Grating Acuity at different distances
On each grating paddle the frequency of the printed grating is given as cycles per centimeter (cpcm). At the distance of 57 cm (22.5”), 1 centimeter equals 1 degree of visual angle*. Thus, only at that distance the cycles per degree value of each grating is equal to the cpcm printed on the paddle. For example, at 57cm, the 0.25 cpcm paddle is equal to 0.25 cpd. When the paddle is brought closer, the number of cycles per degree decreases. When used at a distance longer than 57cm, the number of cpd increases. In the table below, cpd values are calculated at some common distances. If another distance is used, the cpd results can be calculated using this formula:

\[
\text{cpd} = \frac{\text{cpcm}}{\text{distance in cm}}
\]

"NOTE: This is derived from the formula below: A circle has 360° and the circumference of a circle is equal to 2 \(\pi\) r (where \(r\) = the radius). In this case, "\(r\)" is equivalent to the distance between the child's eye and the paddle. If the circumference of a circle measures 360 cm, then each degree of angle subtends to a distance of 1 cm on the circumference. The radius of such a circle is then calculated as follows:

\[
r = \frac{360 \text{ cm}}{2 \pi} = \frac{57.2 \text{ cm}}{2} = 28.6 \text{ cm}
\]

Grating Acuity Reported in Cycles Per Degree

<table>
<thead>
<tr>
<th>Distance in CM (Inches)</th>
<th>Cycles Per Centimeter (cpcm): Printed On Paddles</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.25</td>
</tr>
<tr>
<td>29 cm (11.5”)</td>
<td>0.12 cpd</td>
</tr>
<tr>
<td>57 cm (22.5”)</td>
<td>0.25 cpd</td>
</tr>
<tr>
<td>86 cm (34”)</td>
<td>0.40 cpd</td>
</tr>
</tbody>
</table>

In adults visual acuity is measured as “recognition acuity,” which uses standard line tests. This type of test cannot be used in examining infants and children with multiple handicaps. Visual acuity in these individuals is measured with grating acuity tests.

In this grating acuity test, the infant or child detects the presence of parallel lines of decreasing width, a task simpler than recognizing optotypes. When a striped pattern is presented in front of an infant simultaneously with a gray surface of the same size and luminance, the infant is likely to look at the striped pattern because there is more to see than on a gray surface.

The Lea Gratings test uses paddles to present gratings. The handle allows the tester to hold the test easily.

The gratings are defined by the frequency, i.e., the number of pairs of black-and-white stripes or cycles, within one degree of visual angle. When grating is printed on a surface, it can be defined also as the number of cycles per centimeter of surface.

When a grating is held at 57cm (~ .2 feet) distance from the infant’s face, one centimeter equals one degree of visual angle. This is a convenient test distance because number of cycles/cm corresponds to grating acuity as cycles per degree.

Infants and children at an early developmental level may not respond to stimuli placed at 57cm distance. Their visual sphere may be limited to less than 30 cm (~ 1 foot). If the gratings are held at the 57cm distance, the number of cycles per degree (cpd) is half of that at 57cm. If the infant’s response can be elicited only at 15cm (~1/2 foot), 1/4 of the frequency of the grating is 1/4 of the value printed on the test. If the child responds to the stimuli at about 1 meter (exactly 114cm or ~4 feet), the grating acuity values are twice the value printed on the test.

In the examination of infants it is advisable to choose test distances that are parts or multiples of 57cm, i.e. 28cm, 43cm, 85cm or 115cm. Longer distances are rarely used.

In an extreme case, the largest fixation stick (#253200) is used along with the smallest fixation stick before equal saccadic responses are elicited. If the horizontal halves are unequal or when there is horizontal nystagmus, test whether responses to the vertically presented stimuli are more symmetric.

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5: Visual Attention
In children with attention problems, test the symmetry of visual attention at the same time the infant or child is being tested for saccadic movement. If there is asymmetry in the saccadic movement, assess whether the response becomes symmetric by increasing the size of the stimulus on the side of weaker response. For example, present the smallest fixation stick (#253100) on the better functioning side and the medium size stick (#253000) on the less functioning side and observe whether the responses become equal.

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*NOTE: This is derived from the formula below: A circle has 360° and the circumference of a circle is equal to \(2 \pi \) r (where \(r\) = the radius). In this case, "\(r\)" is equivalent to the distance between the child’s eye and the paddle. If the circumference of a circle measures 360 cm, then each degree of angle subtends to a distance of 1 cm on the circumference. The radius of such a circle is then calculated as follows:

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facing the 2 cpcm grating (on the other side of the 1 cpcm grating). When you have shown a grating place the paddle on the table with the grating facing upwards. This way the grating on the other side of the paddle is ready for presentation. If the infant responds to the 0.25 and the 1.0 cpcm grating, but not to the 4.0 cpcm grating, present the 2.0 cpcm grating. The threshold is found quickly before habituation occurs. If the infant or child seems to lose interest, show a face figure (#255200 Large paddle, or #255100 Medium paddle) or colorful toys to motivate him or her to respond again.

