LEA Contrast Sensitivity

LEA Test Intl, LLC™
www.leatest.com

LEA Contrast Sensitivity Test

Introduction

Measurement of contrast sensitivity has been used in experimental and clinical research for several decades, in some places also in routine examinations of patients with different vision problems.

The clinical tests that have been developed by LEA-Test have been useful in the evaluation of vision of thousands of patients revealing changes in visual function undetectable with the usual high contrast visual acuity tests. Because low contrast vision is not yet covered in all teaching programs, some basic issues, like the definition of contrast and recommendations on luminance, are included in this text.

Since contrast sensitivity tests have not been routinely used, the values measured with the different tests may not depict the quality of visual function when one starts to use the tests. The same was true when high contrast visual acuity tests began to be used.

The combination of high and low contrast visual acuity values defines the location of the slope of the contrast sensitivity curve but diagnostically the most important feature is any change over time.

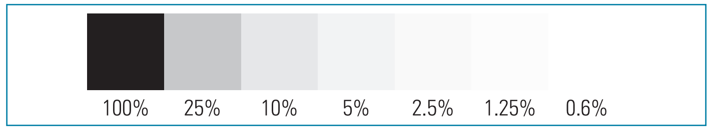
We have been taught that 1.0 (20/20, 6/6) is “normal” visual acuity although actually it is at the lower end of the range of normal values between 0.8 (20/25, 6/9) and 2.5 (20/8, 6/2.5). Similarly, a rather common low contrast visual acuity value is 0.5 (20/40, 6/12) at 2.5% contrast when a person has normal sight. However, the variation of visual acuity at low contrast is nearly five - six lines, similar to variation at high contrast.

Now it is easy to measure, record and detect changes in the transfer of visual information when the change only affects visual acuity at low contrast levels. Repeated measurements and observation of changes in visual functioning will increase our understanding of how the measured values depict visual impairment. Other visual functions need to be assessed as well for classification of visual impairment but the simple visual acuity measurements at different contrast levels give us an easy start.

What is Contrast Sensitivity?

Contrast sensitivity measures the ability to see details at low contrast levels. Visual information at low contrast levels is particularly important:

1. In communication, since the faint shadows on our faces carry the visual information related to facial expressions;
2. In orientation and mobility, where we need to see such critical low-contrast forms as the curb, faint shadows, and stairs when walking down. In traffic, the demanding situations are at low contrast levels, for example, seeing in dusk, rain, fog, snow fall, and at night;



Simulation of Contrast Levels

3. In every day tasks, where there are numerous visual tasks at low contrast, like cutting an onion on a light colored surface, pouring coffee into a dark mug, checking the quality of ironing, etc.;
4. In near vision tasks like reading and writing, if the information is at low contrast as in poor quality copies or in a fancy, barely readable invitation, etc.

Contrast sensitivity is the reciprocal of the contrast at threshold, i.e., one divided by the lowest contrast at which forms or lines can be recognized.

If a person can see details at very low contrast, his or her contrast sensitivity is high and vice versa. Depending on the structure of the stimulus used in the measurement - either gratings of different size or symbols - contrast sensitivity of a person gets different values.

What is Contrast?

Contrast is created by the difference in luminance, the amount of reflected light, reflected from two adjacent surfaces. It can be defined in slightly different ways. In clinical work, we usually use the Michelson formula:

$$\text{Contrast} = \frac{\text{Lmax} - \text{Lmin}}{\text{Lmax} + \text{Lmin}}$$

There is also the Weber definition of contrast:

$$\text{Contrast} = \frac{\text{Lmax} - \text{Lmin}}{\text{Lmax}}$$

Lmax = Luminance on the lighter surface
Lmin = Luminance on the darker surface

When the darker surface is black and reflects no light, the ratio is 1. Contrast is usually expressed as percent, then the ratio is multiplied by 100. The maximum contrast is thus 100% contrast. The symbols of the visual acuity charts are close to the maximum contrast. If the lowest contrast perceived is 5%, contrast sensitivity is 100/5=20. If the lowest contrast perceived by a person is 0.6%, contrast sensitivity is 100/0.6=170.

There is no international recommendation on how contrast of visual acuity charts should be defined. Therefore there are differences in the contrast of tests of different manufacturers.

Which Luminance Level Should Be Used?

An international recommendation does not exist on the luminance level for contrast sensitivity testing, but there is a recommendation for visual acuity testing. It recommends a luminance level equal or higher than 85 candelas per square meter (cd/m²).

In the United States and in a number of other countries, measurement of visual acuity for research purposes is done by using the back illuminated ETDRS light box with the luminance level adjustable from 220 to less than 1 cd/m² by using layers of filters. In the small light box the maximum luminance level is 125 cd/m².

Measurement of Contrast Sensitivity

Measurement of contrast sensitivity resembles audiometry: a pure tone audiogram depicts which are the weakest pure tones at different frequencies that the person can hear. Contrast Sensitivity Curve or visuogram shows the faintest contrasts perceived by the person. If the stimulus is a sine wave grating, then the curve depicts similar function as does the pure tone audiogram. If the stimuli are optotypes (letters, numbers or pediatric symbols), recognition is required and the test resembles speech audiometry. As in audiometry, the result of the contrast sensitivity measurement is not one single value but a diagram.

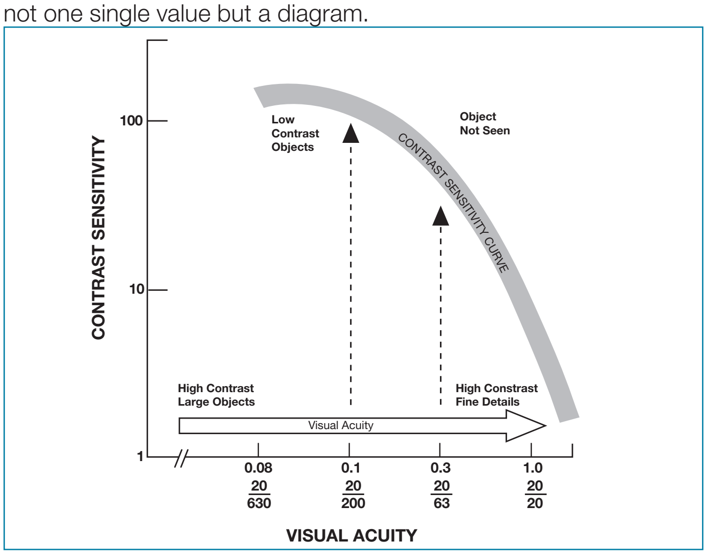


Figure A

Contrast sensitivity curve

Visual acuity is plotted along the horizontal axis and contrast sensitivity along the vertical axis (Figure A). The size of the symbols decreases along the horizontal axis and they become paler and paler in the vertical direction (Figure B). The boundary between symbols perceived and those that are too small or too pale and thus not seen, is depicted by a curve, called Contrast Sensitivity Curve. Its declining right-hand slope is the most interesting part of the curve in clinical cases. To define the slope of the contrast sensitivity curve, we need two or three measurements. The first one defines the point at the x-axis, the visual acuity value determined in the usual way. The second is the definition of the upper end of the straight part of the slope usually located in the 1-5% contrast area. An additional measurement at lower contrast is often of interest.

The threshold values can be measured with two different techniques when using optotype tests:

1. By using low contrast visual acuity charts, or
2. By using tests with one symbol size and several contrast levels.

Test Procedure When Using Low Contrast Visual Acuity Charts

Testing is identical to the measurement of visual acuity at high contrast level, i.e., we measure the smallest size of the optotypes that the person can recognize. The threshold is defined as the line on which at least 3 out of the 5 optotypes are correctly recognized. The 2.5% test is the most practical test in clinical use. The resulting threshold point on the curve is far enough from the high contrast value so that the declination of the slope of the curve can be defined. In severe low vision, the test must be quite close, which may require use of reading lenses.

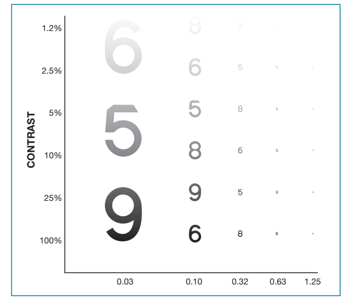
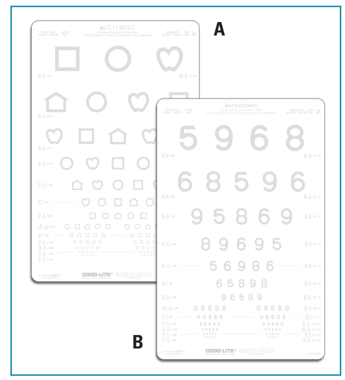


Figure B

Move quickly down the chart and ask the person to identify the first or the last symbol on each line. When the person hesitates or makes an error, recede one line and ask the person to read the entire line. To record the result carefully, record the number of optotypes read correctly, i.e., if on the 2.5% chart one of the symbols was read incorrectly on line 20/63 (6/18, 0.3) record the visual acuity value as 20/63 (-1) at 2.5%.



Translucent Low contrast visual acuity charts for the small light box. The optotypes are printed at 2.5% (the old 25%, 10%, 5%, and 1.25% contrast charts are still available). Low contrast chart is available also for the ETDRS cabinet.

