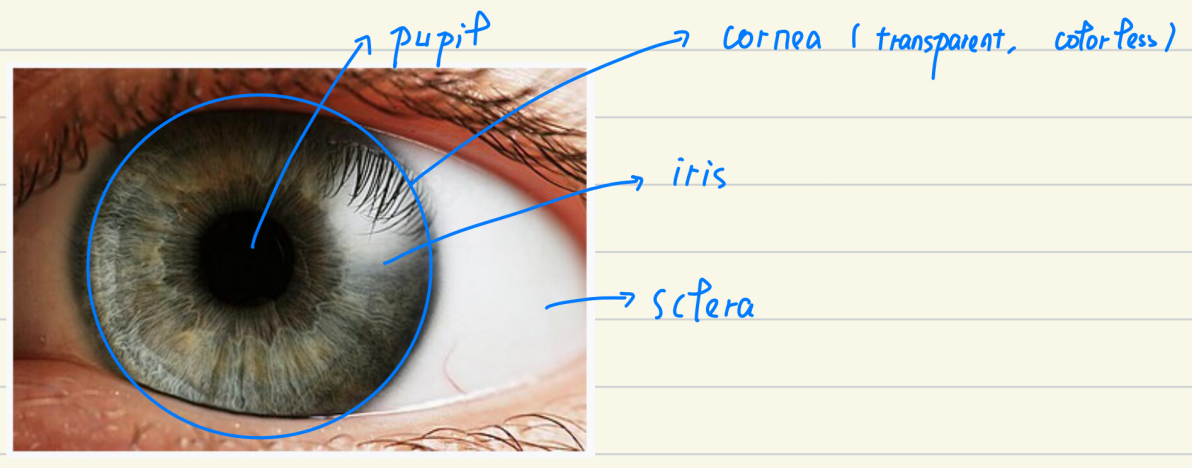
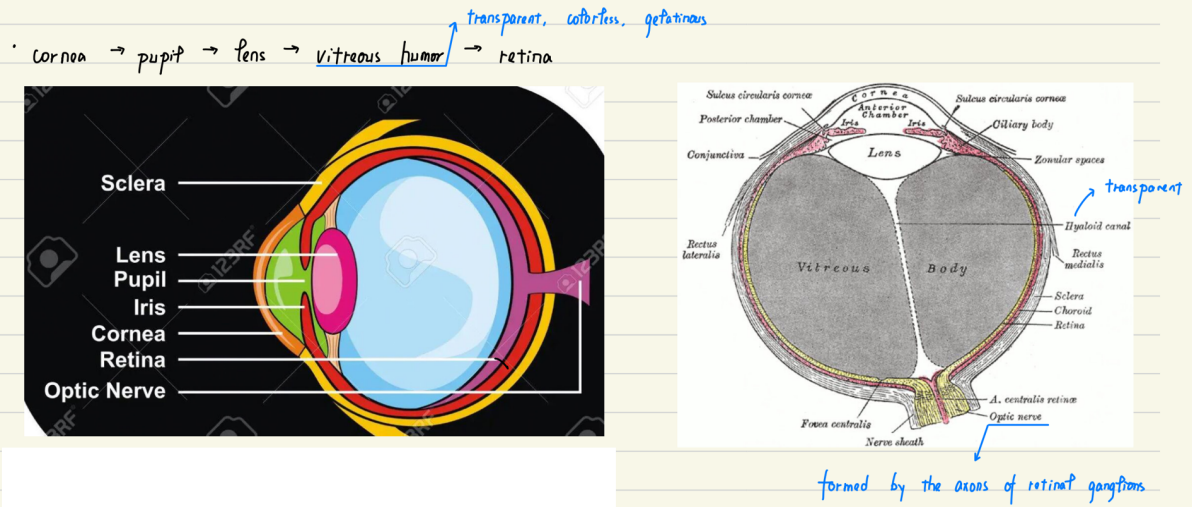
From A Biological Point of View

