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Contextual modulation in motion direction processing

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Statement of the Problem: Contextual modulation is a common phenomenon observed at different levels of the visual system. It mainly represents the modulation of neuronal response from stimuli outside the receptive field and is often described as center-surround interactions. Diverse motion phenomena are related to center-surround interactions in visual information processing. Typically, changes in sensitivity are observed at short stimulus presentation times, while at longer presentation times more often the perceived motion direction and speed are biased. In the present study a large set of stimulus parameters were chosen with the aim to obtain indirect information on the potential contributions of center-surround interactions, tuned and/or untuned normalization and neuronal correlation in motion processing on the perceived motion at longer duration.

Methodology & Theoretical Orientation: In six experiments we studied the effects of the size of the central region, the total contrast, the motion speed, the motion direction of the surround and the relative orientation of the elongated elements in the stimulus with respect on the motion trajectory on the perceived motion direction of the center in a center-surround configuration. The observers had to determine whether the direction of the central patch moved to the left or to the right of the vertically downward direction.

Findings: The surround motion significantly affected both the precision and the sensitivity to the motion direction in the central region. In most cases, the sensitivity is lower when the surround moved in a direction orthogonal to the reference axis or at ±45° of it. The highest sensitivity to motion direction in the central region was observed when the surround moved upwards along the reference axis (at about 180° away from the motion direction of the center). The size of the central region has little effect on the performance, while the effect of the contrast varies depending on the other stimulus characteristics. The deviation of the motion trajectory from elements' orientation had various effects depending on the contrast of the configuration and the size of the central region.

Conclusion & Significance: The observed effects could hardly be explained by the changes in sensitivity of single neurons due to the presence of surrounding motion. They suggest cooperative activity at the population level in orientation and motion encoding and at different levels of dynamic information processing. The potential functional significance of the observed effects will be discussed

Biography

Nadejda Bocheva is Associate Professor at Institute of Neurobiology, Bulgarian Academy of Sciences. Her research interests are in human visual information processing, spatial vision, motion perception, visual recovery of 3D shape and ageing. She has more than 40 publications in scientific journals. She is a Fulbright fellow and has a Fogarthy international collaborative Award in 2002. She is member of American Psychological Association and of the Sofia section of the Bulgarian Physiological Society.

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