Appendix A: Computational simulation of optical lateral masking

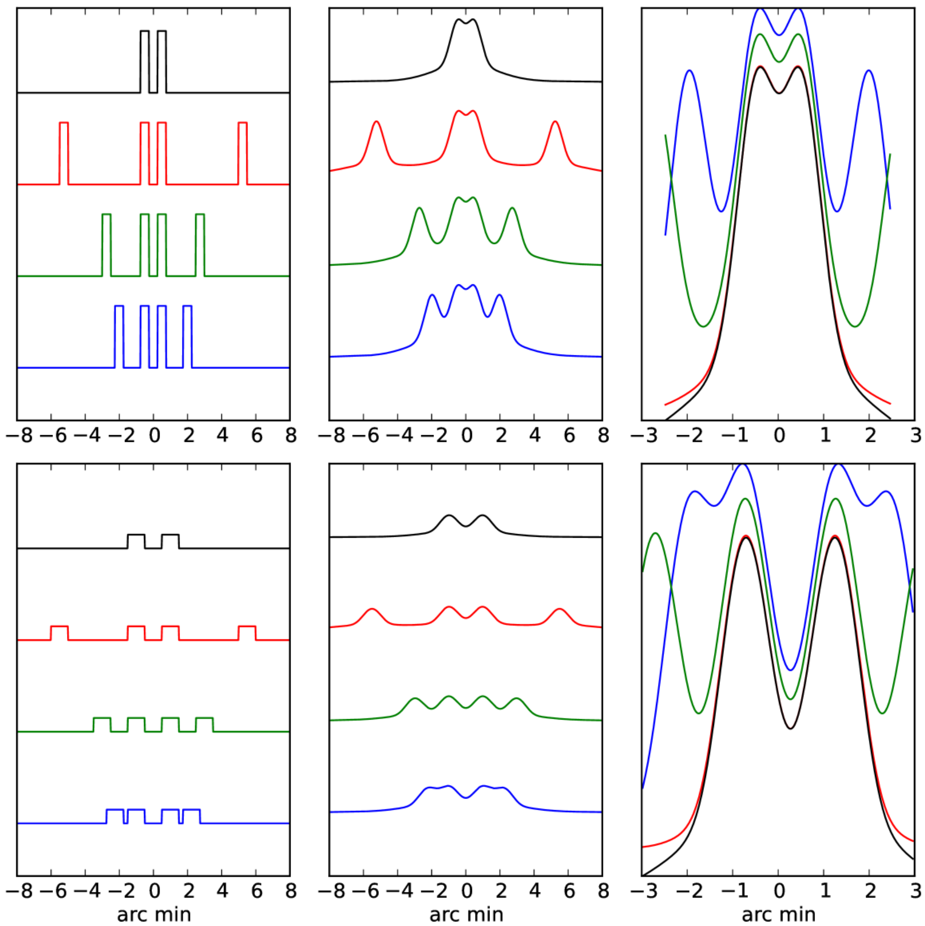

Fig. A1. Luminance profiles of flanked acuity stimuli. Stacked lines in leftmost column represent cross-sections of acuity targets with the following flanking conditions (from top to bottom): unflanked, distant flankers, nearer flankers, nearly abutting flankers. Upper panel indicates small high-contrast stimuli, while lower panel shows larger, lower-contrast stimuli. Middle column shows stimuli after filtering with the eye's optical point-spread function. Rightmost column shows magnified view of center of stimulus array, overlaid to demonstrate that nearby (within 2-3') flankers will increase the luminance of the target, thereby impacting the contrast ratio of peak-to-valley and elevating detection thresholds. Abscissa is expressed in minutes of arc.

Fig. A1 presents a schematic depiction of the optical influence of flankers on a very simple acuity target such as the gap between two lines. The left column shows a cross-sectional luminance profile of the stimulus. Four stimuli are shown, from top to bottom: unflanked, with distant flankers (5' target center-flanker center), nearer flankers (2' target center-flanker center), and nearly abutting flankers (1' target center-flanker center). This analysis is based on flankers of equal stroke-width and contrast placed tangentially on either side of the target. Two different conditions are shown in the two rows: high-contrast (0.5' bar-width,small symbols) and low-contrast (1' bar-width, larger symbols). The middle column shows the luminance profile after filtering with the optical point spread function of the eye using a sum of two Gaussians fit to the data of Campbell and Gubisch (1966), for a 3 mm pupil. The rightmost column is a magnified view of the center of the stimulus array, where the target is located. The luminance increase caused by the nearby flankers will make the contrast ratios between the peaks and valleys smaller. Thus acuity worsens and the task becomes more difficult, as the Rayleigh criterion is impacted. Such a purely optical influence on contour interaction was ruled out by Flom et al. (1963) who identified it as a cortical phenomenon, based both on their observations with amblyopic eyes (Flom, Weymouth and Kahneman, 1963) and by presenting the flanks to one eye, and the target to the other (Flom, Heath, Takahashi, 1963; also shown by Tripathy & Levi, 1994).

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