outside world -> cornea



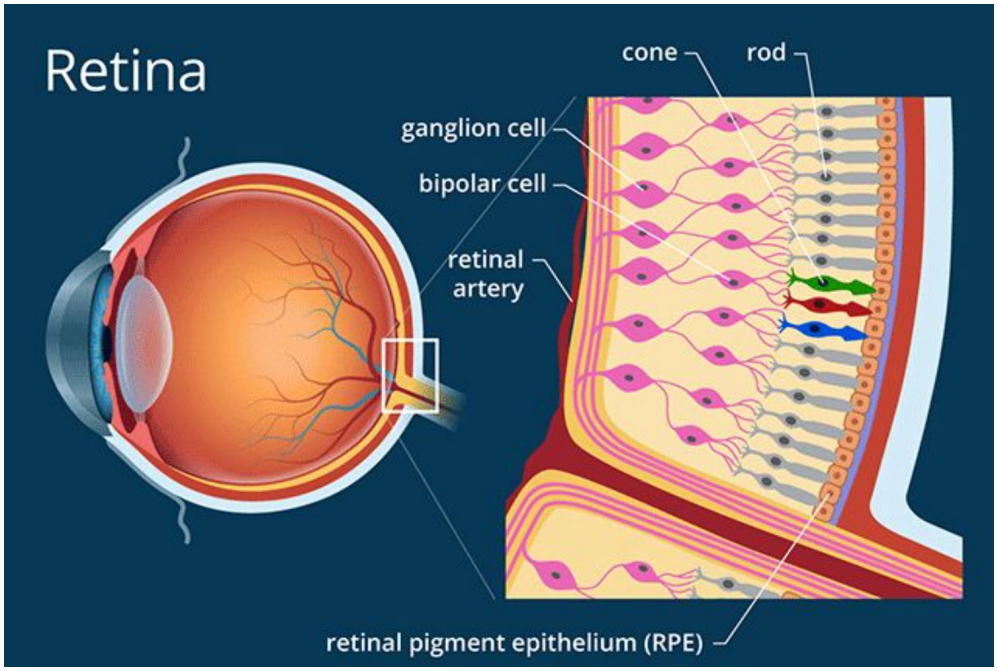
(figure from the Internet)

cornea -> retina

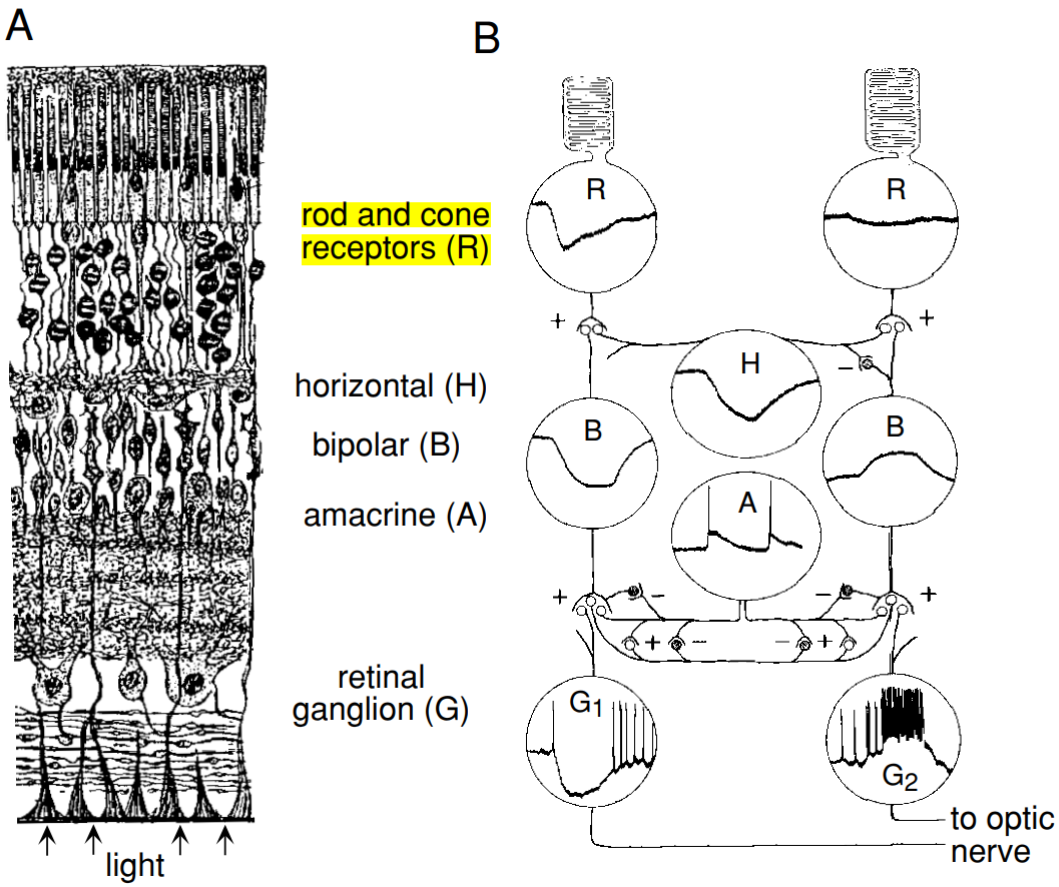


(figure from the Internet)

