

VISION ASSESSMENT

1. Background and Rationale

Visual Acuity

The prevalence of blindness and impaired visual acuity increases with age; conservative prevalence estimates are 10 – 13% among people 65 years and older, and 25- 52% among those 85 years and older.[1, 2] Impaired vision is associated with decreased mobility, increased physical disability and difficulty performing everyday tasks, imbalance, and falls.[3-5] Despite these findings, mortality data are less clear. A study of older registrants who had detailed eye examinations found that while older adults with moderate visual impairment had lower survival rates than those with normal vision, the survival rates of legally blind seniors were similar to rates for community-dwelling older adults.[6] Although the data on low vision and physical function are consistent, this study suggests that factors other than vision may modulate the vision-mortality relationship.

Although many studies have shown that high-contrast acuity is a poor predictor of overall visual performance, it has nevertheless been shown to be predictive of poor survival,[7] physical disability,[5, 8, 9] decline in physical functioning,[10, 11] and impairment of mobility and activities of daily living.[4] It is also both a necessary descriptor of the BLSA study population for comparison to other groups and the measure with most current clinical relevance. Finally, it is a familiar measure that may be reported to participants as a retention aid.

Contrast Sensitivity

Contrast sensitivity has been shown to be an important predictor of falls and fractures[12-14] and has been measured in a number of large scale vision studies as well as studies of aging. Studies indicate a linear decline in contrast sensitivity with age.[2] It has also been shown to decline at least a decade earlier than noticeable declines in high contrast visual acuity. Previous studies found contrast sensitivity and visual acuity to be significant risk factors for self-reported disability[15, 16] and for objective performance of function.[4] Assessing these vision components in the BLSA will provide a comparison between BLSA and other studies, allow us to track changes with aging and to study the relationship between these measures and important health outcomes over time.

Stereopsis

Stereopsis, or depth perception, is a test of binocularity, or ability of the two eyes to work together. In population-based studies, stereopsis remains relatively stable until age 70 then declines sharply thereafter.[2] It gives information about the functioning of the poorer eye, while the other tests generally measure the better eye. Stereopsis was shown to be a good predictor of falls in the Study of Osteoporotic Fractures [13, 17] and has obvious relevance to mobility and activities of daily living in BLSA.

Visual Fields

Loss of visual field sensitivity has been associated with normal aging[18, 19] and with mobility performance, independent of age.[20] Specifically, visual field loss is associated with slower walking speed and/or bumping into objects,[20-22] and a higher risk of falls.[23, 24] These important findings related to mobility in older persons in cross-sectional studies underscore the need for further analyses in longitudinal studies.

Gaze Stabilization

Even when one seems to be completely at rest, the body is in constant motion. With each movement, the eyes must move in an equal and opposite direction to maintain a fixed image on the retina. The vestibulo-ocular reflexes (VOR) are the major compensatory mechanism responsible for this, by providing fast compensation during both translational and rotational motions. “The functional goal of the translational VOR is to decrease conjugate retinal slip and minimize binocular disparities during either self-motion or passive displacements such as those experienced when riding in a car.”[25] Failure of the VORs to maintain gaze causes retinal slip with compromised fixation and impaired vision. This visual blurring with head motion is called oscillopsia.

Oscillopsia commonly occurs among patients with vestibular hypofunction, to a lesser degree in normal persons,[26] and probably occurs to some degree with aging.[27] Effects related to ‘normal’ aging, however, are not well described, particularly among the oldest old. One possible explanation proposed for oscillopsia in older adults without clinical disease or symptoms of vestibular disease is a prolonged VOR latency period, allowing a longer time in which head motion is uncompensated.[28] Among persons with vestibular hypofunction, research has shown that oscillopsia occurs while walking or riding in automobiles.[29] If similar effects are present with aging, with or without vestibular dysfunction, older adults may experience important declines in performing daily activities and on their quality of life.

Gaze stabilization is necessary for many activities. To maintain visual acuity requires gaze stabilization at velocities at approximately 20°/sec while walking, 70 – 80°/sec while running, 80 - 90°/sec while driving, and 120 - 150°/sec while playing tennis.

The ability to stabilize a visual image on the retina and/or fovea can be measured as dynamic visual acuity (DVA), the threshold of visual resolution obtained during relative motion of either optotypes or observer, and gaze stabilization. These measures are used to quantitatively measure oscillopsia and to therefore reflect functionally significant abnormalities of the VOR.[30] Studies have suggested that the ability to maintain a stable gaze is an important determinant of function for many important tasks in both young persons (e.g. athletes and pilots) and in elderly (e.g. more frequent automobile driving[30]) In addition, functional improvements in balance, DVA, and gait stability have been demonstrated following vestibular physical therapy in patients with central or peripheral vestibular dysfunction or central nervous system pathology[31], suggesting

that such impairments are modifiable.

The gaze stabilization test (GST) of the InVision system measures the maximum velocity at which one can maintain visual acuity and is an important indicator of function of the VOR, particularly at velocities near 100°/sec. (NIA-ASTRA Pearls lecture by Lewis Nashner, ScD, January 21, 2005) Not only do we lack data from longitudinal studies addressing the role of gaze stabilization on functional outcomes, such as mobility, but basic measures such as normative data in older adults are lacking as well.

Objective

The objective of this assessment is to measure and report visual acuity, contrast sensitivity, stereopsis, gaze stabilization in the horizontal axis, and visual fields in the BLSA participants, the changes that occur in each of these vision measures over time, and the relationship between these measures and important health outcomes such as mobility, physical function/disability, cognition, and survival.

Recommended Instrument(s)

Vector Vision CSV-1000CVA Unit & test face
Remote control
Stereo Fly Kit SO-001 Graded Circle Test with standard 3-D Viewers
NeuroCom InVision Gaze Stabilization Test
Humphrey Model 650-II Visual Field Analyzer
Lens cloth
Contact lens holder and solution/disinfectant
Lensometer
+1.0, +1.5, +2.0, +2.5 reading glasses

Strengths and weaknesses of selected approach

Visual Acuity and Contrast Sensitivity:

The Vector Vision CSV-1000 is an easy to use, self-standardized vision-testing instrument. One important advantage of the Vector Vision unit is its ability to automatically adjust for external and internal lighting so that it provides a constant test luminance level of 85 candelas/m². A wireless remote control allows individual lighting of the row being tested, providing easier viewing by the participant. The Vector Vision CSV-1000CVA tests three contrast levels (high, 25%, and 12.5%) of LogMAR acuity and contrast sensitivity with one instrument rather than two. This instrument has the advantage of using gratings, which define contrast sensitivity in different sizes of targets as several different cycles per degree and are therefore considered optimal over optotype tests, which test

using letters (Pelli-Robson).[32] The Pelli-Robson only measures 1 cycle per degree (cpd) region at a given distance. The CSV-1000CVA measures at 6 and 12 cpd. (Other grating tests usually test from 1.5 cpd to 18 cpd, or higher with computer-based equipment.)

Stereopsis:

The Stereo Fly Test Circles pattern is a standardized assessment of stereopsis that can be easily administered and is not affected by literacy. It is a well-known instrument in clinical and research environments that provides a “finely graded sequence for critical testing.” Minor variations in testing distance will have little effect on the score. Our protocol describes, however, using the recommended 16 inches test distance. One drawback is the reported (from WHAS II) fragility of the special 3D glasses required for testing.

Visual Fields:

The Humphrey Visual Field Analyzer is the most accepted and widely used visual field assessment instrument in the United States. The current model, Model HFA II, is an updated version of the previous instrument (HFA I, Model 640) used in the BLSA. Previously performed tests included the Central 24-2 Threshold and Peripheral 68 Point Screen; primarily due to time constraints, these cannot be performed in the current protocol. Instead, an 81-point screening test strategy will be used (81 Full Field Screening Test). The number of participants previously assessed from 1992 - 1997 was approximately 106. The updated visual field assessment protocol was developed in 2004 – 2005 as a collaborative effort with Dr. Shirin Hassan, Assistant Professor of Ophthalmology (2004) at Johns Hopkins University and Dr. Chris Johnson, Devers Eye Institute. The date of first VF data received was in fall of 2006.

