

Retinal Representations

In the report (1) by D. Lee and J. G. Malpeli and in the accompanying Perspective (2) by M. P. Stryker a thermodynamic model or simulation is offered that purports to explain why the separate small celled layers of the lateral geniculate nucleus of Old World monkeys, within which the visual field has an orderly representation, fuse in the region of the representation of the optic disc or blind spot. The model seems of interest except that in other species the blind spot is not represented near laminar fusions. An earlier account (3) of the human lateral geniculate nucleus had clearly shown this in single sections and in several serial reconstructions. In the mink, too, the blind spot is represented a large distance from the fusion of the "leaflets" that corre-

spond to the small celled layers of Old World monkeys (Fig. 1) (3). Lee and Malpeli discuss the possibility that the coincidence of the laminar fusions with the representation of the blind spot could be a "developmental epiphenomenon," either as a feature having no functional significance or perhaps as one evolved to be exploited by the brain. They state that at present there is "no apparent functional link" to account for the coincidence. Their report provides only one possible model of a well-established observation in a single species and is unlikely to have more general applicability.

R. W. Guillery

*Department of Human Anatomy,
Oxford University,
South Parks Road,
Oxford OX1 3QX,
United Kingdom*

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Response: In the rhesus monkey, a plane of transition in the number of layers making up the lateral geniculate nucleus (LGN) coincides with small gaps in layers representing the blind spot (1). In our report (2), we offered the hypothesis that the gaps are the causal factor in determining this relationship. We presented a computer model of geniculate morphogenesis that produced the laminar transition without a blind spot, and then we showed that the addition of a blind spot would draw the transition to the resulting gaps without any additional developmental rules.

Guillery suggests that, because the blind spot and laminar transition do not coincide in the human and mink LGNs, the model has no implications for morphogenesis beyond the rhesus monkey. We disagree. The simulations confirmed the intuitively evident: the further the gaps from the "natural" position of the transition, the less likely they are to trap it. The reason that gaps and transition do not coincide in the human or mink could be that the "natural" position of the transition is too far from the gaps in these species. One can easily adjust the parameters of the model to replicate the situation in the human, so Guillery's observations could just as well be taken to support the model as to refute it. This is not to say that comparative studies are irrelevant to this issue. Quantitative data on the distributions of laminar transitions and gaps in other primates may place more realistic limits on the parameters of our model, or even refute it. However, such data are not presently available.

The relationship we attempted to explain is a purely morphological one, and not every morphological feature need have a function. We are unaware of any evidence that either the co-localization of blind spot and transition in the rhesus monkey, or the transition itself in any species, has functional significance. The question of functional significance has no direct bearing on the generalizability of the hypothesis or the model used to evaluate it.

Daeyeol Lee

Joseph G. Malpeli

*Department of Psychology,
University of Illinois,
Champaign, IL 61821, USA*

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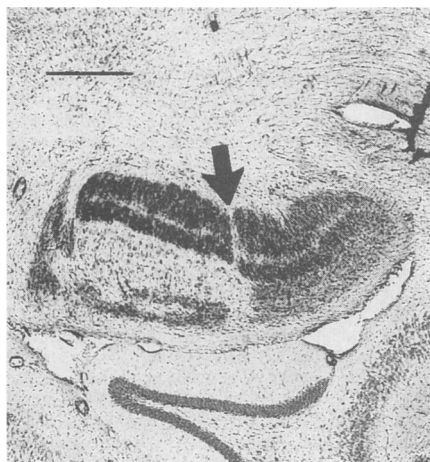


Fig. 1. Frontal section prepared as an autoradiograph shows the terminal distribution of the crossed retinogeniculate component in a mink. The representation of the blind spot (arrow) passes through both leaflets of layer A of the lateral geniculate nucleus. Scale bar, 500 μ m.