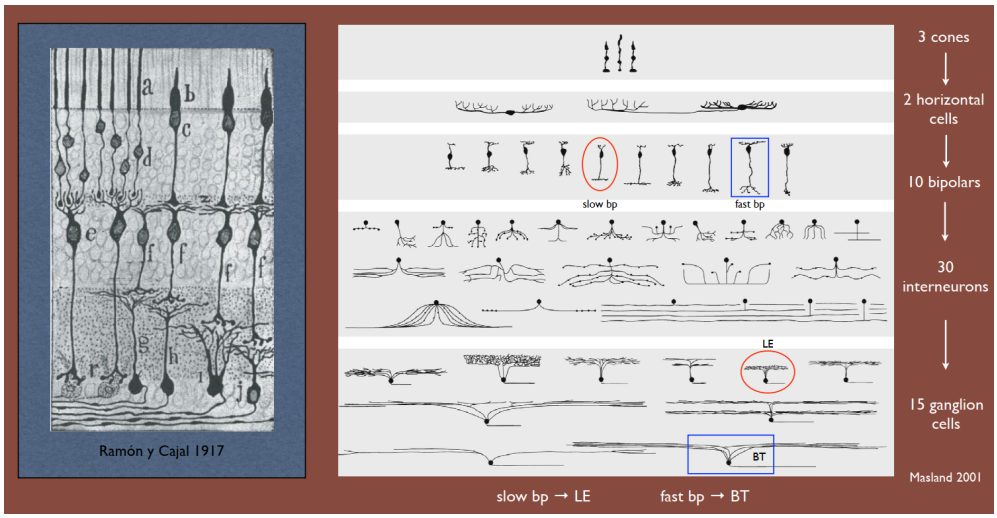
retina



(figure from the Internet)

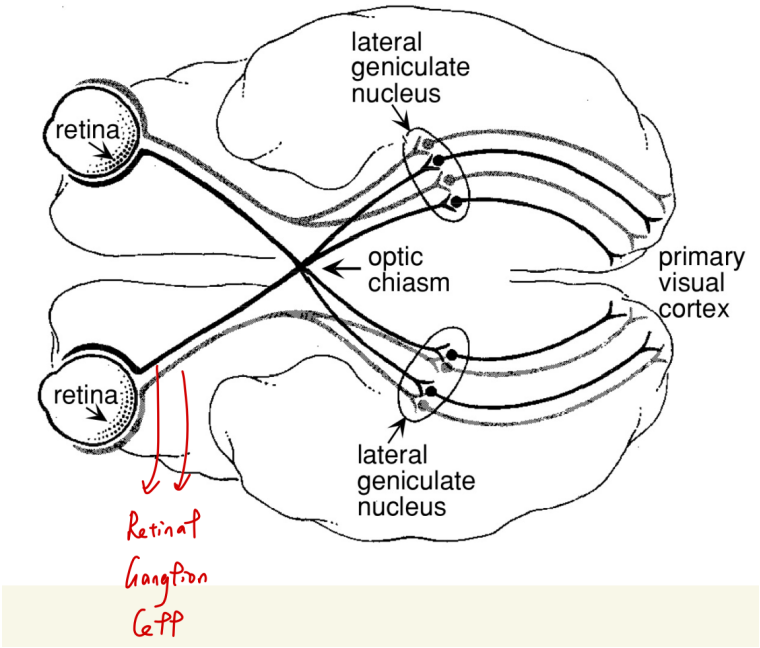


(figure 2.4 of Peter's Book, left panel originally from Ramon Cajal)



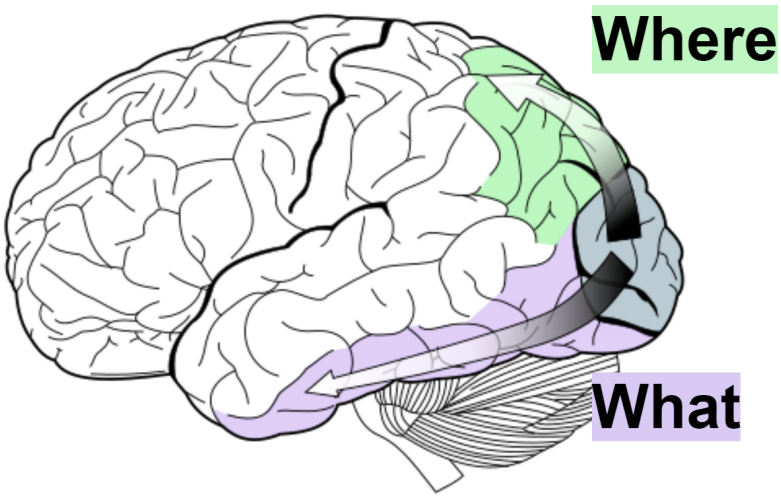
(figure from slides of Quan Wen)

