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Effects of Attention on Multifocal Pupillographic Responses

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ABSTRACT

Purpose: This study explored the presence of attention-related changes to multifocal pupillary activity.

Methods:

Two experiments were carried out, the manipulated variable was the colour of the stimulus (white/yellow); at 288cd/m² (19 subjects) and 150cd/m² luminance (22 subjects).

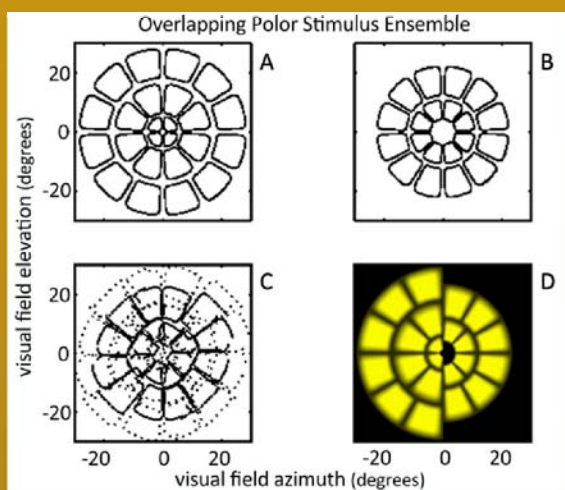


Figure 1. A representation of the 44-regions stimulus ensemble. A and B show the borders of the regions at half height. C shows the overlap of the regions so that the visual field is covered. D shows the two sets of superimposed stimuli in the left and right halves of the image, but no overlapping regions were concurrently shown on any video frame.

- Subjects fixated a cross at the centre of stimulus ensemble, and on attention trials responded by clicking a button whenever the cross changed into a dot, while their pupil diameters are monitored.
- 33 ms duration multifocal (mf) stimuli were presented at a mean rate of 44/s/eye.
- Each protocol was divided into eight 30 s segments.
- Multiple linear regression analysis determined the significance of attentional effects in response to white and yellow mf-pupillographic stimuli.

Results:

Attention reduced the amplitude of the transient pupil responses of white stimuli to yellow stimuli (Exp 1: -0.870dB, p=0.0000; white stimuli, 0.528dB, p=0.006; yellow stimuli) and reproducible at lower luminance (Exp 2: -1.78dB, p=0.0000; white stimuli, -1.460dB, p=0.001; yellow stimuli).



INTRODUCTION

- The size of the pupil can serve as an indicator of an eye's potential for vision [1-3].
- Pupillometry was developed as a method to evaluate visual field objectively by measuring the pupillary light reflex (PLR) to spot stimulus of fixed luminance presented at each test region [4-5].
- Its uses had also been expanded in e.g., estimating retinal ganglion cell loss, pupillary defect glaucoma, diagnosis of diabetic autonomic neuropathy, examining the breakdown of cognitive disorders in Parkinson's, schizophrenia, depression, and recently visual field assessment in glaucoma [6-8].
- Cognitive factors like attention have been found to contribute significant changes in pupillary activity [9]. We were interested to see if perhaps similar attention-related responses could also be derived from multifocal pupillography.

