

ARVO '98 Poster

Investigative Ophthalmology & Visual Science, 1998; 39(4), Abstract nr 2900, p.S623

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Hysteresis in Ocular Torsion Under Varying Luminance

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2900

1

Stereo image pairs with opposite rotation induce cyclovergence that partially nulls the rotation disparity (Howard & Zacher, '91)



A neural process is also required since the rotation-disparity image *does not* appear inclined (Howard & Kaneko, '94)

2

If a zero-disparity (ZD) planar surface is superimposed, it will compete for nulling.

The nulling of disparities in one surface will increase residual disparities in the other. The residual disparities are perceived as inclination of that surface.

Question: How does varying the energy of the ZD affect the inclination percepts of a surface with 4 degrees of rotation disparity (R4)?

3

Methods

Each stereo-pair consisted of two superimposed surfaces (ZD & R4) of randomly distributed texture elements.

The luminance of R4 was constant, while the luminance of ZD was either (a) a cosine function of time (15 repeated cycles at 30 sec each) or (b) randomly varied at 1, 8, or 16 seconds duration (3 repetitions each).

The fused images subtended 44H X 36V degrees and were displayed at 33.5 cm using a mirror haploscope.

4

$$\text{Luminance} = \text{Cosine} \frac{\text{time}}{\text{time}}$$

Tilt & Luminance vs Time

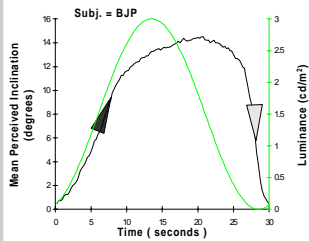
Tilt vs Luminance

Random Control

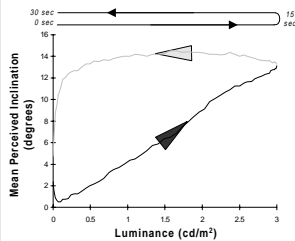
average of all presentation durations

Tilt vs Luminance

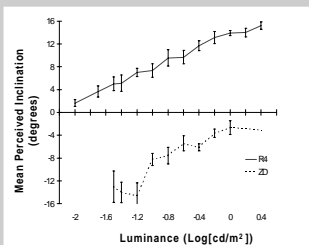
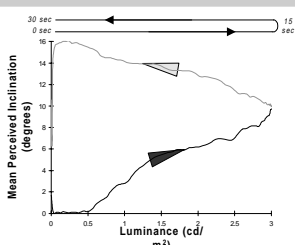
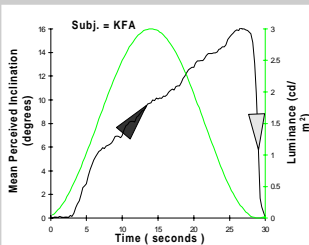
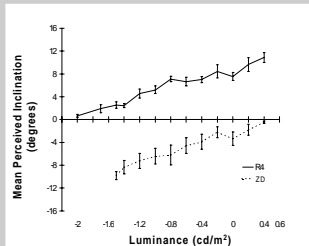
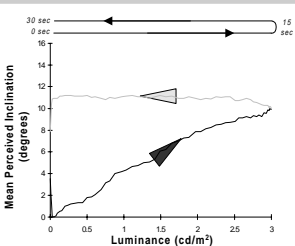
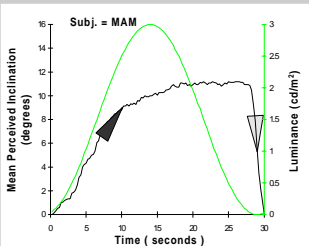
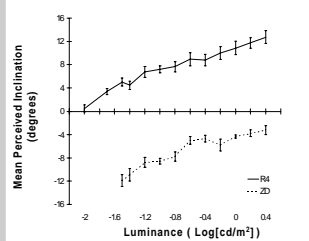
5



6



7



8

Inclination Percepts

ZDS nulled

ZDS residual



R4 residual

R4 nulled

9



10

Conclusions

Control trials show that inclination-nulling is a linear function of Log-Luminance of the ZD stimulus. For most observers the amount of nulling is constant over time for a fixed stimulus energy ratio.

However, there is substantial hysteresis in the data when the energy varies dynamically and the nulling depends on the direction of variation. This implies a temporal factor of one or both of the inclination-nulling processes (i.e., cyclovergence and neural). The ramping-up phase is a linear function of linear luminance.

The system seems to be efficient in adapting to the introduction of new information, but robust against the diminution of that information, as would occur during normal fluctuations in viewing.