retina -> V1

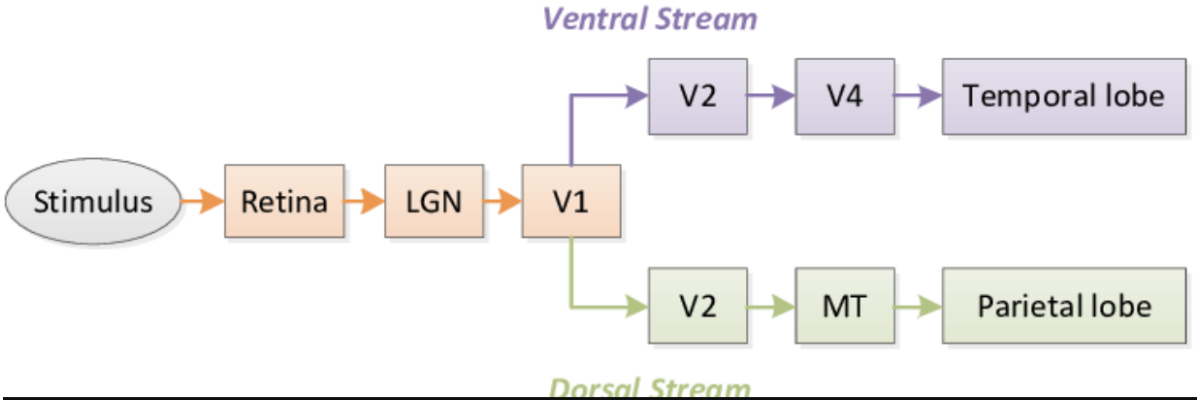


(figure 2.5 of Peter's Book)

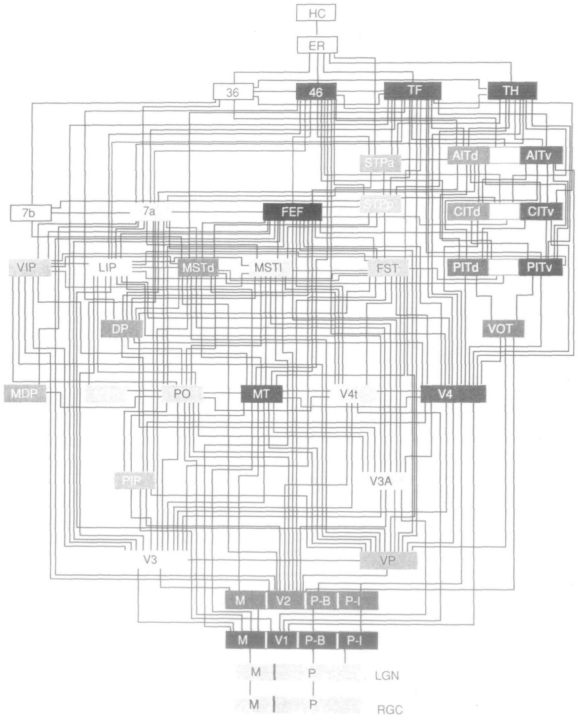
V1 -> ...



(figure from the Internet)



(figure from the Internet)



(figure from Felleman et al., 1991)

From A Physics Point of View

(If not clare, figures of this section are all from P. Z. Marmarelis et al., *Analysis of Physiological Systems*, 1978)

See it as a system/black box

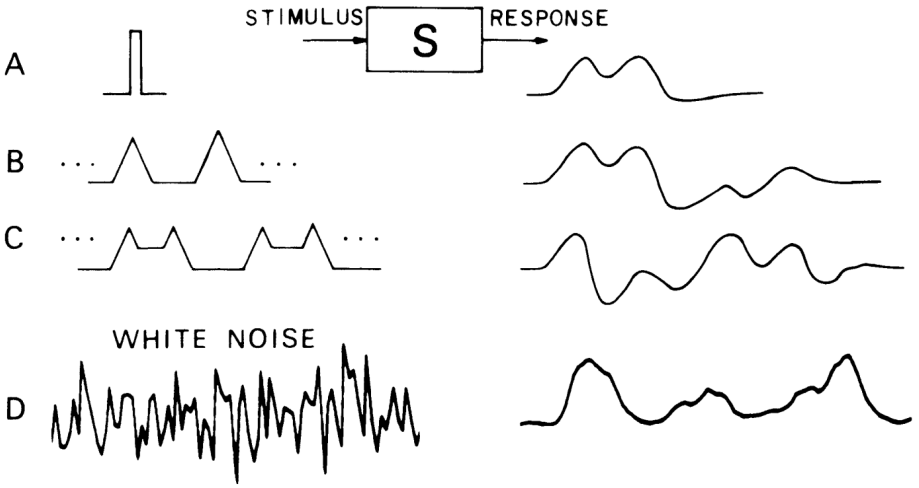


Fig. 4.1. Various stimulus–response pairs.

A real experiment

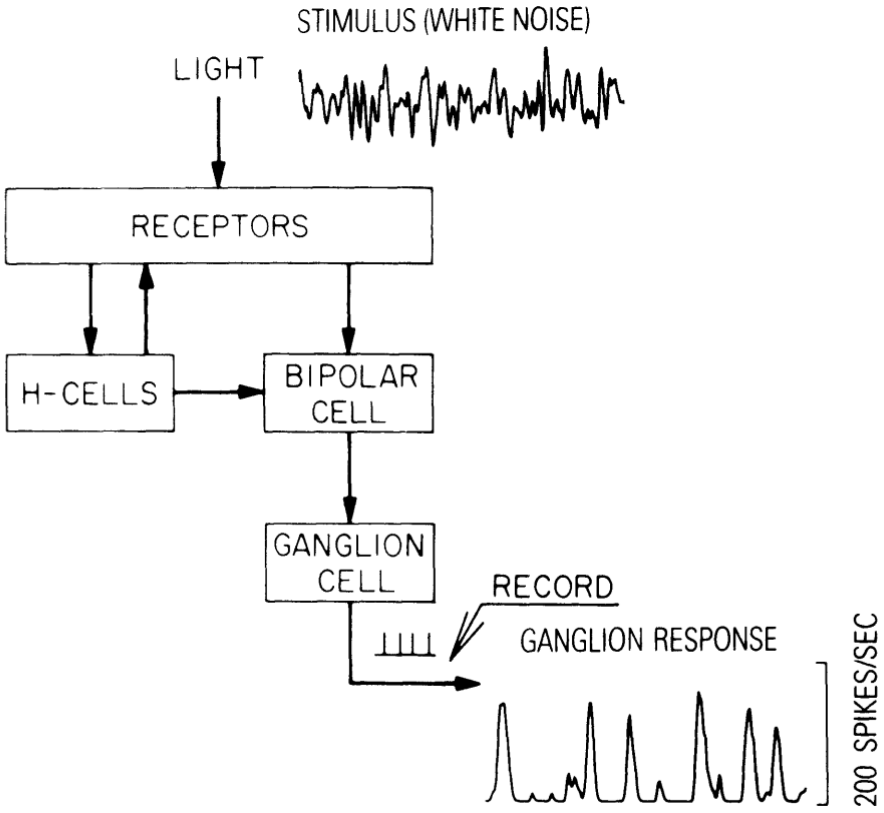


Fig. 4.16. Experiment diagram.

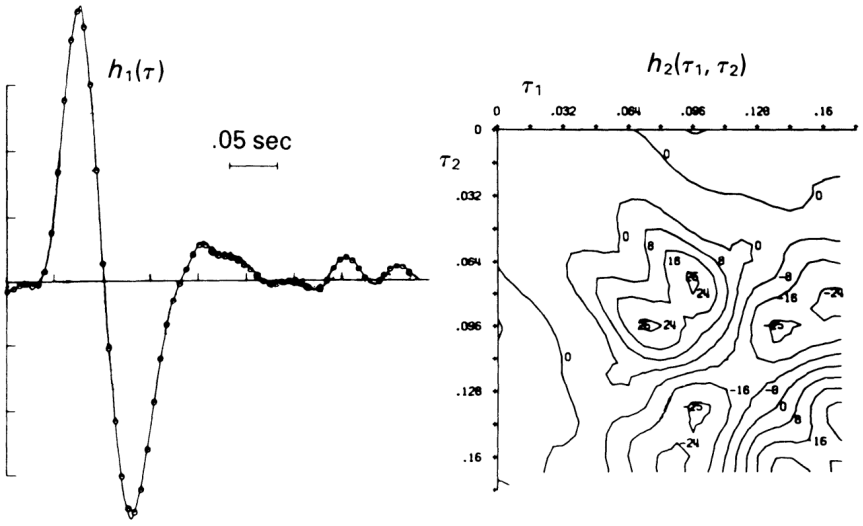


Fig. 4.17. First- and second-order kernels for field light → ganglion cell.

