THE CARDIFF CONTRAST TEST

The Cardiff Contrast Test is designed for contrast sensitivity measurement in toddlers and young children, and in older children or adults with intellectual impairment or communication difficulties.

THE VALUE OF CONTRAST SENSITIVITY

Contrast sensitivity is the ability of the visual system to detect large but faint targets. There are some pathological conditions that reduce contrast sensitivity without impairing visual acuity, and the test will help in the identification of these conditions. However, reduced contrast sensitivity and reduced visual acuity often occur together, so that some (by no means all) people with visual impairment also have reduced contrast sensitivity. Tests for the two functions are therefore complementary and obtaining a measure of both will give a fuller description of visual deficits than will one alone.

A person with visual impairment who retains good contrast sensitivity will benefit from enlargement of tasks – he or she sees large faint objects well. A person with an equivalent acuity but with reduced contrast sensitivity has a much more severe impairment, and will not get the same benefit from enlargement. Large objects as well as small objects are difficult to see. So a measurement of contrast sensitivity can help determine appropriate management of a visual impairment.

Treatment for visual deficits (including amblyopia therapies) can result in improved contrast sensitivity sometimes in the absence of increased visual acuity. Contrast sensitivity can therefore be an essential tool in monitoring therapies.

Some progressive eye conditions will result in changes in contrast sensitivity, so that monitoring contrast sensitivity alongside visual acuity (and other visual functions) may be essential in determining progress of the condition.

THE TARGETS

Like its 'sister' test, the Cardiff Acuity Test, the Cardiff Contrast Test uses vanishing optotypes. The targets are drawn with a light band bordered by two darker bands, each of half the width of the light band, all on a neutral grey background; thus the average luminance of the target is equal to that of the grey background. If the target lies beyond the subject's contrast limit, it merges with the grey background, and simply becomes invisible.

The targets used are pictures, all of the same overall size, but decreasing in contrast between the light and dark bands. The contrast sensitivity is given by the faintest bands for which the target is visible.

PROCEDURE - PL

The principle of the test for the youngest children or least able adults is that of Preferential Looking (PL) – a patient will choose to look towards a target rather than towards a plain stimulus. Each target is positioned either in the top half or in the bottom half of the card. If the target is visible, the patient will look towards it, and the examiner, watching the patient's eye movements, can judge the position of the target from those eye movements. An important feature of the preferential looking technique is that the examiner **should not know in advance the position of the target.** The test includes three cards at each contrast level, although only two are usually presented. This is so that once one card at a particular contrast level has been presented, the position of the next card to be presented cannot be predicted by either patient or examiner.
For any given contrast level, if the examiner estimates the position correctly on two consecutive occasions, the target is assumed to be visible to the patient. If the examiner incorrectly estimates the target position, or is unable to make a judgement from the patient's responses, then the target is assumed to be below the patient's contrast sensitivity.

The procedure is identical to that of the Cardiff Acuity Test. For each contrast level, shuffle the three cards, and present the first card at the patient's eye level, with the centre of the card at your own eye level. From the patient's eye movement/position, estimate the position (top/bottom) of the target. Once you have made your decision present the second card; you may then check your decisions. If two correct estimates are made, proceed to the next level.

If an incorrect estimate is made, return to the next HIGHER CONTRAST target, and repeat the tests at this and the 'failed' level. At this stage in order to avoid any expectations on the part of the examiner or the patient, shuffle the cards between each presentation. The end-point can then be taken at the lowest contrast level at which two out of two presentations are scored correctly.

PROCEDURE – naming

For older children and adults, the test can be used as a naming test – at each level the patient is simply asked to name the picture. The test incorporates pictures suitable for both children and adults. Only one of each set needs to be shown.

WORKING DISTANCE

Contrast sensitivity is most usefully measured with a size of target well within a patient's acuity limit. If acuity is good, then the peak of the contrast sensitivity function lies at around 1.5 – 4 cycles per degree. When the Cardiff Contrast Test is carried out at a distance of 50 cm the targets represent 1.9 cycles per degree (or 6/90, 20/300) and at a distance of 1 m the targets represent 3.8 cycles per degree (or 6/45, 20/150). At a distance of 25 cm the targets represent 1.0 cycle per degree (or 6/180, 20/600)

When working with people with visual impairment, closer working distances are recommended so that the patient's ability to detect large (relative to acuity) targets is tested. The rule of thumb is to use a distance such that the first level is easily seen. A short working distance may also be appropriate to allow closer interaction with a young child. Remember to specify the working distance when recording your result. For a more thorough evaluation of contrast sensitivity, you may choose to conduct the test at several distances. However, few young children will remain co-operative for repeated testing.

The contrast and contrast sensitivity values for the cards are given in Table 1.

Card	Picture	Contrast (%)	Contrast Sensitivity
A	House	46	2.17
B	Clock	32	3.13
C	Boat	22	4.55
D	Telephone	16	6.25
E	Teacup	12	8.33
F	Car	8	12.5
G	Fish	6	16.67
H	Boat	4	25
I	Clock	3	33.33
J	House	2	50
K	Car	1.5	66.66
L	Train	1	100

Table 2 presents expected monocular values for contrast sensitivity in children with normally developing vision, measured with the Cardiff Contrast Test at 50cm. These figures are taken from a study with a population of children aged 1 to 3 years carried out in Cardiff.

Age group	N	Lower Limit	Upper Limit
1-2 yrs	14	25	66.66
2-3 yrs	14	33.33	100
3-4 yrs	21	16.70	100
4 and beyond	16	50	100

Table 3 presents expected binocular values for contrast sensitivity in children with normally developing vision, measured with the Cardiff Contrast Test at 50cm.

Age group	N	Lower Limit	Upper Limit
1-2 yrs	54	6.25	100
2-3 yrs	28	33.33	100
3-4 yrs	35	33.33	100
4 and beyond	21	50	100