Visual fields (VF) are assessed at each examination in the BLSA using the Humphrey Visual Field Analyzer by Carl Zeiss Meditec, which is state-of-the-art equipment for both clinical assessments and research studies. However, the fields recorded by the Humphrey Field Analyzer are stored on double-sided, doubledensity, 5 ¼" floppy disks in a specialized format derived by Humphrey Instruments. The data files are not compatible with any database software packages. It is therefore necessary to convert the data files on the Humphrey disks into a format which can be imported into database programs. Initially, the VF data were sent via FedEx to Dr. Chris Johnson (c/o Kim Cello, UC Davis visual field reading center) for conversion. In 2009, a contract was developed to continue working with Dr. Johnson after he moved to the University of Iowa (UI) as Professor and Director of the UI VF Reading Center (UIVFC). The data from the UIVFC will be transmitted via web-based technology using SQL format,

and will include created variables described in this manual as well as the automated variables from the Humphrey Visual Field Analyzer. Thus, data prior to this contract origination required creation by BLSA data manager (variables for central & peripheral vision and variables by quadrants of visual fields).

Gaze stabilization/Dynamic Visual Acuity:

NeuroCom's InVision system was developed with a leading expert in vestibular/posturography research and was assessed and recommended by an expert in the field as the state of the art system. The InVision system is versatile in that it provides a wide range of start and stop frequencies for head movement set by the operator, provides an assessment of static visual acuity or allows the operator to enter the field, and allows the operator to choose direction. Importantly, the InVision system also measures the degree of movement of the head and measures and reports actual, as well as target, head velocities.

Analogous (past) measures used in the BLSA (including time periods covered)

Descriptive History from

<http://blswww.grc.nia.nih.gov/i613/info613d.htm>:

Information Type 613 Contrast Sensitivity

Clarification of data element description:

The format of the card showing X-ray number, age, etc. was used because the data are shared among the collaborators on the project.

Card one, cols 16-19 The instructions were originally given completely automatically, via computerized voice interaction with participant. This was shortened when it proved to be unnecessary to have the complete instructions. The time to get through the instructions is of interest procedurally but not scientifically. The time for the test is in minutes, not seconds as shown on the "units" column for that item.

Card one, cols 20-25, threshold contrast 0.5. The 0.5 refers to a visual display with the designated number of alternating dark and light vertical bands in one degree of visual angle. The correct term for the display is "0.5 cycle per degree of visual angle." The 0.5 condition was one of several "spatial frequencies" employed in the test. In a forced-choice' test format, the participant chose which of two displays, the upper or lower, that contained the vertical bands. The other display was always blank. Determination of a threshold began by presenting the dark and light bands

at 80% contrast, and, depending on the sensitivity of the participant, reduced the contrast until the participant could no longer distinguish between the upper and lower displays. The details of the procedure are provided by Schieber et al (1992).

Card one, cols 26-55, threshold contrast for displays with 1.0, 2.0, 4.0, 8.0, and 16.0 cycles per degree of visual angle.

Descriptive history:

(From James L. Fozard, PhD.)

“In 1987, I had the existing BLSA data, procedures, and analyses on visual acuity, color vision, stereopsis, etc. reviewed by two outside experts, John Corso, Ph.D., Distinguished Professor Emeritus at the State University of New York at Cortland, and Donald W. Kline, Ph.D., Professor and Chair, Psychology Department, Calgary University, Edmonston, Ontario, Canada. Both recommended changes in the BLSA visual assessment procedures. After reviewing the recommendations, I asked Donald Kline and Professor Frank Schieber now at the Department of Psychology at the University of South Dakota, Vermillion SD, to develop the procedure used to assess contrast sensitivity. The protocol was devised to give sufficient data at each spatial frequency so that the chances of getting good longitudinal data are high.”

Data collection instruments:

“A computer-driven crt display was designed by Dr. Schieber and built at GRC. The equipment was surplused in June 1997. The data were recorded directly onto tape. Calibration was automatic and trouble shooting was done remotely from Dr. Schieber's laboratory.”

Investigators:

James L. Fozard.

Collaborators include, Drs Frank Schieber and Donald W. Kline as mentioned above.

Related protocols:

Diagnoses of ocular diseases from medical history and examination.

Frequency of data collection:

All consenting participants between 1988 and 1993.

Publications:

- Schieber F, Fozard JL, Gordon-Salant S, Weiffenbach J . Optimizing the sensory-perceptual environment of older adults. *Internat J Indust Ergonomics*, 1991; 7:133-162.
- Schieber F, Kline DW, Kline TJB, Fozard JL. The relationship between contrast sensitivity and the visual problems of older drivers. Warrendale, PA: Society of Automotive Engineers, Tech Paper 920613, 1992, pp.1-7.

Current contrast sensitivity, visual acuity, and stereopsis assessments differ from measures prior to November 2003 in that the test distances are now formally standardized. Previous contrast sensitivity and visual acuity measurements were taken at approximately 8 feet. The current protocol reinforces the 8-foot distance. If visual acuity is worse than 20/50, contrast sensitivity is tested at 4 feet. Stereopsis has been tested using participants' eyewear for near vision if available. In November 2005, reading glasses will be kept in the examination room and offered to all participants 40 years and older or at any age if they report the test circles appear blurry.

Previous visual field assessments included static Central 24-2 Threshold and Peripheral 68 Point Screening. Beginning in 2006, visual fields will be assessed using the Full-Field 81 Screening test (FF-81) in the HFA II to allow comparability to other ongoing studies of older individuals. Gaze stabilization and/or dynamic visual acuity will be included in the 2006 protocol.

Reliability/Validity Studies

The CSV-1000 has proven itself to be sensitive for detecting subtle differences in contrast sensitivity in studies of patients with glaucoma,[33] drug-related central visual field abnormalities,[34] following refractive surgery,[35] and for detecting retinopathy levels in diabetics.[36] The test-retest reliability of the CSV-1000 is favorable, and it is considered a reliable measure of contrast sensitivity.[34]

Randot® represents the standard in assessment of stereopsis in clinical and research arenas, as is the Humphrey® Visual Field Analyzer. NeuroCom's InVision system reports a preliminary review of normative data for DVA and GST protocols. (Appendix on L drive)

Reliability criteria for visual field data: Data are considered non-reliable if the following are present:

1. >33% false-negative responses
2. >33% false-negative responses, or
3. >33% fixation losses

These indices include the following:

- (a) Fixation losses. A light is periodically presented in the physiologic blind spot, and the number of times the participant responds as seeing the stimulus is recorded.
- (b) False positive errors. The noise associated with the stimulus presentation is produced without a light being presented, and the number of times the participant responds is recorded.
- (c) False negative errors. A stimulus is presented in a location for which the assessment has been previously completed, and the number of times the participant does not respond as seeing the light is recorded.

Key Variables (Teleform and Humphrey VFA):

Do you wear eyeglasses or contacts:

Never, Near activities, Distance activities, Near and distance

Type of glasses

Type of contacts

Did you bring them with you?

Tests conducted with eyewear?

Test distance visual acuity

Test distance contrast sensitivity

Low contrast visual acuity without glare lights

Last group correctly identified

Last group correctly identified before an error was made

Medium contrast visual acuity without glare lights

Last group correctly identified

Last group correctly identified before an error was made

High contrast visual acuity without glare lights

Last group correctly identified

Last group correctly identified before an error was made

Contrast sensitivity at 6 cpd without glare lights

Last group correctly identified

Last group correctly identified before an error was made

Contrast sensitivity at 12 cpd without glare lights

Last group correctly identified

Last group correctly identified before an error was made

Low contrast visual acuity with glare lights

Last group correctly identified

Last group correctly identified before an error was made

Medium contrast visual acuity with glare lights

Last group correctly identified

Last group correctly identified before an error was made

High contrast visual acuity with glare lights

Last group correctly identified

Last group correctly identified before an error was made
Contrast sensitivity at 6 cpd with glare lights
Last group correctly identified
Last group correctly identified before an error was made
Contrast sensitivity at 12 cpd with glare lights
Last group correctly identified
Last group correctly identified before an error was made
Stereopsis (sec arc):
Last group correctly identified
Last group correctly identified before an error was made
GST/DVA horizontal pending

Visual Fields variables:

Full Name (this is input by tester as “BLSA#####_xx” where #####=BLSA id number and xx=tester id)
Patient ID
Birth Date
Visit Date
Series Date Time
Site
Exam Time
Trial Sphere
Trial Cylinder
Trial Axis
Distance Sphere
Distance Cylinder
Distance Axis
Pupil Diameter
Field15
Pupil Diameter Auto
Test Type
Test Pattern
Test Strategy
Stimulus Color
Stimulus Size
Background Color
Exam Duration
Fixation Target
Fixation Monitor
Blind Spot X
Blind Spot Y
Blind Spot Stimulus Size
False Negative Method