Pipeline

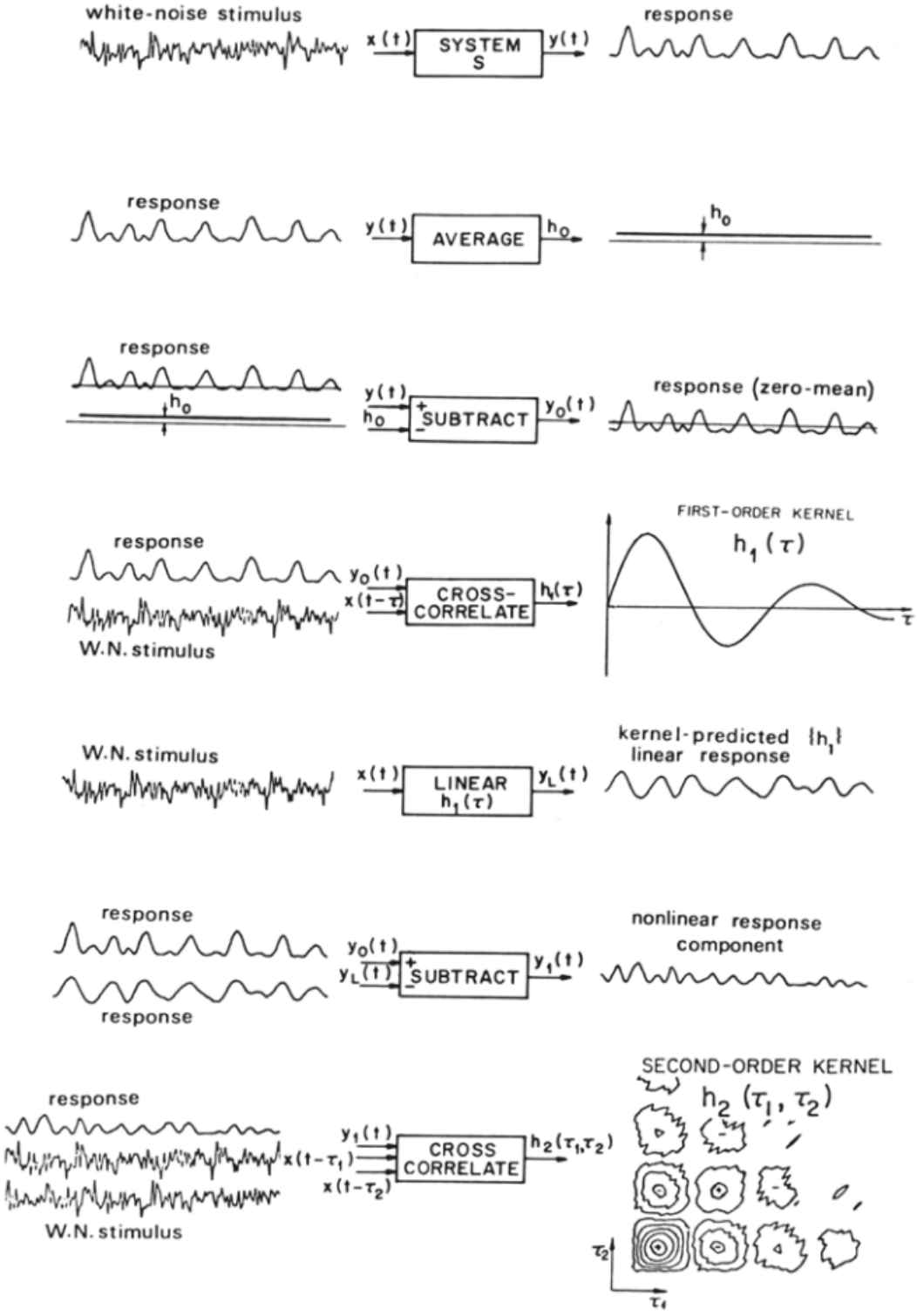
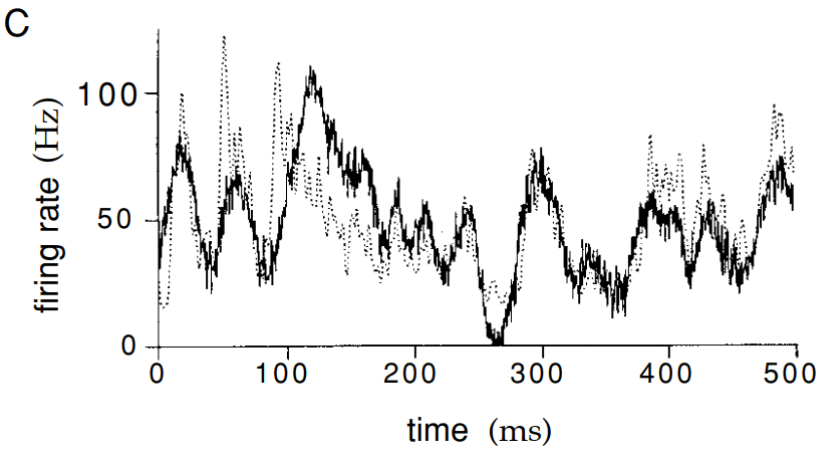