A. Translucent 2.5%Low Contrast Symbols Chart (#253800)

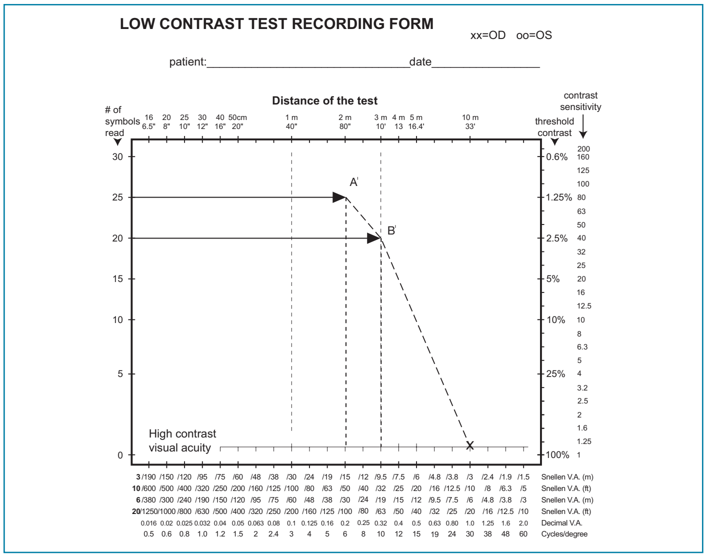
B. Translucent 2.5%Low Contrast Numbers Chart (#271600)

Contrast Sensitivity Measured By Using Low Contrast Visual Acuity Charts

Test results are marked on the recording sheet at the level used (see example below) going along that level toward the right until the visual acuity value, measured at that contrast (A' at 1.2%, B' at 2.5%), is reached. If the person's visual acuity was 20/20 (6/6, 1.0), the line connecting these three points, A', B' and X, depicts the slope of the contrast sensitivity curve of this person. Record the results as 20/50 (6/15, 0.4) at 2.5% and 20/100 (6/30, 0.2) at 1.2%.

Test Procedure When Using Low Contrast Tests with One Symbol Size

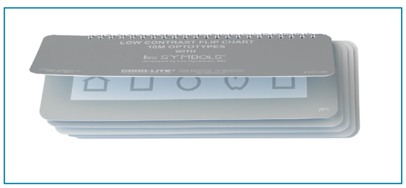
In this test type the 10M size is convenient because at the most common testing distance of 1 meter, it corresponds to visual acuity 0.1 (20/200, 6/60), at 2 meters to 0.2 (20/100, 6/30), at 4 meters 0.4 (20/50, 6/15) and at 0.3 meter distance 0.03 (20/600, 6/180) covering the low contrast visual acuity range of most persons with visual problems. The contrast levels of the test lines on the five pages are 25%, 10%, 5%, 2.5% and 1.2%.



Example of using the Low Contrast Test Recording Form

The same diagram that was used when testing with the low contrast visual acuity charts, can be used also for reporting of the results from testing with tests with one symbol size. The number of correct answers is read on the left vertical axis and the cross is placed corresponding to the distance used when testing.

Luminance variation affects the threshold values in many disorders and even in normally sighted individuals. It is difficult to arrange high enough luminance on the test in a regular room except by pointing a light source toward the test.



Low Contrast Flip Charts (#251100)

Then the amount of light falling on the test is dependent on the distance of the test from the light source. For reliable follow-up measurements, the test should be at a fixed distance from the light source. In field surveys, the variation in the results caused by variation in illumination needs to be taken into consideration.

The surface of the low contrast charts is easily damaged. Avoid touching the white test surface. If a person needs to point with his/her finger at the optotype to fixate on it, use tube gauze or a white glove to cover the finger.

- If the person has not seen the contrast tests before, explain that you are using a low contrast test the same four symbols that were used in the high contrast testing (" the same pictures that we just looked at and you gave the names...").
- Start measuring at 3 meter distance if you expect close to normal visual functioning.
- Ask, which is the first picture on the line. If the person sees the first number/picture correctly with ease, move to the next page. Continue this way until the person makes an error.
- If the person answers incorrectly, ask, which is the next picture and then next going through the whole line. If the person sees three out of five symbols correctly and does not see any numbers on the next line, mark the result as the sum of all the optotypes on the previous lines + the three on the last line read.
- To make it easier to know how many optotypes there has been on the previous lines, there is a small number on the left lower corner of each page showing the sum of optotypes on the previous pages and the contrast level marked on the right lower corner.
- When coming to a new page, the child may say that "there is nothing" on that page. It is difficult to focus on optotypes close to the threshold values. Therefore, tell the child to look at the optotypes on the previous page and not to move the gaze when the page is turned. Quite often the child can see the whole line that (s)he did not perceive when the image was not in perfect focus on his/her retina.
- For measurement at larger optotype sizes, move closer. If the first measurement was at 3 meters, move to 1.5 meters and measure until threshold.
- The results are marked on the recording form as the crossing of the lines marking the testing distance used and the number of optotypes seen correctly.

The result of the measurement is written down as the number of correct answers. Although only one optotype was tested on each line, each line above the threshold line is credited for 5 correct answers.

Thus, if a person reads 3 of the 10M LEA SYMBOLS® correctly on line 5 at a distance of 1.6 meters, the result is written: LEA-S, 10M:23 at 1.6m.

