optotype, the visual acuity value is not a true visual acuity value and you could under-refer children who have vision problems.

Full occlusion is especially important for young children who will attempt to peek when they have full responsibility for occlusion, meaning a young child will likely try to peek around, over, or under the occluder if it is covering their "good" eye and you are asking the child to identify an optotype with an eye that is defocused or has blurry vision.

IS A CHILD'S HAND AN APPROPRIATE OCCLUDER?

The answer to this question is: No. Occluders run the gamut of the child 's hand or screening partner's hands to index cards and spoons. Excluding the assumption that a child might not necessarily appreciate someone holding a hand over their eyes . . . especially a stranger . . . two primary problems occur when using the child's hand or the hand of a parent or partner screener:

1. The heel of the hand can press into the eyeball and you, the screener, must wait for the "stars" to disappear from the child's hand-occluded eye before screening the other eye. Do you have time to wait for the stars to clear when you must screen hundreds of children with 45 days of enrollment in a Head Start program or 200 children before lunch in a school setting?
2. Fingers of the hand cupped over the eye can provide little slots of open space for peeking.

Try this experiment. Cover one eye with your hand. Close the eye that is uncovered and open the eye underneath your hand. Look through the little slits of open space between your fingers. What do you see? Surprising, right? Of course, objects can become clearer when viewed through a small slit, or pinhole – but that's another topic for another day.

If you are using index cards or spoons, a child can peek around the edges . . . and will try hard to peek if they cannot see well with the uncovered eye. Attempting to peek is a typical reaction, not a naughty child.

WHAT IS AN APPROPRIATE OCCLUDER FOR A YOUNG CHILD?

Because it is unwise to give a young child responsibility for covering an eye during screening, use an adhesive eye patch, medical tape, or an occluder that a young child does not need to hold.

Adhesive eye patches or medical tape are preferred occluders for preventing a child from peeking and using the covered eye.[1] You could give children the opportunity to decorate the patches as a prescreening activity to further engage their cooperation during vision screening.

If the child will not tolerate adhesive eye patches or medical tape, commercial occluder glasses are designed to prevent peeking.

Commercial occluder glasses, which often include whimsical frames with parrots, tigers, and horses, are available in sets of two, one for screening each eye. One of the openings is covered with a frosted lens to occlude the eye. In other sets of occluder glasses, the lens is dark but opaque . . . somewhat similar to sunglasses. The glasses with a frosted lens allow more ambient light around the eye and is not as intrusive to the child as the dark lens.

Occluder glasses framed with parrots, tigers, or horses can also increase participation when children are uninterested in playing your vision screening game. Most children like the novelty of the glasses; none have asked to keep the glasses at the conclusion of the screening.

We do not recommend making your own occluders by purchasing two sets of sunglasses and removing one lens from each set. The commercially available occluder frames have an important benefit in that they include extra material around the frame's outer edges to help prevent peeking.

Another commercially available option for young children—with petite faces—is occluder glasses where each eye piece pops up separately.

You can clean occluder glasses between screenings with alcohol or non-alcohol wipes. Clean all parts of the occluder glasses except occlusive lenses.

WHAT IS AN APPROPRIATE OCCLUDER FOR CHILDREN OLDER THAN 10 YEARS?

An appropriate occluder for children older than 10 years (and who are less likely to peek) is the black or gray "lollypop" occluder with a handle. Here is a hint on using this type of occluder . . . many screeners hold the "lollypop" with the handle toward the chin. If you own this occluder, look at the underside of the occluder. Notice a raised portion? That raised portion has a purpose. Hold the occluder with the handle toward the temple. The raised portion fits in the curve of the nose . . . to prevent peeking, even with these older children.

Another occluder option is the handheld flip paddle. This occluder resembles a handheld mask with an opening for only one of the eyes. To switch between eyes, the child flips over the occluder to cover the eye previously screened.

The take-home message is this: If you want to do the best vision screening you can possibly do, ensure that the child does not peek when an eye is occluded. And, to ensure the child does not peek, use occluders designed to help prevent peeking.

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For more information about vision screening as part of a 12-Component Strong Vision Health System of Care, visit the Resources Section of the Year of Children's Vision – National Center for Children's Vision and Eye Health at Prevent Blindness – at: http://nationalcenter.preventblindness.org/year-childrens-vision