High spatial frequencies dominate perception

V. S. RAMACHANDRAN

Psychological Laboratory, Cambridge CB2 1TQ, England

An effect is described which suggests that very high spatial frequencies may "mask" low spatial frequencies. The effect cannot be interpreted in terms of "critical band masking" and is probably due to the higher spatial frequencies dominating our attention.

Blurring can sometimes improve perception. The pattern printed below (Figure 1) is made up of 12 blocks of regular arrays of dots arranged as shown in Figure 2. The gaps between the blocks are arranged to be slightly greater in distance than the distances between the dots themselves. This results in the appearance of "ghost lines" between the blocks. The lines are invisible when seen by the fovea but are seen distinctly in peripheral vision or if the whole pattern is blurred.

The reader may like to try the following experiments: (1) If the pattern is moved rapidly along the horizontal axis (so as to blur the vertical edges of the dots), the horizontal ghost lines appear but not the vertical ones. If the pattern is moved vertically, the vertical lines are seen, and the horizontal ones disappear. (2) If the whole pattern is blurred, the lines can be seen very distinctly. (3) Using cylindrical lenses, if the blurring is carried out along the horizontal axis alone (that is, if the vertically

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Figure 1.

1	2	3	4
5	6	7	8
9	10	11	12

Figure 2.

oriented dot edges are blurred), then the horizontal ghost lines are seen. If the horizontal contours of the dots are blurred, then the vertical lines appear.

These experiments suggest that the very high spatial frequencies defining the sharp dot edges somehow "mask" the perception of the very low-frequency ghost lines, perhaps by drawing our attention away from them. This fact appears a little surprising at first in the light of Harmon and Julesz's recent experiments (1973) which

clearly demonstrate that masking spatial frequencies have to be *adjacent* to the masked frequencies in order to be effective.

Equally interesting is the fact that in this pattern the high spatial frequencies seem to mask the *orthogonal* low-frequency components rather than spatial frequency components which are of the same orientation.

The effect is best interpreted as an example of how high spatial frequencies generally seem to dominate our perceptions. In this particular pattern, the high frequencies of one axis draw our attention away from the orthogonal low-frequency components. Removal of these dominant frequencies "unmasks" our perception of the low-frequency ghost lines.

REFERENCE

- HARMON, L. D., & JULESZ, B. "Masking in visual recognition: Effects of two-dimensional filtered noise. *Science*, 1973, **180**, 1194-1196.

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