Dept. of Physiotherapy

Contrast Sensitivity

- Contrast sensitivity refers to the ability of the visual system to detect differences in luminance between objects and their backgrounds.
- It measures how well one can perceive subtle variations in shades of light and dark, rather than just sharp edges or colors.
- This sensitivity is crucial for tasks such as reading, driving at night, and recognizing faces in varying lighting conditions.
- It can be affected by factors like lighting, age, and certain eye conditions.

Types of contrast sensitivity:

Spatial contrast sensitivity

- The term "spatial contrast sensitivity" describes the ability to identify striped patterns at different contrast and spatial frequency levels.
- The patient is asked to determine the minimum contrast at which the bars are characterized as spatial frequency when they are shown sine wave gratings of a parallel light and dark band during the measurement.
- The definition of bar width is defined as spatial frequency, which expresses the number of light-bar pairs and dark bars that extend to an angle of 1^0 at the viewpoint.
- Low spatial frequency denotes large bars high spatial frequency denotes narrow bars.

Temporal contrast sensitivity

- **Temporal contrast sensitivity** refers to the ability to detect changes in contrast over time.
- This aspect of vision is crucial for perceiving motion, flicker, and dynamic changes in the visual environment.
- It measures how well the visual system can process variations in brightness and darkness as they occur in a sequence. It helps in noticing flickering lights or moving objects.
- Similar to spatial frequencies in spatial contrast sensitivity, temporal contrast sensitivity is influenced by temporal frequencies.
- This refers to the rate at which contrast changes occur over time. The human eye is most sensitive to certain temporal frequencies, often around 10-20 Hz.

- Temporal contrast sensitivity is typically assessed using stimuli that flicker or move.
- Tests often present alternating light and dark patterns at varying frequencies, measuring the lowest contrast at which a person can still perceive the flicker or motion.
- Important for activities that involve motion detection, such as driving, sports, and video games.
- It also plays a role in how well one can read rapidly changing information, like scrolling text.

Measurement of contrast sensitivity:

- The threshold level is indicated when the individual is exposed to grating frequencies and contrast below which resolution is impossible; the reciprocal of the contrast threshold determines the contrast sensitivity.
- It is measured by:

$$L_{max} - L_{min} / L_{max} + L_{min}$$

Methods of Measurement

1. Arden grating:

- It has seven plates: six diagnostic plates (number 2) and one screening plate (number 1).
- The contrast ranges across around 1.76 long units, changing from top to bottom
- Viewing the plate at 57 centimeters, the spatial frequency increases from 0.2 cycles per degree to 6.4 cycles per degree, with each cycle being twice as frequent as the previous one.
- Each plate is given a score between 1 and 20 based on how much of it is exposed.
- For a typical person, the sum of six plates with an upper limit of 82 and an interocular difference of less than 12 was established.

2. Cambridge low contrast grating

- This chart is a set of ten spiral-bound plates with gratings included
- The test booklet is six meters away from the wall and must be used to complete the test.
- The pages are arranged in pairs, with one above the other.
- Every pair of pages has the same mean reflectance, but one has gratings and the other is blank.
- The only task for the subject is to select which page—top or bottom—contains grating.
- When the first mistake is committed, the pages are displayed in descending contrast and are stopped.
- A score of 11 is given if plate 10 is error-free. The conversion table is used to highlight the contrast sensitivity based on the patient's overall score over four series.

3. Pelli- Robson contrast sensitivity chart

- The chart shows letters spaced one meter apart and showcasing a 3 degree angle.
- Both sides of the chart are printed.
- Both sides are the same except for a different letter sequence.
- There are two triplets in each line of the chart, which is composed of letters in a certain order.
- From one triplet to the next, the contrast becomes less prominent.
- Between 0.00 and 2.25 is the range of the log contrast sensitivity.
- The chart is hung on the wall so that it may be tested.
- With the use of a light meter, the chart is evenly light so that the white sections' brightness falls between the permissible range of 60 and 120cd/m, which translates to a photographic exposure between 1/15 and 1/30 sec at f/5.6.
- The subject is seated exactly one meter in front of the chart during the recording.
- Each letter on the chart is meant to be named or described by the subject, which begins from the upper left corner and moves horizontally across the line.
- The person is forced to guess, even if they think the letters are invisible.
- When the subject successfully guesses two of the triplet's three letters, the test is over.
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4. Vistech chart

- The sine wave grating chart is utilized three meters away from the subject.
- In this exam, the individual must determine whether the grating is vertical or angled 15 degrees clockwise or counterclockwise.
- Contrast is measured at multiple spatial frequencies.

Factors affecting contrast sensitivity:

1. Age- Contrast sensitivity tends to decline with age due to changes in the eye, such as lens opacity and retinal health.

2. Lighting Conditions- Low-light environments can significantly reduce contrast sensitivity, making it harder to detect objects. Glare from bright lights can also impair sensitivity.

3. Eye Health- Disorders that alter the way light is processed in the eye, such as cataracts, glaucoma, macular degeneration, and diabetic retinopathy, can reduce contrast sensitivity.

4. Refractive Errors- Uncorrected vision issues, such astigmatism or myopia (nearsightedness), can lessen contrast sensitivity, particularly if they cause blurry vision.

5. Visual Acuity- There is a correlation between contrast sensitivity and visual acuity; people with lower contrast sensitivity are typically also less acuously visioned.

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Potential vision