



# Letter to the Editor

## Mechanism of the Illusory Transformation of Optic Flow Fields

CHARLES J. DUFFY,\* ROBERT H. WURTZ†‡

Received 22 March 1994; in revised form 26 July 1994

As part of our continuing studies of the neuronal correlates of optic flow, we noted their illusory transformation by overlapping patterns of planar motion (Duffy & Wurtz, 1993). We observed that planar motion, overlapping an outward radial pattern, caused the focus of expansion (FOE) in the radial pattern to appear to be shifted in the direction of the planar motion. In their current commentary, Meese, Smith and Harris (1995) confirm our observation of an illusory shift of the FOE in the direction of overlapping planar motion. Further, they suggest that induced motion can account for this phenomenon by way of vector summation with the radial pattern.

In our original report (Duffy & Wurtz, 1993), we considered the similarities between the illusory shift of the FOE and induced motion phenomena, recognizing that they may be related. The importance of these similarities is reinforced by the findings of Meese *et al.* (1995), and we appreciate the significance of a potential relationship between the illusory shift and induced motion. However, the differences between these phenomena suggest that we should not conclude that they necessarily share the same mechanisms. Induced motion consists of the apparent motion of a visual feature in the direction opposite that of overlapping visual motion (Dunker, 1929). In contrast, the illusory transformation consists of an apparent shift of the position of the FOE, not continuous apparent motion of the FOE. In addition, the illusory transformation shifts the apparent FOE in the same direction as the overlapping motion, not the opposite direction.

We also have two general comments regarding the findings reported by Meese *et al.* (1995). First, the illusory shift they observed is more than an order of magnitude smaller than that found in our studies (Duffy & Wurtz, 1993). They suggest that the relatively small magnitude of their effects might be attributable to quantitative differences in stimulus parameters: stimulus

size, visual motion speed, and stimulus duration. We consider this to be a reasonable speculation, but we must be mindful of the differences in our methods and findings when considering their conclusions. Meese *et al.* (1995) also support the hypothesis that the illusory shift is accounted for by induced motion with evidence that the magnitude of induced motion is the same as that of the illusory shift. However, inspection of their Fig. 3 shows that their observations on induced motion predict illusory shifts which are 20–33% larger than the illusory shifts which they observed. Thus, while accepting the strength of this argument, we would hesitate to conclude that there is a direct correspondence between these phenomena.

Second, we disagree with the suggestion that induced motion “can account for” the illusory shift of the FOE, with its implication that a link to induced motion provides some explanatory power. Instead we suggest that both the illusory shift and induced motion are in need of explanations, based on knowledge of the underlying neural mechanisms. Our speculation that the illusory shift might be related to a reafferent signal regarding pursuit eye movements is also not an explanation, since no neuronal mechanism for such an effect has yet been identified. However, that proposal does attempt to relate the illusory shift induced by artificial stimuli to the perceptual complexities of optic flow field analysis. We might also speculate that induced motion could be related to pursuit eye movements, a possibility considered by Dunker (1929) in his original description of the phenomenon, and which we think could reflect a reafferent mechanism. We might cite parsimony, and group the illusory shift with induced motion, but we will refrain from such an inference until a more complete understanding of these illusions is available.

### REFERENCES

- Duffy, C. J. & Wurtz, R. H. (1993). An illusory transformation of optic flow fields. *Vision Research*, 33, 1481–1490.
- Dunker, D. (1929). Induced motion. In Ellis, W. D. (Ed.), *A source-book of Gestalt psychology (1938)* (pp. 161–172). London: Routledge and Kegan Paul, Ltd.
- Meese, T. S., Smith, V. & Harris, M. G. (1995). Induced motion may account for the illusory transformation of optic flow fields found by Duffy and Wurtz. *Vision Research*, 35, 981–984.

\*Departments of Neurology, Neurobiology and Anatomy, and Ophthalmology, and the Center for Visual Science, University of Rochester Medical Center, Rochester, NY 14642, U.S.A.

†Laboratory of Sensorimotor Research, National Institutes of Health, National Eye Institute, Bethesda, MD 20892, U.S.A.

‡To whom all correspondence should be addressed.