
VISUAL ACUITY

1. Background and Rationale

The frequency of blindness and visual impairment increases among older people, and vision problems are associated with disability. Some vision problems lead to decreased mobility, and hence decreased activity and increased risk of falling, while others may lead to decreased social interactions, possibly leading to depression.

Although many studies have shown that high-contrast acuity is a poor predictor of visual performance, it has nevertheless been shown to be predictive of poor survival (Klein et al., 1995), physical disability (Verbrugge, et al., 1989; Havlik, 1986), decline in physical functioning (Mor, et al., 1989; LaForge, et al., 1992), and impairment of mobility and activities of daily living (Branch, et al., 1989). It is also both a necessary descriptor of the study population for comparison to other groups and the measure with most clinical relevance. Finally, it is a familiar measure that may be reported to participants as a retention aid.

Visual acuity refers to the ability to see detail and is tested by measuring distance vision at a set distance using a standard chart. The participant reads the chart from left to right and top to bottom as if from a page in a book. Visual acuity is measured as a fraction, like 20/20. The top part of the fraction is always 20 and the bottom part is a number that gets bigger the worse your vision is. One way to understand this fraction is that 20/20 means that you can see at 20 feet what a person with good vision can see at 20 feet. If your vision is 20/40, it means that you have to stand at 20 feet to see what a person with normal vision can see at 40 feet. In other words, you have to get a bit closer to see what others can see farther away.

2. Equipment and Supplies

- Bailey-Lovie High Contrast Distance Acuity Chart
- Letter literacy card
- Sekonic Zoom Master L-508 light meter
- Occluder
- Measuring tape with both inches and cm
- Copy stand

3. Safety Issues and Exclusions

This test is safe for all participants. Participants will be tested for letter literacy. As long as a participant can accurately recognize English letters, the test for acuity can be carried out.

3.1 Letter Literacy Exam

The letter literacy test is required for all participants.

The letter literacy exam consists of 15 letters on a laminated card. Ask the participant to put on their reading glasses if they use them, and hand them the card. They may hold the card at any distance that is comfortable for them.

Script: *“Can you see these letters?”*

If they say “yes”, then:

Script: *“Read me the letters one by one across the line.”*

Record the number correct on the form. If the participant gets 10 or more letters correct, proceed with the vision exam.

If the participant cannot see the letters, do not administer the Bailey-Lovie exam. Check “unable to see chart” on the exam form.

If the participant gets less than 10 letters correct, do not administer the Bailey-Lovie exam. Check “did not pass the letter literacy exam” on the exam form.

If the participant refuses to take the letter literacy test, mark “refused” and do not administer the Bailey-Lovie exam.

4. Participant and Exam Room Preparation

The test can be done in any room at least 10 feet long and with controlled lighting. There should be no lighting source such as an uncovered window that creates glare or uneven lighting on the chart (see lighting requirements section 4.1).

Participants should be asked at the time the appointment is made to bring both reading and distance glasses, if they use them.

4.1 Lighting Requirements

The Bailey-Lovie chart should have even lighting, between 50 and 70 foot-Lamberts as measured with a hand-held light meter. The following instructions are for the Sekonic Zoom Master L-508, but any point-and-shoot spot meter capable of measuring a 1 degree spot may be substituted. Most light meters, including the Sekonic, do not have a foot-Lambert scale, so the instructions below are given for EV (exposure value) units.

- a) Turn on the room illumination and any additional lighting you will use. Standing at the spot where the participant will be positioned to view the chart (see Section 4.2), make sure that the lighting does not cast any reflections off the chart. If there are any reflections, adjust the lights so that reflections are eliminated. The best lighting, if the standard overhead room lighting is insufficient, is two spot or flood lights set at about 45 degrees to either side of the chart and far enough away

- from the chart so that the cone of light coming from each evenly illuminates all four corners of the chart. Be sure you are not casting a shadow on the chart as you measure luminance.
- b) Make sure the EV dip switch under the battery cover (dip switch #3) is set to ON. All other dip switches should be set to OFF.
 - c) Make sure the ISO setting is at 100 (if not, hold down the ISO button and turn the Set/change dial until the display in the upper right hand corner shows 100).
 - d) Make sure the Index correction value is canceled (there should be no +/- showing on the display). If the +/- sign is showing, hold down both the ISO and the ISO 2 buttons and turn the Set/change dial until the +/- sign disappears.
 - e) Move the Incident/Reflected Spot selector switch surrounding the eyepiece to the Reflected Spot position (blue triangular icon, not the black-and-white dome icon).
 - f) Turn the power on, hold down the Mode set button, and turn the Set/change dial to the EV position (the letters EV in a square should show on the display; if the letter F shows, you are in the wrong mode).
 - g) Remove the lens cap and twist the zoom lens ring to full zoom (the smallest dot; when looking through the eyepiece, this gives maximum magnification). At this setting the central ring seen through the eyepiece covers 1 degree of area.
 - h) Looking through the eyepiece, center the ring on a white area at the upper right hand corner of the chart. Do not point at any part of a letter. Press the measuring button (right under the eyepiece). The reading at the right side of the display (under the EV square) should be between 10.4 and 11.0. Repeat the measurement in all four corners and at the center of the chart.

For consistent repeated measurements, the readings from one area of the chart to another or from one test to the next should be within 0.2 EV units and between 10.4 and 11.0 EV units. Add or adjust the lights to achieve this degree of uniformity.

If your test area has significant natural light, evaluate chart luminance under a variety of naturally varying conditions to determine if additional artificial light will sometimes be needed, especially at different times of day, or if the natural lighting causes uneven or too bright illumination. Use a curtain or blind if necessary.

The combination of room and accessory lighting needed to achieve this lighting level should be noted, and the same combination should be used for every test. Once a week, these lights should be turned on and the luminance of the chart measured.

4.2 Set-up for acuity task

The Bailey-Lovie chart should be propped on an easel or other support at eye level (the participant may be either sitting or standing). A piece of tape should be placed on the floor exactly 10 feet from the chart, and the participant should be seated in a chair placed on this mark, or should be asked to stand on the piece of tape. If the charts are not numbered, number them to match the letter combinations on the forms.

5. Administration – Bailey-Lovie Chart Distance Visual Acuity Test

There are two versions of the Bailey-Lovie chart, and there are two levels of contrast on either side of each version. Be sure the high-contrast side is showing and that chart #1 is used for the right eye and chart #2 is used for the left eye (See Vision Worksheet).

- a) Ask the participant if they normally wear a correction to see things far away: "Do you usually wear glasses or contact lenses to see things at a distance, like for driving or watching TV?"
- b) If they do wear glasses or contact lenses for distance vision tasks, ask them to put them on, and record the type of glasses or contact lenses they're wearing. If they did not bring them, continue testing, but record that the participant was not wearing glasses or contact lenses. If the glasses are bifocals, be sure the participant is looking through the top part of the lenses.
- c) Have the participant stand or sit over the tape marking the 10-foot distance from the chart. Do not allow them to lean forward during testing.
- d) First ask the participant to cover their left eye with the occluder. Ask the participant to read the row with the double bar, using only the right eye. The examiner may stand by the chart and point to the row with the double bar.

Script: "I'm going to ask you to read me the letters on that chart. Can you read the row with the double bar, using your right eye? Don't squint, and don't lean forward."

The participant must get all of the letters on that row correct. If they make a mistake, have them go to the top row and begin again. Again, the examiner may stand by the chart and point to the subsequent rows to be read.

Script: "Let's try a larger row. Can you read me the top row?"

- e) Have the participant keep reading down the chart as far as they can, guessing if necessary, until they get three or more letters on one line wrong. You may stop once the participant reaches 20/20 vision.

Script: *"Now keep reading down the chart. If you are not sure about a letter, please guess."*

If the participant begins to hesitate, reiterate that it is okay to guess. Do not tell them whether they make a mistake. For particularly hesitant participants, you may provide neutral encouragement (*"uh-huh, uh-huh, good."*)

Script: *"Go ahead and guess. We need you to go as far as you can, guessing when you are not sure."*

- f) When the participant gets three or more letters on one row wrong, tell them to stop after they finish the entire row.

Script: *"Okay, that's great. Now you can stop."*

- g) Repeat the above procedure (steps d-f) with the right eye covered to test the left eye. Use Chart #2 to test the left eye.

5.1 Record Keeping

Be sure to record whether the participant normally wears glasses for distance and whether these glasses were worn for the test and what type of correction they are wearing. Record which distance the exam was performed at and the number of letters read correctly. Use the vision worksheet to keep track of the number of letters read correctly. The vision worksheet has a copy of both chart 1 and chart 2 as well as the chart in the light box used for the home visits.