Fig. 4.15. Successive steps of first- and second-order kernel estimation.

Note: the cross-correlate in step 4 is our

$$D(\tau) = \frac{Q_{rs}(-\tau)}{\sigma^2}$$



(figure 2.1 of Peter's Book)

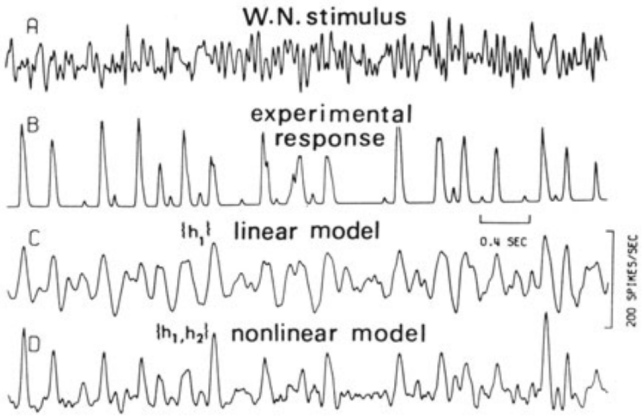
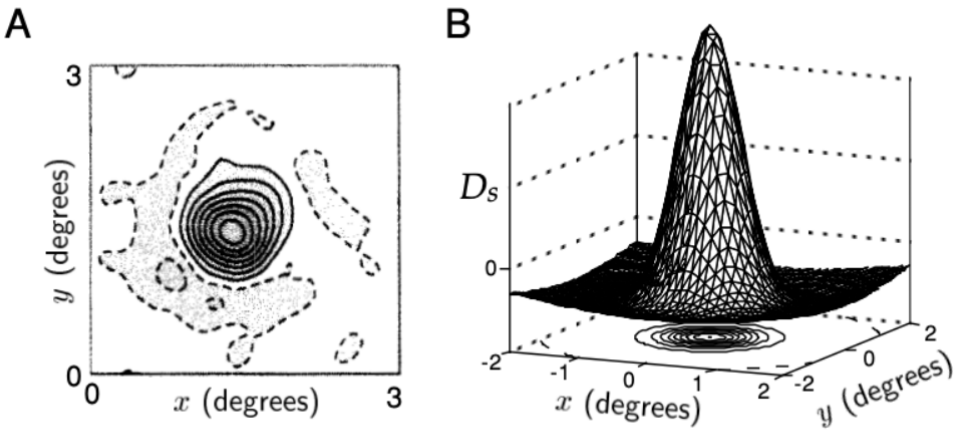


Fig. 4.18. Comparison of model and experimental responses.

