Impact of Visual Fatigue on Pedestrian Distance Estimation

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Abstract
This study investigated the impact of visual fatigue, simulated via optical blur, on drivers' ability to estimate the distance to pedestrians. Thirty younger and thirty older adults participated. Binocular spherical blur was introduced by adding +0.50 diopter (D), +1.00 D, and +2.00 D lenses to each participant's optimal refractive correction (±0.00 D), ensuring equivalent levels of defocus across individuals. Participants estimated the distance to a pedestrian—wearing either black Biomotion clothing or high-visibility safety clothing—under photopic (300 lx) and mesopic (0.3 lx) lighting conditions, with a presentation time of 0.75 seconds. A four-way factorial analysis revealed significant effects of lens condition and luminance, with younger adults showing a tendency to overestimate distance as blur increased. In contrast, older adults were more affected by reduced luminance, but not by blurs. Clothing type did not significantly affect distance estimation. These results suggest that blurred vision particularly impairs distance perception in younger adults and that mesopic lighting leads to overestimation of pedestrian distance across age groups.