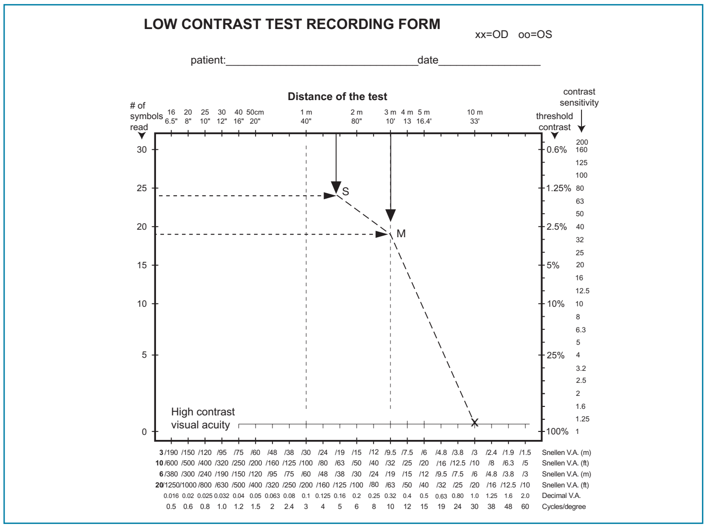
The result can be marked on the diagram by locating the test distance on the upper border of the recording form (top scale) and marking the results (in this case 23) at the point where the line of the test distance (1.6m) and the line of the number of the correct answers cross each other. This point is marked with S in the diagram. In the diagram, it is easy to calculate that the result can also be written 0.16 (-2) at 1.2% contrast (0.16 = 20/125 or 6/38).

The number of correct answers is read on the left vertical axis and the cross is placed corresponding to the distance used when testing. In this case the result would then be 18 correct at 3m (marked M) and 23 correct at 1.6m (marked S). Line S-M-X depicts the slope of the contrast sensitivity

After having used the test for a while, you will not need the recording form any more, except for reporting your results to somebody who is not accustomed to using the test. You will have a mental image about where the threshold is located on the form. You will mark down the name of the test, the number of the correct answers and the distance at which you measured. These three numbers carry the necessary information for follow-up.

When both optotype and grating measurements are made, it is interesting to mark them on the recording form to see the relationship between the different threshold values. The luminance of the tests needs to be kept closely equal, otherwise the results are not comparable.

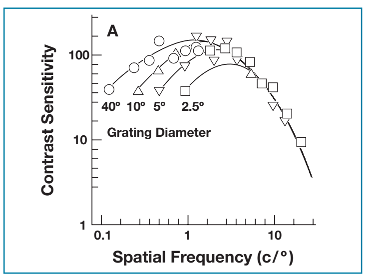
This contrast sensitivity recording form can be used to record any test results from contrast sensitivity tests. The comparison of test results from different tests is easy when they are plotted on this form. By combining results from optotype tests and grating tests the quality of the central visual field can be evaluated for low vision or occupational assessment.



LEA Low Contrast Gratings

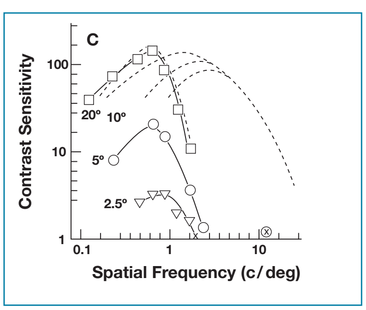
Grating Acuity Test at Low Contrast Levels

Grating tests have been used to measure contrast sensitivity since the 60's. These computer controlled grating tests have not become widely used in clinical medicine because they are expensive and require an experienced technician to use them. However, studies with them have taught us some important principles in measurement of contrast sensitivity in cases of low vision. The most important finding is that contrast sensitivity values in nearly all cases of low vision are different when measured with gratings of different sizes: the larger the grating, the higher the contrast sensitivity value. This is particularly common in cases of central scotoma that 'eats up' some of the stimulus and thus the effective stimulus is smaller than the physical stimulus.



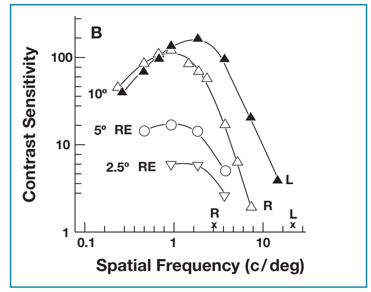
Contrast sensitivity as a function of stimulus size in normally sighted subjects: the larger the grating, the higher the contrast sensitivity values at low spatial frequencies.

Small grating stimuli would often give a misleading picture of visual function at low contrast. Therefore it is wise to make one measurement with a large grating stimulus to learn about the subject's ability to see low contrast information. On the other hand, it is interesting to evaluate the function of the fixation area by using a smaller stimulus. This is possible by covering the grating stimulus with a grey folder that leaves either one fourth or one tenth of the stimulus visible.



Contrast sensitivity curves of a person with optic atrophy in both eyes. With the 2.5 degree stimulus contrast sensitivity is barely measurable, yet with the 20 degree stimulus the values at low spatial frequencies are normal.

LEA Low Contrast Gratings measure contrast sensitivity at 3 contrast levels, 100%, 10% and 2.5% using 3 grating frequencies: 0.5cpcm, 2cpcm and 8cpcm. The grey folder covers part of the grating and leaves visible either one forth or one tenth of the stimulus. With this simple technique it is possible to find out the effect of stimulus size on the threshold values. When the grating is turned into a new orientation it is covered with a grey surface.



Contrast sensitivity curves in case of macular degeneration, L = the normal left eye, R = the right eye with dry macular degeneration. Contrast sensitivity measured with 10 degree stimulus is nearly as good as in the normal left eye, whereas when measured with 5 degree stimulus it is one fifth of the maximum value of the 10 degree curve and when measured with 2.5 degree stimulus the maximum value is only one twentieth of the 10 degree maximum.

Guide

Start with the high contrast grating. Show the gratings at a distance of 2.5m starting with the 0.5cpcm grating. Turn the gratings in different orientations before exposing them from behind the grey cover. Do not move the grating when presenting it. Ask the person to respond by showing the orientation of the lines with his/her hand or with the ruler that is included in the test. Threshold value is reached when three out of five presentations lead to correct response.

If the broadest lines could not be seen at 2.5m distance, move closer until they are seen. Step back a little, turn the grating behind the cover and present it again. If a person has uncorrected astigmatism, grating will be seen at different distances when presented in different orientations. Thus you learn about the person's refractive error while measuring grating acuity.

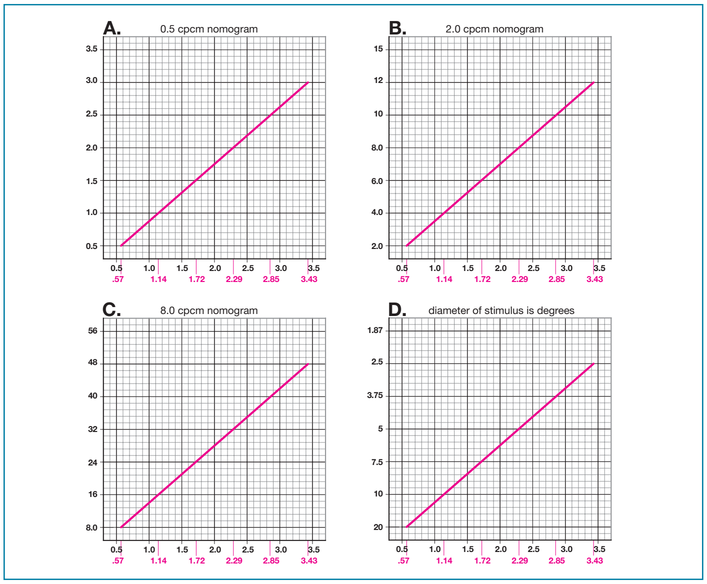
If the broadest lines were seen at a distance of 2.3m, grating acuity is 2 cpd (0.5cpcm equals 0.5cpd at 57cm, 1cpd at 114cm and 2cpd at 230cm). This is a low value.

When testing normally sighted persons one starts by showing the finest grating at about 1.5m distance, moves backward until the lines cannot be discerned and then moves toward the person until they become visible again. At this distance make the presentations while slightly changing the distance in order to find the threshold value. Test first with the large stimulus and then with the two smaller ones.

The distance needs to be measured accurately. It is easy to measure if the person sits with his/her head supported on the head rest of a corneal microscope and a tape measure is fixed on the head rest. When the distance is measured the result can be read on the corresponding nomogram (Diagram A). For example, if a person saw the 8cpcm grating at 1.15m distance, grating acuity is 16cpd with a 10 degree stimulus (the grating is 20cm in diameter, thus 20 degrees at 57.2cm and 10 degrees at 115cm distance, Diagram B).

Grating acuity at the lower contrast levels is measured similar to the measurement at high contrast level.

It takes some time to get accustomed to locating the correct value on the nomogram. It is best to mark down the result on a diagram immediately. If an error is made in one of the measurements the

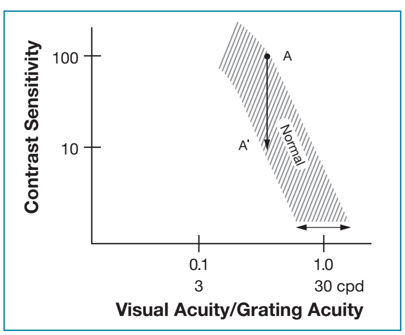


Nomograms: Grating acuity (cpd) as a function of testing distance, A. 0.5cpcm grating, B. 2.0cpcm grating and C. 8.0cpcm grating. D. Diameter of the stimulus as a function of testing distance.

resulting curve looks strange. Then the strange value should be measured again. If the approximate multiple values of 57.2 cm are used (115, 170, 230, 285 and 340) grating acuity is easier to calculate. It is 2,3,4,5,or 6 times the cpcm value of the grating or between two of these values. This helps in locating the exact value on the nomogram. The result is marked on the answer sheet the same way as the values measured with optotype tests. Grating frequencies are on the bottom line.

