The role of magnocellular and parvocellular visual pathways in altitudinal visual hemifield anisotropies

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Background

- Sensitivity is typically greater in the lower visual field (LVF) than in the upper visual field (UVF) (Carrasco et al., 2001; Levine & McAnany, 2005)
- Most reports have indicated that sensitivity differences between the UVF/LVF are restricted to the vertical meridian.
- The size of the visual field anisotropy increases as spatial frequency and target eccentricity increase.
- Mechanisms mediating the visual field sensitivity differences have not been elucidated.

Purpose

To examine the role of the magnocellular (MC) and parvocellular (PC) pathways in visual hemifield sensitivity differences using the steady- and pulsed-pedestal paradigms of Leonova, Pokorny, and Smith (2003)

General Methods

Adaptation Test Delay Response

Steady-pedestal paradigm

Pulsed-pedestal paradigm

Pulsed-pedestal paradigm

Threshold for 0.25 cd/° Gabor Patches

Data from three subjects shown separately but combined for statistical comparisons

- Threshold increased as the pedestal luminance increased (approaching Weber's law), consistent with both previous work and with sensitivity being mediated by the PC pathway.
- Compared to the LVF, threshold values were significantly lower in the LVF (F(1,48)=14.39, p<0.01)
- The shape of the function remained in the upper and lower visual fields were not the same.
- Threshold rose more quickly in the LVF than in the LVF (e.g. steeper V-shaped function in the LVF)
- Follow-up comparisons indicated that threshold in the LVF was only significantly lower for the two greatest decrement pulses and three greatest increment pulses.

Threshold for 2.50 cd/° Gabor Patches

- Threshold was inferred to be mediated by the PC pathway under both paradigms (see right)

Steady-pedestal paradigm

- Threshold increased as the pedestal luminance increased.
- In contrast to the data obtained with the low spatial frequency Gabor patches, threshold values were significantly lower in the LVF (F(1,20)=8.03, p<0.01)

Pulsed-pedestal paradigm

- Threshold increased as the pedestal luminance diverged from the surround luminance (the V-shaped functions were much shallower than those obtained with the low-spatial frequency Gabor patches)
- Threshold values were significantly lower in the LVF (F(1,20)=15.79, p<0.01) for each pedestal.
- Differences between the LVF and LVF were greater than those obtained with the 0.25 cd/° Gabor patches (see table to right).

- The table gives the log difference in threshold between the upper and lower visual fields for high spatial frequency Gabor patches (Differences listed in the table are averages across all pedestal luminances)

References

- Results are consistent with a greater density of PC cells in the LVF (and/or smaller PC receptive fields in the LVF)