False Negative Trials
False Negative Errors
False Postive Method
False Postive Trials
False Postive Errors
Fixation Trials
Fixation Errors
Foveal Result
Central Ref Level
Thrown Out Points
Minimum Stimulus
Field Size
Language
Screen Mode
Peripheral Reference Level
Point Seen
Relative Defects
Absolute Defects
Num Point Screening List
Screening Result 1
Quantified Defects 1
Screening Result 2
Quantified Defect 2
Screening Result 3
Quantified Defect 3
Screening Result 4
Quantified Defect 4
Screening Result 5
Quantified Defect 5
Screening Result 6
Quantified Defect 6
Screening Result 7
Quantified Defect 7
Screening Result 8
Quantified Defect 8
Screening Result 9
Quantified Defect 9
Screening Result 10
Quantified Defect 10
Screening Result 11
Quantified Defect 11
Screening Result 12
Quantified Defect 12
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Screening Result 74
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Screening Result 75
Quantified Defect 75
Screening Result 76
Quantified Defect 76
Screening Result 77
Quantified Defect 77
Screening Result 78
Quantified Defect 78
Screening Result 79

Quantified Defect 79
Screening Result 80
Quantified Defect 80
Screening Result 81
Quantified Defect 81
Screening Result 82 (This appears to be an extra variable; there are only 81 points tested)
Quantified Defect 82 (This appears to be an extra variable; there are only 81 points tested)
Left Eye Central 30 degrees Relative Defects
Left Eye Central 30 degrees Absolute Defects
Left Eye Peripheral Relative Defects
Left Eye Peripheral Absolute Defects
Left Eye Nasal Upper Quadrant Relative Defects
Left Eye Nasal Upper Quadrant Absolute Defects
Left Eye Central 30 degrees Nasal Upper Quadrant Relative Defects
Left Eye Central 30 degrees Nasal Upper Quadrant Absolute Defects
Left Eye Nasal Lower Quadrant Relative Defects
Left Eye Nasal Lower Quadrant Absolute Defects
Left Eye Central 30 degrees Nasal Lower Quadrant Relative Defects
Left Eye Central 30 degrees Nasal Lower Quadrant Absolute Defects
Left Eye Temporal Upper Quadrant Relative Defects
Left Eye Temporal Upper Quadrant Absolute Defects
Left Eye Central 30 degrees Temporal Upper Quadrant Relative Defects
Left Eye Central 30 degrees Temporal Upper Quadrant Absolute Defects
Left Eye Temporal Lower Quadrant Relative Defects
Left Eye Temporal Lower Quadrant Absolute Defects
Left Eye Central 30 degrees Temporal Lower Quadrant Relative Defects
Left Eye Central 30 degrees Temporal Lower Quadrant Absolute Defects
Left Eye Total Relative Defects
Left Eye Total Absolute Defects
Right Eye Central 30 degrees Relative Defects
Right Eye Central 30 degrees Absolute Defects
Right Eye Peripheral Relative Defects
Right Eye Peripheral Absolute Defects
Right Eye Nasal Upper Quadrant Relative Defects
Right Eye Nasal Upper Quadrant Absolute Defects
Right Eye Central 30 degrees Nasal Upper Quadrant Relative Defects
Right Eye Central 30 degrees Nasal Upper Quadrant Absolute Defects
Right Eye Nasal Lower Quadrant Relative Defects
Right Eye Nasal Lower Quadrant Absolute Defects
Right Eye Central 30 degrees Nasal Lower Quadrant Relative Defects
Right Eye Central 30 degrees Nasal Lower Quadrant Absolute Defects
Right Eye Temporal Upper Quadrant Relative Defects

Right Eye Temporal Upper Quadrant Absolute Defects
 Right Eye Central 30 degrees Temporal Upper Quadrant Relative Defects
 Right Eye Central 30 degrees Temporal Upper Quadrant Absolute Defects
 Right Eye Temporal Lower Quadrant Relative Defects
 Right Eye Temporal Lower Quadrant Absolute Defects
 Right Eye Central 30 degrees Temporal Lower Quadrant Relative Defects
 Right Eye Central 30 degrees Temporal Lower Quadrant Absolute Defects
 Right Eye Total Relative Defects
 Right Eye Total Absolute Defects,

- where “Screening Result”
 - =1 if the person recorded seeing the light at the initial usual intensity and
 - =4 if the person did not record seeing the light at the initial usual intensity
- where “Quantified Defects”
 - = “ ” if the person saw the light at any intensity (this is how the data were returned to us from the reading center—a blank.)
 - = x , where x represents the maximum increased light intensity presented to the person during testing
- where “Relative Defects”
 - = number of points, or positions of the light, (of 81 points presented), that the person required a higher light intensity than initially presented, even if they eventually saw the light
- where “Absolute Defects”
 - = number of points, or positions of the light, (of 81 points presented) that the person did not record seeing, despite being presented with higher light intensities. A person could have relative defects and no absolute defects.

NOTE: Data are considered non-reliable if the following are present:

4. >33% false-negative responses
5. >33% false-negative responses, or
6. >33% fixation losses

2. Equipment and Supplies

CSV-1000CVA Unit and eye chart
 Remote control
 Stereo Fly Kit SO-001 Graded Circle Test with standard 3-D Viewers
 NeuroCom InVision system
 Humphrey Field Analyzer
 Lensometer
 Pen light
 Small trial lens set
 Eye patch or adhesive coverlets
 Lensometer (Topcon Model LM-T3)

Eye patch or adhesive coverlets
Lens cloth
Saline solution for hard and soft contacts
Contact lens holders

Maintenance

The remote control operates with a 9-volt battery, which will need replacing periodically. The investigators and research assistants will visually inspect the equipment for wear and tear prior to testing the first participant of the day. The test faces can be cleaned with mild soap and water if needed, and Armour-All brand products are recommended for the CSV Unit. No other routine maintenance is needed for this equipment.

3. Safety Issues and Exclusions

The vision tests are performed without pupil dilatation and are safe for all participants. Participants who refuse the test will not be tested. Document the reason for refusing. Any condition that leads to marked discrepancy of vision between eyes, including an artificial eye, unilateral absence of eye (congenital or traumatic), unilateral blindness or severely impaired vision in one eye with normal or near-normal vision in other eye is considered an exclusion criteria for visual field testing. DVA can provoke nausea or dizziness. The test should be stopped if symptoms develop.

4. Participant and Exam Room Preparation

Tests of visual acuity, contrast sensitivity, stereopsis, and dynamic visual acuity should be performed binocularly (using both eyes) with the participants wearing their usual corrective eyewear, if applicable. Use the algorithm (see Vision Teleform page 1) to determine which eyewear (distance vs. near), if any, should be worn for specific tests. All vision tests are done in Consult Room #508 using forced-choice testing. This room is set up with the CSV-1000CVA unit in position. Tape on the floor marks the 4-foot and 8-foot distances from the chart. The participant's head should be centered over the tape. The participant should sit up straight during testing and not be allowed to squint, lean forward in the chair, or otherwise change position. The participant can move the page of the stereopsis test booklet slightly if he/she is having difficulty discerning differences, but the distance from the book to the participant's forehead should not change.

5. Detailed Measurement Procedures

All vision tests are conducted at each BLSA visit. The full battery requires approximately

75 – 90 minutes. The room is set up for testing as described in each section and does not require additional preparation.

5.1 Lensometer Reading

Description: Measures spherical and cylindrical power of participant's spectacles.

Instructions:

Automated Lensometer (Reichert AL200)

Turn machine on using switch at bottom of back of machine. Machine automatically performs a calibration check upon initialization. Do not place any object in front of the aperture during calibration.

Press any button to continue. Then select measurement mode (single vision (default mode), progressive (press button once), bifocal (press button twice)) using the second button from the left. If the operator inserts a progressive lens in the single vision mode, the progressive icon may flash to indicate the mode should be changed. The operator should watch for flashing symbols which generally indicate a problem needs addressing.

Place participant's eyeglasses on the unit, with the right lens in test position (right is ALWAYS tested first), facing the operator. The lens which the machine is testing will be highlighted in the upper corner of the screen (right or left). Align the crosshairs (+) with the center of the screen (\oplus), or the optical center. When centered, the lensometer automatically locks the measurements on the screen. Record these on the Teleform. If progressive or bifocals are being measured, raise the lens and measure the Near-Add in the part of the glasses used for near vision, aligning the cross hairs as described for the single vision lens when the lens is a bifocal/trifocal. For progressive lenses, arrows to the right and left of the add zone indicate the operator is appropriately moving outside the progressive zone. The add power, displayed at the bottom corner of the screen, will increase as you move progressively lower on the lens, and black lines will fill the progressive area on the screen. Continue following the direction of the arrows until the maximum add power is reached. To lock the add power on the screen, press the hold button to lock the distance value on the screen. Record the measurement on the Teleform.