The Range of Normal Contrast Sensitivity

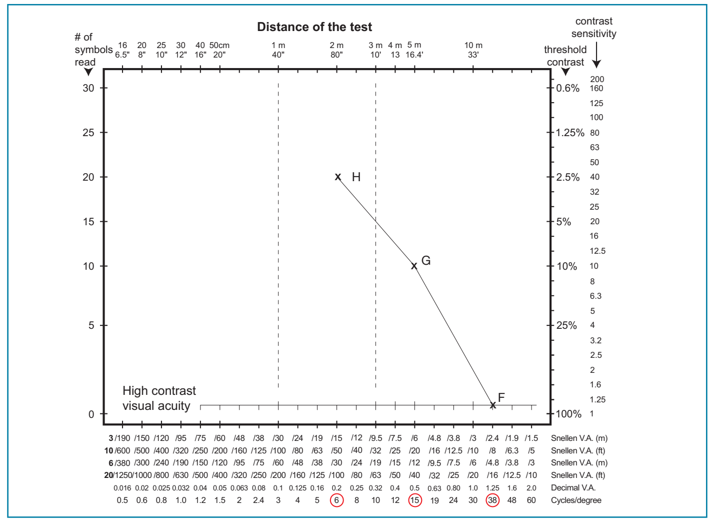
Among the normally sighted people, both visual acuity and contrast sensitivity have a wide range of variation. In visual acuity, 20/25 (6/9, 0.8) is a low normal value; the highest normal values are three times higher, 20/8 (6/2.5, 2.5). Similarly, the range of normal variation in contrast sensitivity values is great. Therefore, a value within the range of normal may or may not mean that particular person has normal contrast sensitivity. If his or her contrast sensitivity was previously high, it may decrease to less than one-half or one-third of its original value and still be "normal."



The range of normal variation in both visual acuity values (horizontal arrow) and in contrast sensitivity (vertical arrow) is great. If a person's contrast sensitivity was previously A and has then decreased to A', the value is still within the range of normal values but is highly pathologic to this person.

A change in contrast sensitivity is the diagnostically important feature that will be watched in the future. Because of the large variation in the normal values, we need to have an older value to compare with to notice a change.

Ideally, contrast sensitivity and visual acuity should be measured when children leave their high school/ secondary school or in young adulthood. These

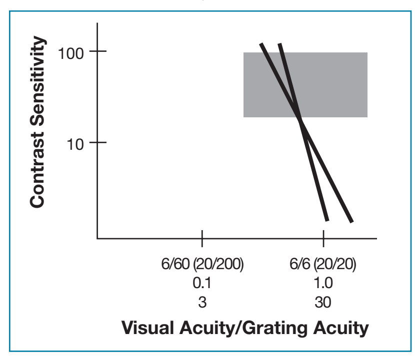


Result of a measurement at the three contrast levels. The person saw the 8cpcm grating at 270cm at high contrast, which corresponds 38cpd (F). The 10% contrast 8cpcm grating was seen at 110cm distance, which corresponds to 15cpd (G). The 2.5% contrast 2cpcm grating was seen at 174cm distance, which corresponds to 6cpd (H). The line H-G-F depicts the slope of the contrast sensitivity curve. It is Type III curve.

values should be recorded and saved as part of the basic information related to each person's health. A change warrants an examination to find out the cause of the change. Although the most common cause would be a small change in the refractive power of the eye, which is a benign finding, repeating the measurement of contrast sensitivity would be beneficial as a part of routine health examinations to rule out changes in the visual pathways.

Measurement of contrast sensitivity would also help us to better understand the complaints of a person whose visual acuity at high contrast has not changed but whose vision has decreased at low contrast levels. Then we would not annoy him/her by saying that his/her vision is as good as before, a situation which is now experienced by all too many patients/clients.

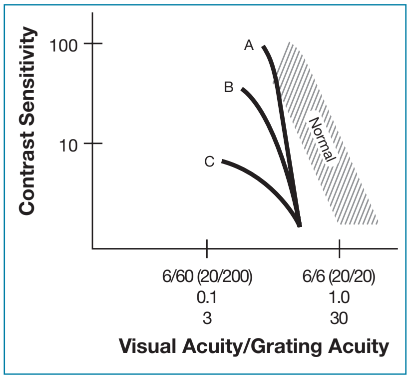
If occupational tasks require good visual function at low contrast levels, visual acuity alone does not select the most suitable persons for that particular task. For example, if the task is to notice airplanes approaching within low clouds, these planes are best seen by a person with good visual acuity in the contrast range of 1-5%. Since the declination of the slope varies even in normal individuals, it is possible that a person with lower visual acuity at high contrast has better function at the lower contrast levels than a person who has higher visual acuity at high contrast. This is important to remember in all such occupational tasks that require exceptionally good visual function at low contrast levels.



