A new experimental setup to study central and peripheral visions with gaze-contingent protocol and artificial scotomas.

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Abstract

Understanding roles played by the processing of central and peripheral stimuli would mean a better understanding of the ocular behaviour and strategies of patients with peripheral or central visual field defects. This could lead to detection tests, visual field restoration therapies, or adapted viewing devices and applications designed to help visually-impaired individuals.

Considering this, we devised an experimental setup to simulate scotomas during visual tasks. This protocol relies on online eyetracking data to modify on-screen stimuli; applying a mask covering part of the screen. For instance, this mask can be a disk displayed at the center of the participant's vision, effectively preventing any sampling of the scene with the fovea. The eyetracking device continuously sends gaze positions to the rendering computer which modifies the display accordingly.

One issue here has to do with the delay between eye movements and relocation of the mask, for scene perception has been reported at very low latencies [1, 2, 3]. A maximum latency of 13 milliseconds was achieved by relying on the GPU acceleration to update the scene with the latest gaze position.

In our application, the rationale stemmed from the fact that experimenting on patients presents many drawbacks (e.g. variability of visual defects, cognitive idiosyncracies of elderly subjects and evolution of coping strategies); but this protocol allows the study of visual defects with normal participants through simulation. The nature of the masks is binary (hiding part of a surface, showing the remainder) as in the previous example. Though, we know that visual field defects can be experienced in many ways [4, 5], this is why this protocol allows adjusting the size, deepness, form and localization of the defect.

This setup could find applications in visual field training [6, 7, 8]. It might become useful in training patients toward developping proper pseudofoveas in the case of AMD [9].

Recent Publications

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4. Crabb, D. P., Smith, N. D., Glen, F. C., Burton, R., & Garway-Heath, D. F. (2013). How does glaucoma look?: patient perception of visual field loss. Ophthalmology, 120(6), 1120-1126.
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7. Xi, J., Yan, F., Zhou, J., Lu, Z. L., & Huang, C. B. (2014). Perceptual Learning Improves Neural Processing in Myopic Vision. Investigative Ophthalmology & Visual Science, 55(13), 784-784.
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Biography

Erwan David is a PhD student in the LS2N laboratory (University of Nantes, France). After completing Master degrees in social and cognitive psychology (2014), then in cognitive sciences (2016) he is now studying visual attention in a multidisciplinary position, harnessing knowledge from computer science, psychology and vision science to create new visual attention models. With his team, they are studying central and peripheral visions' idiosyncracies thanks to patients with visual defects (glaucoma, AMD) and normal participants.

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Notes/Comments: