

How gaze direction and dynamics affect visual resolution

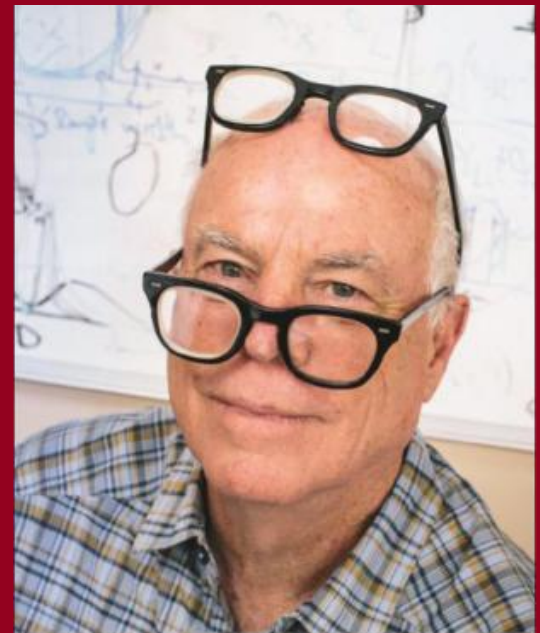
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ABSTRACT: Humans exhibit machine-like eye movements in space and time while performing demanding acuity tasks. To these, we used an adaptive-optics imaging and display system to present ultra-sharp Vernier acuity stimuli briefly every two seconds while simultaneously measuring eye movements, including precisely where on the retina each stimulus fell. We found that drifts and microsaccades combined to confine the landing location of the anticipated stimulus to a tiny retinal region centered on the preferred retinal locus (PRL). The variance of landing location was smallest at the time of stimulus presentation and a few hundred milliseconds after. We correlated where the stimulus fell in space and time with correct or incorrect responses. The PRL and a small area around it, including the anatomical fovea, conferred the best acuity. Acuity declined consistently in the rare events in which the stimulus fell more than 7–10minarc from the PRL. We also found that acuity was best when the last microsaccade occurred sufficiently prior to stimulus presentation.

Our findings reveal a highly evolved oculomotor system where gaze direction during fixation is rarely far enough from the PRL to compromise visual resolution when a person makes natural fixational eye movements.



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BIOGRAPHY OF THE SPEAKER: Martin Banks is a distinguished Professor Emeritus at the UC Berkeley School of Optometry, renowned for his pioneering research in human visual development, visual space perception, and multi-sensory integration, particularly how we perceive depth and motion, with significant applied work in virtual reality (VR) and advanced displays, earning him election to the American National Academy of Sciences. He received a B.A. in Psychology from Occidental College in 1970, M.S. in Experimental Psychology from UC San Diego in 1973, and PhD in Developmental Psychology from the University of Minnesota in 1976. Martin Banks received a number of notable awards, among them the McCandless Award, American Psychological Association; Koffka Medal, Giessen University; Holgate Fellow, Durham University; Fellow, American

Association for the Advancement of Science; Fellow, American Psychological Society; Prentice Award, American Academy of Optometry; Honorary Professor, University of Wales; Borish Scholar, Indiana Univ; Schade Prize, Society for Information Display, and Tullyer Award from the Optical Society of America.