The Near Add is only measured for the right lens. Next, move the spectacles to test the left lens. Record results for left lens on the Teleform.

NOTE: The design of certain progressive lenses may prohibit auto distance measurement. In these cases, the operator must press the hold button to lock the distance value on the screen.

S = Sphere

C = Cylinder

A = Axis

Manual Lensometer (For use only if automated lensometer is non-operational):

Turn on lensometer and focus the eye-piece of the lensometer.

Ask participant for spectacles and establish when they use them (*i.e.* general wear, only for driving, only for reading or for both distance and near etc.). Record the prescription type and use on the Teleform. Clean spectacles with a tissue or cotton cloth and lens cleaning solution.

Mount spectacles on lensometer against lens alignment plate with **front of spectacle facing towards you**. This will place the **LEFT** eye lens on the right.

Position left lens on lens support and rotate lens alignment plate lever to position lens so that target pattern (a ring of dots) is centered on the screen.

Raise lens holder lever to release, and lower over lens to hold it in place.

Examine the target (ring of dots) projected inside the lensometer. If you are able to focus all the dots of the target using **ONLY** the power drum (located on the right-hand side of the lensometer), the lens is spherical. For spherical lenses, focus the target, note the power reading on the power drum (right side of the instrument), and the axis (on the eyepiece of the instrument), and record these on the Teleform. If the target does not focus as a ring of dots, go to step A for sphero-cylindrical lenses. For multi-focal glasses, include step B.

A. Sphero-cylindrical Lenses

If you rotate the power drum and the target is **NOT** circular and all the dots are not focused, the lens will be sphero-cylindrical. Rotate the **POWER** drum until the target is focused as a cylindrical bundle of lines, with the longest axis lying parallel to the cylindrical bundle of lines. At this point, take note of the power reading and the axis. Then rotate the power drum again until the orientation of the cylindrical bundle has changed by 90^0 (*i.e.* appears to be directed in the opposite direction), taking note of this power reading and the axis. Again, the longest axis should be parallel to the cylindrical bundle of lines. Determine which power reading is the highest plus power (or the lowest/least minus power) and assign this as the **SPHERE 1 POWER**. The other power reading (lowest plus, highest minus) will be the **SPHERE 2 POWER**. For example, if one reading is -3.00 at 60° , and the other reading is -1.0 at 150° , then -1.0 is the least minus (lowest minus or most positive) so it will be called **SPHERE 1 POWER** and -3.00 will be called **SPHERE 2 POWER** (the more negative power).

Rotate the **POWER** drum to the **SPHERE 2 POWER** reading. Then rotate the **AXIS** drum (located just behind the eyepiece) so that the longest line of the graticule (network of lines) is aligned with or parallel to the bundle of lines from the **SPHERE 2 POWER** reading.

The prescription from a sphero-cylindrical lens will be the form of:

SPHERE / -CYLINDER POWER x AXIS

The **SPHERE** = the SPHERE 1 reading (-1.00DS in the example)

The **CYLINDER** power = the difference in power between the SPHERE 1 and SPHERE 2 readings; ignore the + or – sign once this is determined. (2.00 in the example)

The **AXIS** = the AXIS scale reading from the SPHERE 2 power (60° in the example)

Record the prescription of the left lens on the Teleform sheet. **Power readings are displayed outside the instrument on the drum.** Determine the Near Add if necessary (step B) otherwise repeat above process for the right lens and record the results on the Teleform. The values for Sphere, Cylinder, and Axis obtained here are then entered in the HFA II machine for each eye.

B. Multi-focal Lenses

To determine the NEAR ADD for bifocals, trifocals, or progressive lenses, bring the distance SPHERE power into focus; this is the value for Sphere 1 which is recorded on the Teleform. Then re-position the lens to take a SPHERE reading through the NEAR/READING portion of the lens. The dioptral difference between the DISTANCE and NEAR SPHERE powers will be the NEAR ADD. For example, if the distance sphere reading is -1.00 DS as shown in the example, and the reading for power on the near portion of the bifocal is +2.00 DS, then the difference between these two is 3.00.

If participant wears bifocals, ensure that the prescription determination is performed through the TOP portion of the lens (through the distance portion of the lens).

If participant wears progressive lenses (also sometimes referred to as *graduate lenses* or *progressive lenses*), ensure that the prescription determination is performed through the DISTANCE ZONE of the lens. The distance zone is the region of the lens where the participant's pupils are centered when they are looking straight ahead into the distance.

If you perform the prescription determination outside of the distance zone, you will have an artificially inflated astigmatic (CYLINDER, or CYL) reading and lens aberrations and distortions may prevent you from sharply focusing the SPHERE and CYL targets. In these cases, re-position the lens to capture readings in the distance zone. If you are unable to achieve correct alignment (it can be difficult), position the lens where you believe the participant's pupils are centered while looking straight ahead into the distance and take the SPHERE and CYL readings as

best you can by adjusting and focusing the power and axis drum to the point of least blur/distortion

5.2 Visual Fields

Set room lighting to a low-to-moderate level or the Humphrey will display a message that it cannot adapt to the background luminance.

Turn on machine and have participant sit in chair. While machine goes through its warm-up calibration or while you are explaining the test, sterilize the chin and forehead rests as well as the response button using the small, square alcohol swabs. Never touch the 'bowl' of the machine, which is the white area where the flashing lights are seen.

Once the Humphrey has booted up, select PATIENT DATA from the Main Screen Menu and enter the following parameters:

- Enter ID – enter study acronym, ID number_TESTER ID number (e.g. BLSA5000_120)
- Enter NAME – enter the study acronym then study ID number (e.g. BLSA5000)
- Enter BIRTHDATE – enter as MM-DD-YYYY
- NOTE: If the participant's data have been entered before, choose RECALL PATIENT DATA from the Patient Data screen. Select SOURCE – Hard drive. Choose PROCEED. Type the study acronym and participant's ID number. Press ENTER to see the list of names. Select the correct one; press PROCEED. Make certain that you adjust ID to reflect your tester ID number.
- Enter Comments Right Eye – enter the VISIT number preceded by 'v' e.g. v04 means it is the participant's fourth visit. Include the 0 if single digit visit.
- Select TRIAL LENS and then CALCULATE TRIAL LENS:
 - Enter the DISTANCE prescription for each eye as measured from the lensometer if the participant is wearing glasses. Use three digits for each entry or 0.00 for plano if the participant forgot to bring their glasses or does not wear glasses. Also enter lens powers with their respective sign e.g. -2.00 Sphere.
 - If participant wears contact lenses for only their distance vision (driving), enter distance prescription as plano (0.00).
 - If the participant wears *bifocal or mono vision contact lenses*, enter their distance prescription as plano.
 - When typing data from the lensometer into the HFA machine, type in the exact measurements with one exception for cylinder. If the cylinder is 0.24 or less, type in 0.00 for cylinder.

Then, when choosing the trial lens for over-refraction:

SPHERE:

To choose the correct sphere for the trial lens, round the automated lensometer value up when it is within .04 of the next increment. Otherwise, round down. Example: if the measurement is -1.95, -1.96, -1.97, -1.98, or -1.99, round to -2.0. If the measurement read a -1.45, -1.46.....-1.88, -1.89, -1.90, -1.91, -1.92, -1.93, -1.94, round to -1.5 (spheres are available in 0.50 increments above +1.50 or less than -1.50 in the kit).

CYLINDER:

For any cylinder less than 0.25, enter 0.00 for cylinder. For cylinders of 0.25 or higher, round down to nearest cylinder unless the measurement is within .05 of the next 0.25 increment (just like sphere).

The prescription/trial lens are only required for central visual field testing only (*i.e.* the *first half* of the visual field test).

FIGURE 1. Trial lens kit.



- Select PROCEED to advance to the main menu
- Use the algorithm on the vision Teleform to determine whether the participant should wear eyewear during testing.

Select FF Screening 81 from the main menu screen

Select RIGHT EYE

After the right eye has been selected, the screen goes back to the PATIENT DATA screen. Ensure that all participant details have been correctly entered. When all details are correct, select PROCEED.

The FF 81 test screen should now be displayed. This screen displays the test grid, eye movement video monitoring window in the top left hand corner as well as menu settings.

