Acuity in Mice (and other non-humanoid species)

Allan Hytowitz, October 8, 2013

The Dyop™ concept is a visual stimulus based upon photoreceptor physiology rather than cognition. Because the Dyop™ concept is based upon photoreceptor physiology rather than cognition, it has successfully been used to measure acuity in children as young as five months of age. It also should be possible to use Dyop™ images to measure acuity in non-humanoid primates or animals such as mice.

The calibrated stimulus of the incrementally-scaled Dyop™ images combines the angular arc width image diameter, segment/gap stroke width, circumferential rotation speed, color, contrast, and the strobic refresh rate of the pixel photoreceptors to create a **detection threshold** as an indicator of visual acuity and the refraction end point. Unlike static images that get increasingly blurry as they get smaller or further away, **Dyop™** image rotation seems to disappear at that **detection threshold.** As a result, **Dyop™** vision tests are more precise than static Snellen/Landolt tests, faster to use, and do not require literacy, let alone the ability to read English. **Dyops™** take the guesswork out of vision testing, and provide optimum accommodative rest rather than visual stress, because you either see the rotation at the **detection threshold** (your precise point of acuity/refraction) or you don't. Because **Dyops™** maximize accommodative rest during refraction, unlike staring at static images which increase accommodative stress, the fovea detection threshold is the refraction end point.

If it is possible to get a mouse to respond to a visual stimuli, it should be possible to get a conditioned response to based upon sensing the angular arc width (diameter) of a Dyop™ image at a fixed distance such as on a computer monitor 12 inches outside of the glass wall of the mouse cage. Conditioning with a stimulus such as food could be initiated when a rotating Dyop™ of a noticeable size is visible on that nearby display. **The mice would be taught to respond to a rotating Dyop™ image and ignore a static image.** By starting with a large image, a conditioned response can be created, followed by the same response at smaller and smaller Dyop™ image diameters. When the image is sufficiently small, there should be no response because the image diameter is below the perception threshold of the test subject.

It is likely that a test with 6 mice would be sufficient as a proof-of-concept. It is also likely that the acuity detection threshold for the mice is close to that of humans. For humans, a Dyop™ image with an angular arc width of 7.6 minutes has a 20/20 acuity response and a screen diameter of 13.5 mm at a 20 foot viewing distance. That 7.6 angular arc width is 6.75 mm at 10 feet or 1.35 mm at 2 feet, or 0.675 mm at 1 foot. Having scaled images from 6.75 mm in diameter in increments of two foot detection threshold distances should allow a determination of acuity in mice

The scaling and controls would be similar to that of the current Dyop™ refraction test in humans. http://www.dyop.org/documents/Dyop3_SL-22x_BW-G3.html except that only a single image would be displayed at a time.

Two Foot Viewing Distance

Detection Threshold (20/20) distance	Diameter (mm)	Angular arc width (min) at 20 feet	Angular arc width (min) at 2 feet	2 foot Dyop™ Acuity Ratio
20	**13.50**	**7.60**	**76.00**	**20/200**
10	6.75	3.80	38.00	20/100
8	5.40	3.04	30.40	20/80
6	4.05	2.28	22.80	20/60
4	2.70	1.52	15.20	20/40
2	1.35	0.76	7.60	20/20
1	0.68	0.38	3.80	20/10

Subsequent tests would likely involve measuring acuity in color with the objective of determining if specific lights or colors act as a visual deterrent to specific organisms, and for understanding the matrix of visual perception. http://www.dyop.org/color_refraction.htm. Additionally the application could serve to assist the development of gene therapy for treating color blindness such as being done with squirrel monkeys by Dr. Jay Neitz of Genevolve. http://www.genevolve.com/index.html

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(Note: Having seen the movie "Rise of the Planet of the Apes," I would prefer not to use the Dyop™ concept for testing acuity in humanoid species such as monkeys because of potential "unforeseen consequences.")