Visual evoked potentials and contrast perception

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INTRODUCTION

In 1970, Campbell & Maffel (1970) observed a linear relationship between steady-state visual-evoked potentials (VEP) and liminal spatial frequencies. The relationship was considered to be dependent on the supra-threshold contrast levels, with a negative slope for the low contrast and a positive slope for the high contrast. However, in 1986, Scheidler & Maffel reported a linear relationship between the VEP and the psychophysical detection thresholds. (Note that the two graphs show VEP and psychophysical results.)

METHODS

Steady-state visual-evoked potentials observed in response to sine-wave gratings of variable contrast and spatial frequencies. These were recorded using a digital system and analyzed by using a computer-controlled digital-sweep technique. The contrast was varied from 0 to 100% in steps of 10%, and the spatial frequency was varied from 0.1 to 10 cycles/degree (cpd). The VEP thresholds were obtained using a method of adjustment, and the psychophysical detection thresholds were obtained using a method of limits.

VEP AMPLITUDE

In a 2D-plot of amplitude vs. spatial frequency and contrast, the VEP response shows a clear peak at the spatial frequency corresponding to the grating detection thresholds. As the contrast increases, the amplitude response increases, and the peak becomes sharper. However, at low contrast, the amplitude response shows a clear dip at the spatial frequency corresponding to the grating detection thresholds. As the contrast increases, the dip becomes shallower, and the amplitude response increases.

VEP PHASE

The temporal phase increases with increasing spatial frequency and decreases with increasing contrast. However, the temporal phase is not as variable as the amplitude response. In the VEP response, the temporal phase remains relatively constant across a range of spatial frequencies, and the phase is independent of the contrast level. However, in the psychophysical detection thresholds, the phase is variable across a range of spatial frequencies, and the phase is dependent on the contrast level.

CONCLUSION

Steady-state visual-evoked potentials are sensitive to changes in spatial frequency and contrast, and they can be used to measure psychophysical detection thresholds. However, the VEP response is not as sensitive as the psychophysical detection thresholds, and the amplitude response is more variable than the phase response. Therefore, the VEP response is not a reliable measure of psychophysical detection thresholds.