This step has already been done for you. If you need to change any of these parameters, do the following; else skip to the next step. Select CHANGE PARAMETERS and enter the following settings:

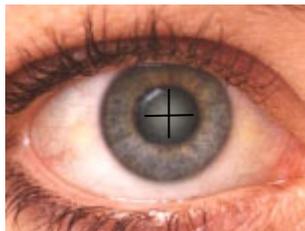
- TEST STRATEGY: Quantify Defects
- TEST SPEED: Normal
- FIXATION TARGET: Central
- FIXATION MONITORS: Gaze/Blindspot
- BLUE-YELLOW: OFF
- TEST MODE: Age Corrected
- STIMULUS SIZE: III
- STIMULUS COLOR: WHITE
- Upon completion of inputting parameters for SCREENING PARAMETER SETUP, hit SELECTION COMPLETE. The HFA returns to the Full Field 81 pt Screening test window.

Participant should remove their glasses or *bifocal or mono vision contact lenses*; distance contact lenses may be worn. If you want to verify that all test parameters are correct, select DISPLAY STATUS.

Occlude left eye with eye patch. You may place a 2x2 or tissue inside the patch if needed. Be sure that eye patch string is above brow.

Seat participant comfortably at instrument. The participant should be close to the machine with his/her back straight. Adjust the chin rest (using the left/right/up/down control keys) and table height to align the eye movement video monitor's fixation cross in the center of the participant's right pupil (see Figure 2). Make the final adjustment after over-refraction and before the gaze monitoring initialization step below. Make sure the participant's forehead is against the band at the top and that the chin is resting comfortably on and against the front of the chin rest.

FIGURE 2: Correct Alignment of eye for Visual Field Testing



Place refractive correction in trial lens holder if required:

- Move lens holder into bowl

- Place cylinder lens in slot farthest away from eye and align axis of the lens with the degree scale on the HFA lens holder. If the HFA did not calculate a cylinder power, do not use one.
- Place sphere lens in slot closest to eye

Make sure the lens is close to the participant's face but that the participant's lashes do not touch the lens. Check the eye monitor video to see that the pupil is at the center of the crosshair before performing the gaze monitoring initialization. It is extremely important to reduce the possibility of trial lens rim artifact by having the lens as close to the patient's eye as possible and by aligning the pupil in the center of the lens. See figure 2.

The prescription lens is only required for central visual field testing only.

If participant does not require any trial lenses for refractive correction from step 3F, move lens holder away.

Before starting the VF test, perform an over-refraction IF trial lenses are required for VF testing. (If trial lenses are not required for VF testing, skip this Over-refraction step and start the VF test (*i.e.* go to step #5.3.).

5.2.1 OVER-REFRACTION

To do an over-refraction, have participant correctly positioned and aligned at the machine. The trial lens should be in the slot **closest** to the participant's eye. If a cylindrical lens is needed, insert it into the slot **behind** the spherical lens. **NOTE:** If the lensometry indicated the participant's eyeglass lenses were sphero-cylindrical, but the HFA trial lens calculation does not report a cylindrical power, **do not** insert a cylindrical lens. The HFA ignores cylinder ≤ 0.75 .

Instruct participant to look through the trial lens at the central light in the bowl. Ensure that the fixation cross from the video eye monitor is in the center of the participant's pupil and trial lens. If not, adjust the participant's position until it is.

Give the following instructions:

"I want you to look straight ahead at the light in the center of the bowl. Is the light clear or blurry?"

If the light looks clear, go to test (*i.e.* go to step 5.2.2). If the light looks blurry, do the following:

Hold the **+0.50 DS** lens as close as possible to the back of the trial lens holder and ask "Is the light clearer **with** this lens or **without**?"

Over-refraction: +0.50 DS improves vision

If participant responds with “The light looks clear with the lens”, remove the +0.50 DS lens you are holding AND the sphere lens already in the trial lens holder if one is there. Place a new sphere lens in the front of the lens holder that is the equivalent of the +0.50 DS and the original sphere lens power. For example, if the sphere lens is -2.0 DS, when you add -2.0 DS and +0.50 DS, you get -1.50 DS ($-2.00 \text{ DS} + (+0.50 \text{ DS}) = -1.5$). Replace the -2.0 with a -1.50 and go to step 5.3.

If participant responds with “the light looks **clearer** with the lens, but it is **still blurry**”, replace the -2.0 DS lens with the -1.50 DS as described above. Hold the **+0.50 DS** lens as close as possible to the back of the trial lens holder again and ask “Is the light clearer **with** this lens or **without**?”

If the participant reports the light is clearer with the additional +0.50 lens, replace the lens in the trial lens holder with the equivalent of the lens in the holder and the +0.50 as you did above. Clarify whether the light is clear now or clearer but still blurry. If you continue the example above, you would remove the +0.50 DS lens you are holding AND the -1.50 DS lens already in the trial lens holder. Replace the -1.50 DS lens with a -1.0 DS lens in the front of the lens holder ($-1.50 \text{ DS} + (+0.50 \text{ DS}) = -1.0$).

Next, hold the **+0.50 DS** lens in front of the -1.00 DS lens and ask the participant, “Is the light clearer **with** this lens or **without**?”. If the participant reports it is clearer but still blurry, check to make certain the numbers have been entered correctly and that the lens powers are correct. If these are correct, remove the +0.50 DS lens from in front of the participant. Hold up a -1.0 DS and a -0.50 DS and ask the participant, “Which is clearer—lens 1 or lens 2?” If the participant reports the -0.50 DS is clearer than the -1.0, continue using increments of +0.50 DS until participant reports that the central light is clear. This means you would replace the -1.0 DS lens with the equivalent of the -1.00 DS and the +0.50 DS ($-1.00 \text{ DS} + (+0.50 \text{ DS}) = -0.50$) which is the -0.50 lens; then hold up the +0.50 DS lens and ask if the light is clearer with or without the lens. If the participant reported little or no difference between the -1.00 DS and the -0.50 DS, replace the trial lens with the original sphere lens (-2.00 DS), which should be the equivalent of the lens currently in place (-1.00 DS) and the -1.00 DS. ($-1.00 \text{ DS} + (-1.00 \text{ DS}) = -2.00 \text{ DS}$). Proceed with testing in step 5.3.

Over-refraction: +0.50 DS worsens vision

If participant reports that the light is **more blurry** when you **first** hold up the **+0.50DS** lens, then do the following:

Hold a **-0.50 DS** lens as close as possible to the back of the trial lens holder and ask “is the light clearer **with** this lens or **without**?”

If participant responds with “The light looks clear with the lens”, remove the -0.50 DS lens you are holding AND the sphere lens already in the trial lens holder. Place a new

sphere lens in the front of the lens holder that is the equivalent of the -0.50 DS and the original sphere lens power. Then go to step 5.3.

If participant responds with “the light looks **clearer** with the lens, but it is **still blurry**”, repeat the above step using successively more MINUS power until the light becomes clear. That is, start with -0.50DS: if this is clearer, but still blurry, remove the -0.50 DS lens you are holding AND the sphere lens already in the trial lens holder. Place a new sphere lens in the front of the lens holder that is the equivalent of the -0.50 DS and the original sphere lens power. For example, if the sphere lens in the trial lens holder is -2.00 DS: $(-2.00 \text{ DS} + (-0.50 \text{ DS}) = -2.50 \text{ DS})$. You would then replace the -2.00 DS lens with a -2.50 DS lens. Hold a **-0.50 DS** lens as close as possible to the back of the lens and ask “is the light clearer **with** this lens or **without**?” Whenever the participant reports the light is clear **without** the additional lens or about the same with or without the additional lens, remove the -0.50 DS lens and proceed to testing in step 5.3. Use the trial lens that is in the trial holder.

If the participant reports the light is clearer with the additional -0.50 lens but **still blurry**, remove the -0.50 DS lens you are holding AND the lens already in the trial lens holder, which is the -2.50 DS in the example. Place a new sphere lens in the front of the lens holder that is the equivalent of the -0.50 DS and the lens currently in the trial lens holder: $(-2.50 \text{ DS} + (-0.50 \text{ DS}) = -3.00 \text{ DS})$.

With this lens now in place, (the -3.00 DS lens in this example) hold a **-0.50 DS** lens as close as possible to the back of the lens and ask, “Is the light clearer **with** this lens or **without**?” If the participant reports the light is clearer with the -0.50 DS lens, check that the numbers have been entered correctly and that the lens powers are correct. If these are correct, hold a +1.00 DS lens and a +0.50 DS lens in the same hand and ask, “Which lens is clearer? Lens 1 or lens 2?” If the participant reports that the +1.00 is clearer, replace the lens in the trial holder with the equivalent of that lens power and the +1.00 DS. In the example we are using, this would be $-3.00 \text{ DS} + (+1.00 \text{ DS}) = -2.00 \text{ DS}$ lens. Note that this is the power of the original lens. If the participant reports the +0.50 DS is clearer than the +1.00 DS lens, remove the +1.00 DS and the +0.50 DS lenses and keep the current lens in the lens holder. Continue presenting increments of -0.50 DS power until clear vision is attained.