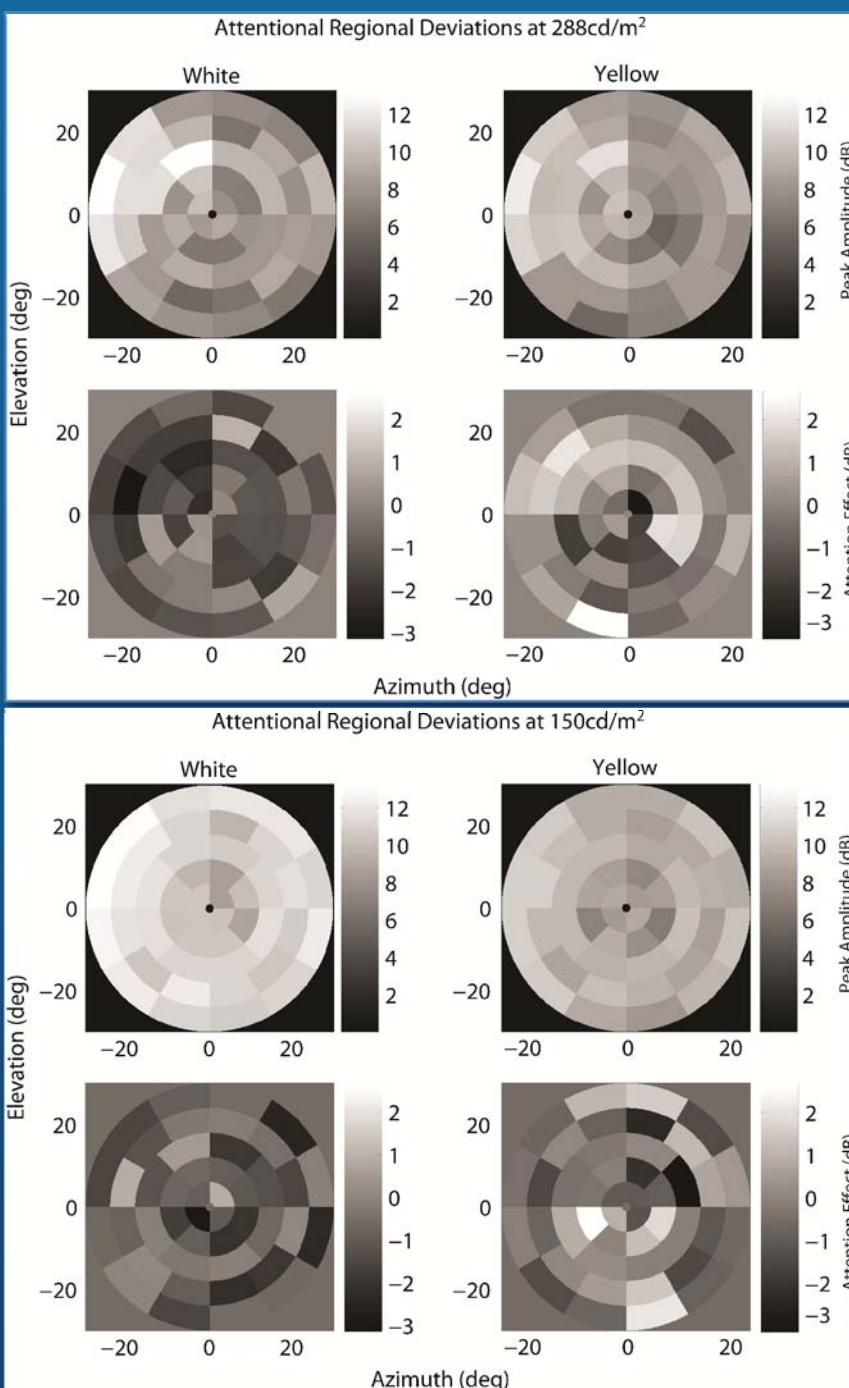


Figure 2, Experiment 1. Region-wise response* to white (Figs 2a and 2b) and yellow (Figs 2c and 2d) multifocal stimuli at 288 cd/m². The response deviations due to attention are shown in Figs 2b and 2d.

*Responses were dB transformed, and referenced to region 1.

Figure 3, Experiment 2. Region wise response* to whites (Figs 3a and 3b) and yellow (Figs 3c and 3d) multifocal stimuli at 150 cd/m². The attentional response deviations are shown in Figs 3b and 3d.

*Responses were dB transformed, and referenced to region 1.

Conclusions:

Pupillary responses were found to be significantly influenced by attention. The overall result seems to suggest that attentional responses were suppressive though the degree of suppressions may be enhanced in certain peripheral regions.

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