On the worksheet, make an X through every letter incorrectly identified by the participant. Although this information is not recorded by the data system and does not need to be sent to the Coordinating Center, it is easy to lose track of the number of letters correctly read when a participant is able to read some of several consecutive lines. If the letters correctly read are marked, this can always be double-checked later; if not, and a mistake is made, it cannot be corrected.

Use the number correct scale on the worksheet to determine the score. Starting with the number correct for the last line read without errors, add one for each letter correctly read on lines below it (if any letters were read correctly in the row with 3 or more errors these should be included in the total letter count). Record the total number of letters read correctly on the worksheet and transfer this number to the Functional Vision form. The worksheet should be kept in the participant's file for future reference.

5.2 Using non-standard distances

If the participant is unable to read even the top line at 10 feet, you should reduce the distance between the participant and the chart. It would be helpful to have an additional

tape mark on the floor at 5 feet from the chart. Be sure the tape marks are easily distinguished so that an examiner doesn't use the wrong one by mistake.

Reduce the distance to 5 feet and ask the participant if they can read any of the chart. If they are still unable to read any of the lines, or can only read part of the first line, check the box "Unable to read at 5 feet." If they are able to read some of the chart at 5 feet, be sure to check the box corresponding to the 5-foot test distance. As before, start with the number of letters correct for the last line read without errors and add one for each letter correctly read on the lines below it.

5.3 Calculating the Snellen equivalent

When calculating the more familiar Snellen acuity to report to the participant, you will have to choose the value corresponding to the distance used. To the right of the vision charts on the worksheet is a table for converting number of letters correct to Snellen acuity. For each number of letters correct, there are two acuities in the table, one for the standard 10-foot testing distance, and one for the five-foot non-standard distance. For example, if a participant read all of the 7th line correctly, three letters on the next line, and two on the line below that, then their number correct is 35+3+2, or 40. If the test was done at 10 feet, this corresponds to a Snellen acuity of 20/50, whereas if the test was done at 5 feet, this corresponds to a Snellen acuity of 20/100.

When the number of letters correct falls between two lines of the table, round up for up to two additional letters, and round down for three or four additional letters. In other words, if a participant took the exam at 10 feet and got 37 letters correct (35+2 additional letters), the correct acuity would be 20/63. If they got 38 letters correct (35+3 additional letters), the correct acuity would be 20/50.

6. Procedures for Performing the Measurement at Home

The visual acuity test can be performed in the home. See home visit protocol.

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

If a participant would like more information about her eye exam, you can provide an explanation sheet with a description of the test (Appendix 1). Remind the participant that she should have a complete eye exam every year, since the incidence of glaucoma and other eye diseases increases in her age group. Be sure she understands that the SOF exam is not a substitute for a complete eye exam.

8. Quality Assurance

8.1 Training and Certification

No experience is required. Examiners must follow the training procedures and be certified. Training should include:

- Read and study manual
- Attend SOF training session on techniques (or observe administration by experienced examiner)
- Practice on volunteers
- Discuss problems and questions with local expert or QC officer

8.2 Certification Requirements

- Completes training requirements
- Knows how to set up and record the exam if the participant can't read the top line at 10 feet
- Conducts exam on two participants while being observed by QC officer using QC checklist
- Demonstrates ability to check lighting of distance charts

Bailey-Lovie chart

- Sets up participant and chart the correct distance from each other
- Turns on correct lighting
- Correctly uses the vision worksheet and transfers value to the form
- Asks participant if they wear glasses or contact lenses for distance tasks and asks them to put glasses or contact lenses on, if applicable
- Records glasses or contact lenses use on form
- Explains test correctly and follows script
- Makes sure participant gets all letters of first line correct, or else asks participant to start with the top line
- Encourages participant to guess
- Stops participant when three or more letters missed on one line
- Correctly records missed letters on worksheet (X through incorrect letters)
- Correctly records number of letters correct on worksheet and form

9. References

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APPENDIX 1.**Visual Acuity-Explanation Sheet**

Visual acuity refers to the ability to see detail and is tested by measuring distance vision at a set distance using a standard chart. The participant reads the chart from left to right and top to bottom as if from a page in a book. Visual acuity is measured as a fraction, like 20/20. The top part of the fraction is always 20 and the bottom part is a number that gets bigger the worse your vision is. One way to understand this fraction is that 20/20 means that you can see at 20 feet what a person with good vision can see at 20 feet. If your vision is 20/40, it means that you have to stand at 20 feet to see what a person with normal vision can see at 40 feet. In other words, you have to get a bit closer to see what others can see farther away.