It is important to remember that near-sighted persons often report the light is clearer with more MINUS power when the light is actually only getting smaller. Therefore, ask the participant each time he/she reports the light is clearer with the additional -0.50 DS lens if the light is *clearer* or is it just getting *smaller*. When using minus lenses, only add extra minus power if participant reports that the light is **still blurry**. Do NOT increase the minus power if the participant reports that the light only looks “smaller”. When the correct lens is in place, proceed with testing.

5.2.2 Explain the test procedure

“I am now going to measure your field of vision, or how well you can see out to the side while looking straight ahead. For this task, you must ALWAYS look straight ahead at the steady yellow light in the center of the bowl. While you are looking at the central light, other lights will flash, one at a time, anywhere inside the bowl. Some of the flashes of light will be bright, and others will be dim. Press the button whenever you see a light flash, but remember to only look at the central light; you should not move your eyes to look directly at the flashing lights. You are not expected to see all of the flashing lights. It’s OK to blink during the test. The best time to blink is just as you press the button. Some people notice that the white bowl starts to look black after staring at the light for a while. This is normal, but you should blink more often if this happens so it will go away. Let me know if you need a break as I can easily pause the machine so that we can rest. I will let you know when you are about halfway through the test.”

If participant cannot see yellow light instruct him/her to look straight ahead or to position/move their eyes such that they can see the light.

5.2.3 Before selecting START, instruct participant:

“We are now going to start. Remember to keep your eyes VERY STEADY or STILL while looking at the light in the center of the bowl. During the first minute of this test, there will be NO flashing lights. So do not become alarmed when you do not see any lights in your side vision- just keep looking straight ahead and eventually you should see lights flash in your side-vision.”

Select DEMO.

Select START to continue.

The following window then pops up:

Initialize Gaze Monitor. Instruct Patient to look at Fixation Lights.

During the gaze initialization process, the eye monitor in the top left-hand corner will “flash”, and the following window should pop up:

Initializing Gaze Successful

Select CONTINUE.

If Gaze Initialization failed, select RE-TRY TO INITIALIZE GAZE and re-emphasize to participant to **keep eye VERY STILL while fixating on the central target.**

If Gaze Initialization fails after 3 attempts, select TURN OFF GAZE TRACKING. When this option is selected, **CONTINUOUSLY monitor that participant's eye remains still and centered (by checking that the cross-hairs are in the center of the pupil) throughout the entire visual field test.**

The following window then pops up:

DEMO in progress for 1 minute. Press END DEMO to start sooner.

Allow the demo to finish and the visual field test will begin automatically. During the demo, monitor the participant's eye position and the POS ERROR indicator. IF the participant has trouble maintaining steady fixation, or if the POS ERROR has an "X" beside it, select RETURN to stop the demo and again explain the procedure to the participant.

Near the beginning of the test, the instrument will try to locate the participant's blind spot. If the blind spot cannot be found, the test will pause and beep.

Explain the test procedure again
Select RE-TRY TO FIND BLIND SPOT

If the blind spot test fails again
Select CHANGE BLIND SPOT MONITOR
Select OFF (This should be avoided if at all possible!)
Instruct participant to continue looking straight ahead

During testing, if the instrument detects an excess number of fixation losses, pos errors or neg errors, a beep will sound. PAUSE. Be sure that participant understands the test. If not, then restart; otherwise CONTINUE.

If participant has trouble keeping up with test, select CHANGE TEST SPEED and change speed to SLOW. Use this option with care since it will increase test time significantly.

The first half of the test assesses the central 30°. When this portion of the test is complete, it will stop and beep and the following window will pop up:

Remove Trial Lens and Holder! To continue choose Appropriate Button

Remove the trial lens and swing the trial lens holder down and out of view.
Select USE SAME GAZE SETTINGS unless refractive error is greater than ± 5.00 diopters.

Select **RE-TRY INITIALIZING GAZE** if prescription used is greater than ± 5.00 diopters sphere.

The second half of the test assesses the field of vision from 30° to 60°.

If participant becomes fatigued during test, a short pause is allowed by selecting PAUSE/CHANGE. To continue testing, select RESUME TESTING.

Ensure that the break is only between 30 seconds to 2 minutes long.

After right eye testing is completed, select YES to:

Do you wish to save this test for [Participant's Name] and [DOB]

Occlude participant's right eye and allow the left eye to adjust to light levels (1-2 mins).

Participants may report that lights seem brighter with the left eye compared to the right eye. This is only because this eye was covered for the last 10-15 minutes! If they report this, explain why and continue testing.

Select TEST OTHER EYE.

Select PATIENT DATA and review eyeglass prescription used for the left eye. Set up the trial lenses for the left eye and perform over-refraction.

RETURN to screening test menu by selecting PROCEED. Correctly position and align participant. Start testing the left eye by selecting START. DEMO trials may be skipped.

After testing left eye, select SAVE DATA ON DISK.

Print results also, by selecting PRINT or the picture of the printer, select SCREENING TEST for **both** eyes (both screening tests will be highlighted) then select PRINT ALL SELECTED ITEMS.

Please be sure that data have been stored on disk for BOTH eyes before dismissing participant. If you forget to store data from a test, these data may be recalled up to the time that you select NEW PATIENT DATA. After that point, the data cannot be retrieved for storage on diskette.

Make a copy of the printout for the participant. Place the original printout in the designated area for "Visual Fields Reading Center". At the end of the week, all printouts should be given to the BLSA Clinical Research Coordinator to be mailed to the reading center along with the floppy disk. Additional back-up of data is done by saving to the hard drive of the HFA and simultaneously to the NIA network.

Introduction

“We’re going to do three vision tests first: distance acuity, which you’re probably familiar with, contrast sensitivity which tests your ability to distinguish between an object and its background, and stereopsis, or depth perception. On all of these tests, if you reach the point where you think you can’t give the correct answer, I want you to guess. Because we are doing these tests for research purposes, I must mark it right or wrong. I can only do this if you give me an answer, even if you have to guess.” (This is called forced-choice testing, which has been demonstrated to provide best results for vision testing in research protocols.) *“Then we will measure your field of vision and finally your dynamic visual acuity, which is the ability to see while you are moving.”*

Establish whether the participant wears glasses or contacts, the type, and whether they use eyewear for distance vision, near vision, or both. Follow the algorithm on the vision Teleform. This will direct the examiner whether the participant should wear glasses or contacts for particular tests.

5.3 Dimensional Testing (Stereopsis) – Circles

Have the participant seated facing the table so that he/she is in a comfortable position for reading with adequate lighting.

For stereopsis testing, offer the following reading glasses to participants who are 40 years or older or to anyone who reports the circles are blurry at the 16-inch test distance and ask if the book is clearer with or without them:

age	power of glasses
40-44	+1.00 or +1.50
45-49	+2.00 (if blurry, then try +1.50, or +2.50)
50-54	+2.00 or +2.50
55+	+2.50

If the participant can see the circles more clearly with the reading glasses, conduct the test with the participant wearing reading glasses—either the ones provided in the exam room or the participant’s personal glasses.

“Next I will test your depth perception. Please put these glasses on” and WHEN APPROPRIATE: *“over the top of your glasses. Be careful with them; they break easily.”*

“Please hold this book for me. I’m going to establish the distance from your eyes to the book.”

Use the 16-inch string attached to the top of the book to establish a distance of 16 inches from the participant’s forehead.

“Please look at the right side of this booklet. What do you see? (A housefly) What part of the fly seems to come out at you or be closer to you than the other part of the fly? (The wings)

“Now look at these sets of 4 circles. Are the circles clear?”

If the participant reports the circles are clear, continue with the instructions in 5.3A.

If the participant reports the circles are not clear, do the following:

5.3.1 If the participant is wearing his/her own glasses:

First remove the participant’s glasses and ask if the circles are clear. Rarely, this may occur, especially in younger, early presbyopic persons. If the circles are not clearer without the glasses, offer reading glasses according to the guideline below, adjusting the strength until the clearest view of the circles can be found, using either the study glasses or the participant’s own glasses:

Reading glasses guideline:

<u>AGE</u>	<u>POWER (DS)</u>
40 – 44	+1.00 or +1.50
45 – 49	+2.00 (+1.50 - +2.50)
50 – 54	+2.00 or +2.50
55+	+2.50

When the glasses are decided upon, place the 3-D stereopsis glasses over the top of the participant’s glasses and go to 5.3A.

5.3.2 If the participant is not wearing his/her own glasses:

Offer reading glasses according to the guideline below, adjusting the strength until the clearest view of the circles can be found. Test participant with 3-D glasses over the top of the reading glasses, if the reading glasses made the circles appear clearer. Go to 5.3A.

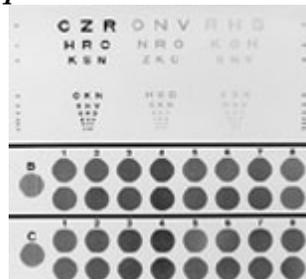
5.3A *In each of these sets, you see top, bottom, left and right circles. There are nine sets like this. One of the circles in each set will be like the fly and appear closer to you than the others. Please tell me which circle in each set appears closer to you – top, bottom, left, or right. Set 1, set 2, etc.?”*

5.4 Visual Acuity

- Make sure that the Vector Vision CSV-1000CVA Unit is plugged into a 3-pronged wall outlet for visual acuity and contrast sensitivity testing.
- Turn the unit on by the switch located on the right hand side of the screen.
- The area around the screen should be clear of distractions: other testing equipment, books, papers, calipers, etc.
- Use the remote control or a flashlight to select the sequence of testing areas on the screen.
- To activate and change rows, point the light to the bottom of the red square on the unit. The range of the remote is 11 feet.
- To use the glare attachment, turn the switch on the bottom left side of the screen and adjust the linear switch so that the knob is positioned at the highest level. Conduct these tests with the participant wearing their prescription glasses (if required). See page 1 of the Vision Teleform for specific instructions.

Position the participant 8 feet from the front of the chart to the center of the participant's head. If 8 feet is not feasible, position the participant at 7 to 9 feet. The chart is designed to automatically ensure the chart is adequately illuminated. Turn the lights off. Point to the chart as needed with the blunt end of a pointer or a pen, but do not touch the chart with your hand or any writing instrument. Do not point to a specific letter. If the participant needs you to indicate where to read, point to the row only.

“Please look at this chart. There are three columns of letters, dark, medium and light. Beginning with the darkest column of letters on the left, I want you to read the letters in that column only, from left to right, beginning with the first line at the top. Don't lean forward in the chair or squint.”



CSV1000cva test face

Stop when the participant misses two letters on any line. On the Teleform, record the last line in which the participant **correctly read at least two of the three letters correctly**. This represents the participant's static visual acuity.

If the participant stops before making a mistake, or if the participant doesn't want to perform vision tests due to impaired vision, (for example, "I can't see it. How can I read

it when I can't see it!"), encourage him/her to give you a best guess. ***“For research purposes, I need to record an answer. Please make your best guess.”***

When the first column (high contrast) of the first lighted row is completed go to the second row and complete the first column. Then do the second (medium contrast) and third columns (low contrast) in the same manner. Do not give feedback during the testing process. Only point to the line if the participant loses his/her place on the chart.

NOTE: After testing, if visual acuity is worse than 20/50, move the participant to 4 feet for contrast sensitivity testing below.

5.4 Contrast Sensitivity

Position the participant 8 feet from the front of the chart to the center of the participant's head. If visual acuity is worse than 20/50, position the participant at 4 feet. **This must be documented on the Vision Testing Teleform.** The unit should automatically ensure the chart is adequately illuminated. Point to the chart as needed with the blunt end of a pointer or a pen, but do not touch the chart with your hand or a writing instrument. Do not point to a specific letter. If the participant needs you to indicate which row to read, point to the beginning of the row only.

Begin in Row B. Point to the first circle, but do not touch the chart.

“Can you see the bars in the first circle?”

If the participant answers “Yes”, respond by saying,

“Tell me if you see bars in the top circle, bottom circle, or none at all. Begin with the left two circles.”

If the participant's response is unclear, you may stop the participant and say,

“Remember, I need you to tell me which circle has the bars in it; you can say ‘Top’, ‘Bottom’, or ‘None’ if you don't see bars in either circle.” The options of top, bottom, or none have been used in the vision protocol for many years. We opted to maintain consistency in the assessment methodology rather than begin the forced choice testing method for contrast sensitivity.

If the participant cannot see the bars in the first test circle, record “blank” for all answers in Row B and go to the test circle in Row C. If the participant cannot see the bars in the second test circle (Row C), record “blank” for all answers in Row C and go to the next test.

With the glare attachment illuminated, repeat steps for visual acuity and contrast sensitivity testing.

“Next we will repeat these two tests with these bright lights that simulate the headlights of an oncoming car. We will turn the lights on gradually to let your eyes become accustomed to the light.”

Use the Vision Testing Data Sheet to record all of the answers, including why the test is missing if the tests were not performed.

ALERTS: Use the alerts only if the visual acuity in the high contrast column (column 1, darkest letters) is worse than 20/50 or if visual field defects are more than 10.

5.6 Gaze Stabilization and Dynamic Visual Acuity

(See L:\BLSA FOLDER- NIA\NeuroCom_manuals\InVision.pdf for detailed manual.)
(To be updated with new equipment.)

Seat the participant 10 feet from the computer screen on which optotypes (test images or letters on the screen) will be presented. The participant should wear his/her usual glasses or contacts during testing and remain seated with his/her back vertical (i.e. without leaning forward in the chair). Selections can be made using the remote mouse, the standard mouse, or the arrow keys on the keyboard. Arrow keys are recommended during testing to select participant choices. Lighting in room should be normal.

Turn the system on by pressing the button to the main power supply on the lower left hand of the unit. Turn the computer on using the button on the Dell tower. (When completed, select "Start" in the lower right of the screen, then "Shut Down." Turn off the main power supply.) Choose 'CONTINUE' on the NeuroCom screen to initialize the system. Participant files will appear and can be sorted by name, ID, operator, or diagnosis by selecting the applicable wording. Names will be suppressed on this list but can be viewed by selecting *System Settings* and deselecting *Require Patient ID to Login*.

Introduction:

I am going to test your dynamic visual acuity, or the ability to see when you are moving. Even when we try to stay perfectly still, our bodies are always moving slightly. In order for you to see clearly, your eyes must move in an equal and opposite direction of your head. This is especially important when we are moving, such as when we walk.

Have you felt dizzy or had a sensation of yourself or the room spinning in the past 2 weeks? No Yes

If wearing glasses, "**During the test, it is important that you look through your lenses at the screen while your head is moving.**" If bifocals/trifocals: "**Use the part of your lenses for seeing things in the distance.**"

Computer Set-Up and Participant Positioning

- Seat the participant 10 feet from screen. (If participant has very poor vision *and* is hesitant to perform vision tests, offer testing at 5 feet from screen.)

- Adjust participant's chair so that the participant's eyes are level with the screen.
- From FILE CABINET screen, select *New Patient File*.
- Enter Last & First Names, Height (from the anthropometrics assessment), Date of Birth, Operator, BLSA ID, and Comment, if applicable. Check to make sure the information is correct. **Height cannot be changed once it is saved.**
- Select *Save Patient File*, then *OK* (or press Enter key), then *CONTINUE*
- At the MAIN MENU, click the *CONTINUE* button, then click the *Assessment* button.
- In the *Assessment Suite* field, you will see **GST-DVT**. If not, select it.
- Click on *Select All* and then *CONTINUE*
- Place the head motion sensor on a stable surface, such as a table, for the 15-second calibration. Click *OK*

Static Visual Acuity for GST testing:

First, we will test your vision with your head still.

Place the headband with motion sensor on top of participant's head with the sensor positioned centrally. Turn the dial in back clockwise to tighten until the headband fits snugly.

- Select Horizontal axis
- The default test distance is 10 feet. Adjust if necessary.
- Select *Continue*
- **“Focus on the center of the screen. An “E” will appear for one second. Tell me whether it is facing left, right, up, or down.”**
- Select *START*. The screen in GST-3 will appear.
- Use the arrow keys to select participant's answer for each response.

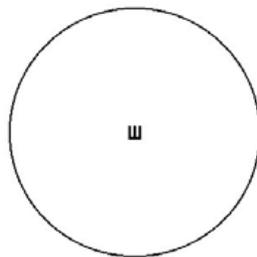


Figure GST-3. Optotype E

- Enter the participant's response using the arrow keys when the screen shown in Figure GST-4 appears.

