Sensing Eye Gaze with Eccentric Viewing

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Overview

Looking direction is an important signal for social communication. However, there have only been a few psychophysical studies on the sensing of eye direction and head direction as indicators of looking direction (Anstis et al., 1969, Cline 1967, Gibson & Pick 1963, and Pusch & Loomis 2001). We report an investigation of human ability to detect eye gaze with foveal and peripheral viewing.

Methods

Four different lookers were digitally photographed with multiple eye gaze directions, ranging from -30° to +30° in increments of 5°, where 0° eye gaze was straight at the camera (see Figure 1 below). To ensure accurate gaze stimuli, the lookers were instructed to fixate a horizontal bar, marked in the correct angular locations.

Eight subjects sat directly in front of a monitor on which were displayed the digital pictures. Positioned 42 cm in front of the monitor was a 2-meter-wide horizontal bar numbered from 0 to 100. When the digital photo was displayed, the subject was instructed to indicate which number on the bar the photographed eye gaze was directed toward. Subjects made these judgments of gaze direction from two distances (0.84 and 3.0 m), with varying levels of eccentricity: the retinal eccentricity of the looker’s eye (the one closer to the subject’s fixation point) was varied from 0° to 16°. Regardless of the viewing distance or retinal eccentricity, the subjects’ task was always the same: to judge the gaze direction of the looker in the photograph.

Results

The eye stimulus subtended 1.7° when the subject was seated at the near distance and 0.5° when the subject was at the far distance. All stimuli were viewed monocularly.

Dynamics of Eye Gaze

While the current findings show that eye gaze is only detectable out to approximately 8° of retinal eccentricity, Pusch & Loomis (2001) found that head orientation of a looker was accurately sensed in the far periphery, even out to 90°. This means that people are able to sense looking direction as specified by the head at eccentricities well beyond the limit of eye gaze sensing. Interestingly, people seem to implicitly know these psychophysical facts. Much of the dynamics of eye gaze would seem to fall out of these psychophysical facts and people’s implicit knowledge of them. For example, when people intend to communicate surreptitiously with others through gaze, they are careful only to move the eyes and not the head.

References


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