Peripheral depth cues for accommodation stimulation

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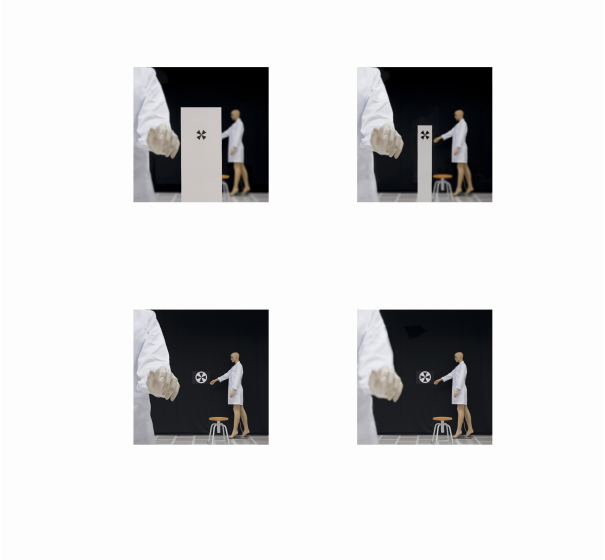
Purpose: To analyze the effect of realistic images that have peripheral depth cues on the accommodative response.

Methods: Monocular accommodative responses (AR) at 2 D and 5 D of Accommodation Stimulation (AS) were measured with PowerRef II (Plusoptix, Inc.) when subjects looked randomly at 4 different scenes: one real scene comprising well known objects at different depth planes (real); and three virtual scenes comprised by different 2-dimensional pictures seen through a Badal lens. First image consisted on a fixation target and a white even surrounding (white); the second image consisted on a photography of the real scene taken in conditions that closely mimic a healthy standard human eye performance (peripheral blur); and finally the third image was the same previous photography but rendered with a depth of focus to infinite (peripheral sharpness). In all cases the field of view of the scene displayed was roughly 25° and the fixation target was a Maltese cross subtending 2°.

Results:30 right eyes from healthy young subjects were measured in this study. The achieved statistical power was of 0.99. At 2 D of AS the repeated measures ANOVA did not show statistically significant differences in the AR among the 4 scenes ($p>0.07$) and the mean AR differences were below 0.25 D in all cases. At 5 D of AS, the repeated measures ANOVA was statistically significant ($p<0.05$) and the corresponding Bonferroni post-hoc tests showed the following mean AR differences ± SD (p-value) between the real scene and the virtual ones: real-white=+0.66 D ± 0.03 D ($p<0.01$); real-peripheral sharpness=+0.43 ± 0.03 D ($p=0.07$); real-peripheral blur=+0.25 ± 0.04 D ($p=0.89$).

Conclusions: It is clinically shown that accommodation is inaccurately stimulated in Badal optometers that display a stimulus poor in depth cues. Contrary, AS can be clinically accurate in the same Badal optometer when displaying a realistic image rich in peripheral depth cues, even though these peripheral cues (also referred to retinal blur cues) are shown in the same plane as the fixation target. These results have important implications in stereoscopic virtual reality systems that fail to represent retinal blur appropriately.

Layman Abstract (optional): Provide a 50-200 word description of your work that non-scientists can understand. Describe the big picture and the implications of your findings, not the study itself and the associated details.:



Photographs of the real scene projected in the Badal optometer at different distances: top left at 5 D, top right at 2 D and bottom right at 0 D of AS. The bottom left image is rendered to depth of focus to infinite (peripheral sharpness) and projected at 5, 2 and 0 D of AS.