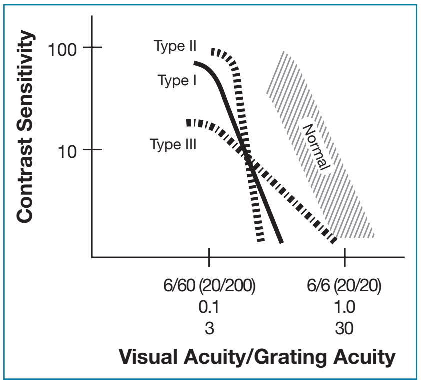
Variation in the declination of the slope in normal subjects.

The Types of Contrast Sensitivity Changes

Usually the loss of visual function is roughly equal at high and at low contrast levels. The slope of the curve moves toward the left without a change in the declination (Type I). When there is a small circumscribed lesion in the center of the macula, visual acuity may decrease several lines, yet in the low contrast vision there is slight or no loss (Type II). Type III change in the transfer of visual information is characterized by moderate to no loss of visual acuity at high contrast and a greater loss of visual function at low contrast. This is often caused by diabetic retinopathy, cataract, glaucoma, or optic neuritis, to mention some of the most common causes.



Contrast sensitivity curves of three persons with visual acuity 20/63 (6/18, 0.3).



Types of changes in contrast sensitivity.

Clinically, it is well known that there can be three people with different types of contrast sensitivity losses even when they have similar visual fields and visual acuity values. They can have very different functional vision. The three people whose contrast sensitivity curves are in figure all have visual acuity of 20/63 (6/18, 0.3). Person A has high normal function at low contrasts and functions like a normally sighted person. Person B has somewhat decreased low contrast function and the typical behavior of a person with low vision (bringing texts closer and moving slightly slower on stairs, etc). Person C has lost visual functions at low contrast and is severely visually impaired. Of these three people with the same visual acuity, one is normally sighted, one has low vision and one is severely visually impaired.

Lower Visual Acuity May Mean Better Vision

If occupational tasks require good visual function at low contrast levels, visual acuity alone does not select the most suitable persons for that particular task. For example, if the task is to notice airplanes approaching within the low clouds, these planes are best seen by a person with good visual acuity in the contrast range of 1-5%. Since the declination of the slope varies even in normal individuals, it is possible that a person with lower visual acuity at high contrast has better function at the lower contrast levels than a person who has higher visual acuity at high contrast. This is important to remember in all such occupational tasks that require exceptionally good visual function at low contrast levels.

Hiding Heidi Low Contrast Face Test (#253500)

Contrast sensitivity needs to be assessed in children and adult persons who are unable to respond verbally or by pointing. If the person can follow a moving target or shift gaze to or turn head to peripherally presented visual stimuli, preferential looking test situations can be used when testing with Hiding Heidi pictures.

Present the test within the distance within which the person visually responds using the highest contrast (100%) first. If you expect normal function in a baby, you may shorten the test situation by showing next the 2.5% picture and then the 1.2% picture. If you do not get a response to the 2.5% picture, show the 25% or 10% picture next and then the 5% picture. The picture is presented by moving both the picture and the white card with the same speed, usually horizontally. If the person has horizontal nystagmus, the pictures are best presented vertically.

The visibility of facial features can be tested also in older children by using the Hiding Heidi test. Then it is more fun to ask the child point to Heidi when she becomes visible. In testing of difficult-to-test children we have sometimes used the following technique: The test is on a table. One of the two persons testing takes the picture of Heidi, the other tester takes the blank card. The testers move to the testing distance and ask “who has the Heidi card?” Some children like to wave “bye-bye” to Heidi.

Whenever contrast sensitivity has decreased, it is advisable to measure visibility of facial features at different distances. Surprises are common. Since the area of the Heidi picture - and that of a face - is so much larger than the area of a symbol or even a grating stimulus, the low contrast pictures may be discernible at unexpectedly long distances. However, it is important not to force children to function at their threshold. If the function of a healthy child at the same luminance level is demonstrated, the teachers and therapists will better understand the requirements of the visually impaired child’s communication.

The ability to detect objects of low contrast is an important component of the visual system. Determining the levels of contrast that an infant can detect, helps planning information for intervention and provides a baseline to evaluate future changes. Deviations from usual behavior may indicate disorders that leave vision at high contrast levels unaffected.

Visual communication is the most important way of communicating during the first year of life. Expressions on faces are mediated by faint shadows and changes of the contours of the mouth and eyes. Most facial expressions are in low contrast, so an infant’s reaction to the Hiding Heidi Low Contrast Cards offers useful information. The cards can also be used with multi-handicapped people.

If an infant only responds to high contrasts, the people in his or her life should be aware of this problem and make their faces more visible. This can be done by wearing lip and eye liners, bright lipstick and eyeglasses with dark frames.

Testing Procedure

Even though "infant" is referenced in the following procedure, the test can also be used on young children and multi-handicapped people.

1. Stack the Hiding Heidi Low Contrast Cards sequentially with the 2.5%, 10% and 100% faces downward, in that order. Since the 25%, 5% and 1.25% faces are on the opposite side, they will face up.
2. Position the infant so he or she faces the examiner and in the optimal position for best visual performance. Support his or her head so involuntary motor movements least affect the infant's performance. The infant can look over the parent's shoulder while being held, sit in their lap or in the child's buggy. Consider the infant's most comfortable position. If possible, select the best time of day when the infant is most alert. Note any differences in performance when not taking the above into consideration.
3. Before observation of the infant's responses to the Hiding Heidi faces, familiarize yourself with the infant's usual response pattern and look for: the head turning toward an interesting visual object, eye widening, breathing, quieting, eyebrow arching, smiling, babbling to or reaching for an object. This will help detect if there are variations of these patterns as the infant fixates on the Hiding Heidi faces. Familiarize and prepare the infant for locating Hiding Heidi in whatever way is appropriate to his or her level.
4. During your communication with the infant, notice how far you can back away from the infant without losing his or her attention to your face. Record this distance, so you can later document changes in the infant's visual sphere.
5. Leave the stack of cards within your reach, out of the infant's sight. When presenting the cards, place them in front of your chest. Present the face cards, one at a time, with the blank card in front of the face card. Encourage the infant to look toward the midline by talking to him or her just above the cards, or play Peek-A-Boo with the blank card in front of your face in an attempt to get the infant's attention.
6. Use two cards for each presentation. One card is always the blank card, the other, one of the six Hiding Heidi faces. Hide the stimulus card behind the blank card. Then ask the child "Where is Heidi hiding?", while moving the blank card off to one side and the stimulus card off to the other side. Both cards should leave the midline at the same speed. Stimulus cards should be moved to the right and/or left in a random order.

   The cards are presented in the following order: 100%, 10%, 2.5% and 1.25%. If the infant does not react to the 10% card, present the 25% card. If the infant then reacts to the 25% card, proceed with the 10% card and lower the contrast cards until a threshold level is reached. If the infant does not react to the 2.5% card, present the 5% and other cards, as above, until a threshold level is reached. If the child responds to the 1.25% face, the contrast threshold at that distance is below 1.25%. Record that as <1.25%.

   The purpose of this order of presentation is to find the infant's contrast threshold as quickly and as accurately as possible. Avoid repeated presentation of the same stimulus card, as this causes habituation.

   The tester may notice that an infant does not follow the movement of the Heidi-picture with eye movements or with combined eye-head movements but makes a quick shift of gaze to the picture when it stops. Another child may follow the movement but looks puzzled when the movement stops and looks at the tester as if asking "Where did the picture disappear to?" These observations need to be reported to the child's neurologist because they may mean that the child has problems in motion perception (= perception of movement or perception of objects that stand still).

   In the examination of older children the child may prefer waving to Heidi "bye-bye" instead of simply pointing. Also, the presentation may be varied by letting the parents show the cards: They hold the cards behind their back while moving to the testing distance. There they present the Heidi card and the blank card at the same time and ask "Who has the Heidi picture?".
7. If the infant does not respond to the low contrast cards, bring them closer. Note the distance. If the infant still does not respond to a horizontal presentation of the face cards, slide the cards in a vertical presentation.
8. Initially present the cards in usual illumination level (average room lighting). If the infant does not respond, increase or decrease the luminance level by utilizing a lamp with controlled lighting that allows you to vary the luminance level. Record the optimal luminance level for communication repeatedly during the first year of life.
9. Since infants rely on near and far visual communication, try to obtain at least two separate thresholds. First, measure at the near communication distance, using the methods described above; record the distance from the child to the cards, the luminance level, and the threshold contrast level reached.

   If the infant responds to low contrast face stimulus at near distance, use one of the cards with higher contrast and the blank card, backing away from the infant to the distance where he or she lost response to your face. Record this distance, the luminance level and the threshold contrast level reached at this distance. This will demonstrate to the child's parents/therapist/teacher the distance at which the infant still responds to visual information at low/intermediate contrast levels.

Summary

Assessment of visual function at low contrast adds an important dimension in the evaluation of a person's capabilities. It should be a part of evaluation of vision in occupational health and in low vision services as well as in all diagnostic work. With the easy-to-use optotype tests, it is possible to assess visibility of low contrast details. A person's ability to see low contrast lines requires grating tests, which presently are under construction.