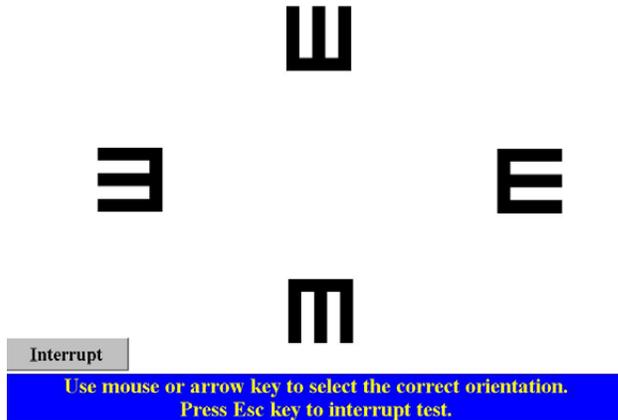


Figure GST-3. Optotype E

Gaze Stabilization in Dynamic Visual Acuity Testing Head Movement Practice

- When static visual acuity is completed, click the *Practice* button then *START*.
- Ask participant to sit up straight throughout testing. Cue during testing.
- Choose *Head Movement Practice*.
- A “speedometer” display of their speed and head movement appears. This teaches the participant to move the head rhythmically back and forth at the appropriate speed.
- **“The green bars indicate speed. They should touch the left bars (or just beyond) when the head moves right and the right bars (or just beyond) when the head moves left.”** Allow participant to practice this.
- **“Continue to move your head, and look at the red bars and the ball below the green. When your head movement is far enough to the left, the ball will move to the right bar or just past it. Likewise, when you move your head far enough to the right, the ball will move to or just beyond the left bar.”**
- **NOTE:** Adequate practice is essential for test reliability and accurate test outcome. Once the participant understands the required head movement dynamics, select *Interrupt*.

GST Horizontal Practice

- On Assessment Menu, select *Practice* again, *Start*, then *GST*.
- The “speedometer” screen will appear first.
- Instruct the participant to relax and allow you to move his/her head in a smooth motion left to right as practiced. He/she should focus on the center of the screen where the “E” will appear. When this is performed well at the appropriate speed, use

- the voice command “Start” to begin the test. press any key or click the mouse to proceed.
- An “E” will appear in the center circle for 1 second.
 - Ask the participant to report the orientation (up, down, left, right) of the E.
 - Enter the response using the arrow keys.
 - **NOTE: Once a stimulus is presented, the operator must enter a response to continue the test. If unsure, encourage the participant to guess so the test will continue. If the participant will not provide a response, the operator must enter an incorrect response.**
 - During practice and testing, if the participant does not achieve the required minimum velocity within 10 seconds, the trial stops. A screen appears “Trial expired. Do you want to continue practice?” Re instruct the participant on the required movement and continue.
 - If participant doesn’t move his/her head in between optotype presentations, ask him/her to do so throughout testing.
 - Pause periodically to see if participant feels okay.
 - Once participant maintains appropriate movement for 5 or 6 optotypes, say, **“You’re doing well with this. Are you ready for the test?”** When ready, select *Interrupt*.
 - When asked if you want to continue Practice, select *NO*. Select *GST*.

GST Horizontal Testing

- Default Velocity Settings: Start at 85, Step by 10, Stop at 125
- Select *START*. The “speedometer” screen will appear first.
- Ask the participant to begin moving his/her head as practiced.
- When head movement is smooth and the direction and speed are appropriate, say, **“When you’re ready, I will make the screen with the “E” will appear. Are you ready to begin the test?”**
- When ready, select any key. Use arrow keys to enter participant responses.
- When *GST* is completed, a screen appears asking if you want to close the test. (Similar to Figure DVA-5b)
- Select *No* then *OK*.
- Select *SETUP*. Select *Yes* to change head movement direction.
- Select *Vertical* and then *Continue*.

- If test must be terminated before it is completed, select *Next Test*, *Assessment Menu*, or *Main Menu* to exit. Select *Yes* to close. Enter comments explaining why test was terminated. Otherwise, continue testing until the program stops.

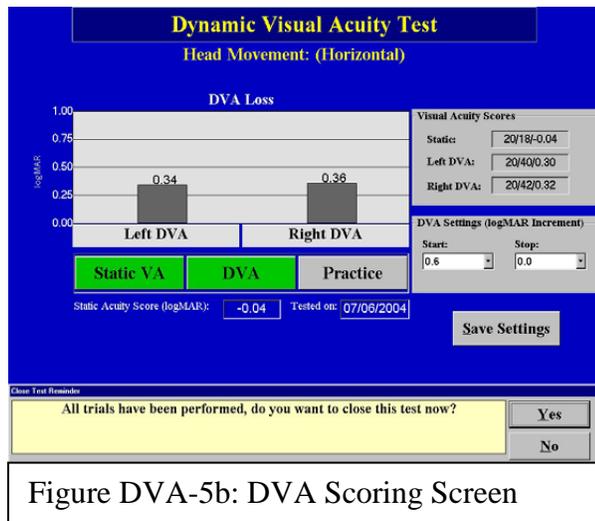


Figure DVA-5b: DVA Scoring Screen

- When testing is completed, the system will display a box stating the test is completed and ask if the operator wants to close the test.
- Select *Yes* then *OK*.
- Select *Analysis*. Hold the “CTRL” key and select every test listed in the upper left corner of the screen for the current date. A “√” will appear next to each test
- Select *Print*
- While printing, select *ASCII Export*. Choose “Yes”
- Save in L:\BLSA NIA-Folder\DVA\id#v#. For example, BLSA participant 983 on the 20th visit would be saved as L:\BLSA NIA-Folder\DVA\0983v20
- Select *Main Menu* then *Close File*
- Select *Shut Down* to end program or *New Patient* to perform another assessment
- When completed, turn main switch and tower off.

6. Procedures for Performing the Measurement at Home

The procedures should be the same if done at home. If 8-foot test distance is not available for visual acuity and contrast sensitivity, perform at 7 – 9 feet. Document the measurement on the data sheet. If 10 feet test distance is not available for DVA, enter actual test distance in the appropriate screen when prompted.

7. Alert Values/Follow-up/Reporting to Participants

Visual Acuity Alerts:

Vision worse than 20/50:

“Have you noticed any recent changes in your vision such as pain around the eyes, blind spots, distortion, blurry vision, haloes around objects, new floaters or flashing lights?”

ﻳ Yes – Go to 7.1.2

ﻻ No - Go to STANDARD ALERT

“When did you first notice these symptoms? Did you first notice them...”

ﻳ *Within the past few days* - Go to **EMERGENCY ALERT**

ﻳ *Within the past few weeks, or* - Go to **URGENT ALERT**

ﻳ *More than a few weeks ago* - GO to **STANDARD ALERT**

STANDARD ALERT: *“I would advise you to have your eyes checked by a qualified eye care professional in the near future.”*

URGENT ALERT: *“I would advise you to have your eyes checked by a qualified eye care professional within the next few days.”*

EMERGENCY ALERT: *“I would advise you to have your eyes checked by a qualified eye care professional today or tomorrow.”*

CONTINUE WITH THE ASSESSMENT

Contrast sensitivity alerts – none

Stereopsis alerts – none

Visual field alerts – none. Clinical interpretations are not made.

8. Quality Assurance

Quality assurance will be provided through training of vision assessments, certification and re-certification regularly, and data monitoring. Visual fields certification is conducted via onsite evaluation and telephone certification with data assessments through Discoveries in Sight Research Labs, Devers Eye Institute; Portland, OR. Data on the HFA models are encrypted. Therefore, BLSA visual field data will be sent to this reading center for analysis and returned in a Microsoft Excel spreadsheet for import into SAS dataset.

Update: 2009

UIVFC will be responsible for quality control of VF data using the following criteria:

Data are considered non-reliable if one of the following is present[37-40]:

1. >33% false-negative responses
2. >33% false-negative responses, or
3. >33% fixation losses

These criteria will be applied to all data to maintain consistency across repeated examinations.

8.1. Training Requirements

A physician or research scientist familiar with the vision assessment must teach research assistants to perform the vision assessments using the standardized protocol.

8.2. Certification Requirements

Research assistants must be certified, following training, to perform the visual assessments. Re-certification will be performed every six months.

8.3. Quality Assurance/Certification Checklist

The *research assistants* will enter data, which will be reviewed monthly for quality assurance. Fields will have restricted ranges/acceptable values as appropriate.

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