

Invariance of the psychometric function's slope across the visual field for contrast-dependent character recognition

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The psychometric function for the recognition of singly-presented digits as a function of stimulus contrast was measured at 2-deg steps across the horizontal meridian, under monocular and binocular viewing conditions. The ML-PEST staircase procedure (Harvey 1997, Spatial Vision) was used in a 10-alternative, forced-choice recognition paradigm to gather the data. At each retinal position, a full range of stimulus sizes were examined; contrast data for a given size/position condition were normalized to contrast threshold and the observer's response data pooled across sizes to achieve independence of stimulus size. Slope estimation was by Harvey's PsychoFit, a maximum-likelihood 2-parameter estimation method of psychometric function fitting. The contrast normalization excludes threshold fluctuations from the slope estimate which results in estimates about 50% higher than conventional ones. To compare slope values across studies, the b' (beta prime) measure of maximum slope, specified as proportion-correct/log10-unit, is proposed and conversion rules to an assortment of other slope measures are provided (Strasburger 2001, Percept. Psychophys.). Both the Weibull and logistic functions provided excellent fits to the observed data. The slopes of these functions at their point of inflection ranged from $b' = 4.0$ to 5.0 proportion-correct/log10-unit contrast, for both monocular and binocular viewing and for all loci in the visual field. A single psychometric function shape, centered around a threshold value, therefore describes recognition performance at all retinal loci and binocularity. The function's slope is rather steep and at least twice that reported for a number of detection tasks. Methodological reasons for these pronouncedly high slopes are discussed, including work by Leek et al., Kaernbach, Klein, Wichmann & Hill, and Link.