Presentation of the Stimuli

The measurement is based on observing the child’s eye movements when the grating paddles are presented to the child. The test situation can be arranged as a play situation for example so that the parents show the paddles and the child points to the parent who has the grating.

Children with brain damage in the cortical areas that handle motion perception or in pathways leading to these areas may show responses that reveal their abnormal perception of movement. When the grating is kept behind the grey surface while moving it in the midline to the testing distance. When the grating and the grey surface are moved in opposite directions (A–D), motion perception is an additional factor in perception of the grating. When the grating and the grey surface are kept motionless (D) in front of the child, which resembles presentation of Teller Acuity cards, motion perception does not affect the test situation.

Grating acuity alone is a poor depicter of visual function. Therefore, never say that the child’s vision was measured to be normal. Say that “grating-acuity value was within the range of normal, other observations and measurements are needed to give a more complete picture of the child’s visual function”. Prerequisites For Measurement Of Grating Acuity

During the measurement of grating acuity, we expect the infant/child to respond with smooth tracking or rapid eye turn to the grating when it is presented. This response requires that:

1. The infant or child can direct his or her attention to the stimulus;
2. The infant or child can track the stimulus.
3. The infant or child has the ability to plan tracking or the saccade toward the target;
4. The infant or child has the motor function of the eye muscles to execute the plan; and
5. The stimulus is presented within the visual sphere of the infant or child.

To evaluate the response correctly, several functions of the infant or child have to be known:

1. Visual Sphere

Use the high contrast face figures to measure how far the stimuli can be moved back before the infant or child loses interest. Always test well within the child’s visual sphere.

2. Fixation

The normal response to look at something is to look straight at it, also called “central fixation.” If the central part of the visual field is not functioning properly, there is central scotoma. The infant or child uses an extrafoveal area for viewing and seems to look past the stimulus, although actually looking at it. Therefore, it’s important to know what kind of fixation the infant or child uses.

3. Visual Field

The infant’s visual field is measured previous to the grating acuity measurement. If there is visual field restriction on one side, make sure the gratings are presented within the child’s visual field.

4. Saccades

When the infant or child is expected to make a swift saccadic movement as the response, the ability to perform saccades must be present. This is tested with interesting playthings of the same size and interest value presented on both sides of the
What to do when the parents and the fellow teachers do not understand the “cpd”?

They do not understand the acuity value of the optic nerve, except when the output of the optic nerve is e.g. 0.3, 2.0/63, 3/18 optic nerve. Similarly, you can show the grating that the infant or child responded to and say: “As you saw, your child could respond to the fine lines at this distance. This kind of grating is called... e.g. 2 cycles per cm, which means that there are two pairs of lines in each centimeter of the sample.”

If you explain grating acuity to this well, the parents understand grating acuity much better than they will ever understand the optic nerve acuity. (How many of the readers can explain what a certain acuity value means?)

What is normal at different ages?

The illustration below shows the range of normalcy at different ages. Values that are clearly below the lower line are highly likely to be deviant (except when the infant or child was tired or fuzzy). Values that are above the upper line are likely to be good normal values. Values within the range of normal are normal but do not mean that vision would be developing normally.

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Prerequisites For Measurement Of Grating Acuity

During the measurement of grating acuity, we expect the infant/child to respond with smooth tracking or rapid eye turn to the grating when it presented. This response requires that:

1. The infant or child sees the grating in that part of the visual field.
2. The infant or child can direct his or her attention to the stimulus.
3. The infant or child has the ability to plan tracking or the saccade toward the target.
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Instructions

Make sure the background setting (including your clothing) is either evenly light gray or even dark color to avoid patterns that could distract the infant. If the infant’s visual sphere is limited, the surrounding visual information does not affect the child. However, these children are often disturbed by even weak noises and uncomfortable or unusual body postures.

Start with the coarsest grating. Show the infant the grating simultaneously with the gray stimulus. Then show every other grating in succession. This is made easy by placing the 4 cpd grating facing the table, the 1 cpd grating facing the 8 cpd grating (which is on the opposite side of the 4 cpd grating). The top paddle is placed with the 0.25 cpcm grating facing the 4 cpcm grating. The top paddle is placed with the 0.25 cpcm grating facing the 4 cpcm grating.