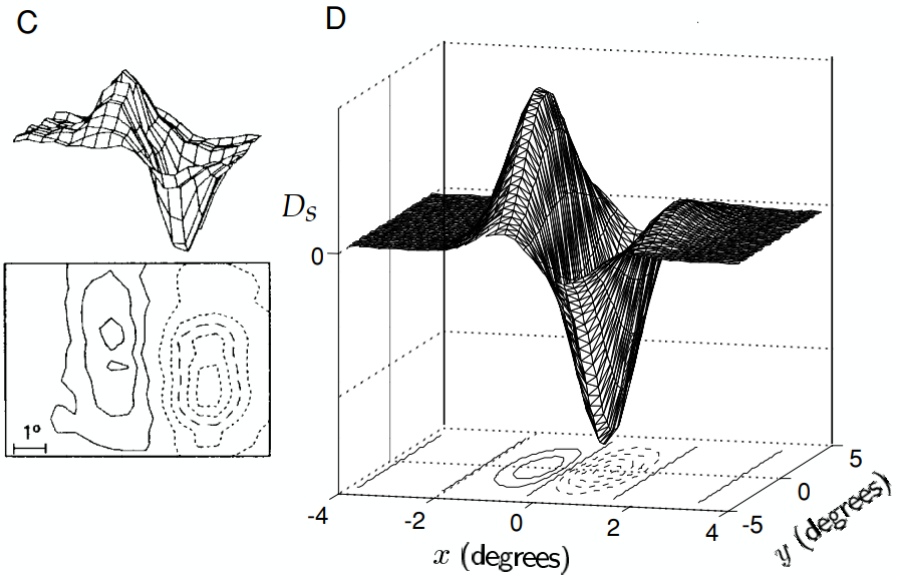
From t to (x,y,t)

retinal ganglion cells

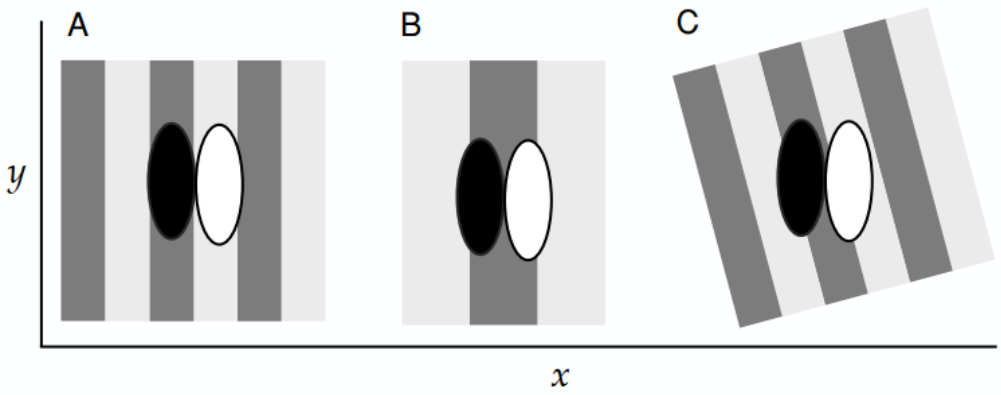


[Mexican Hat Function/Marr Function]

simple cells in V1



hope you remember HW1!

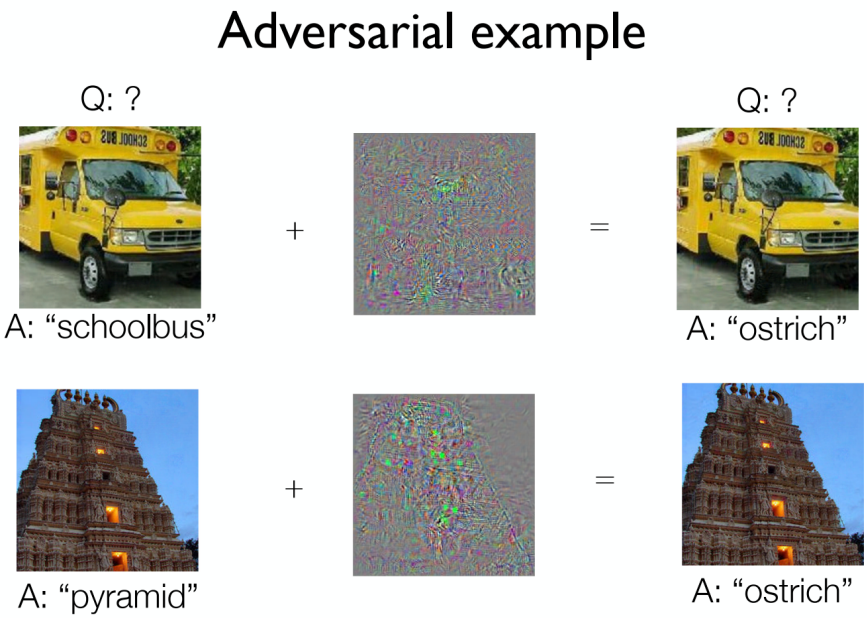


From Linear to non-Linear

- Using more terms in the Wiener Series.
- Using activation function: in the same vein with ML!
- Using DL

Biological Vision vs Computer Vision

eg 1



(figure from slides of Quan Wen)

eg 2

A team from TsingHua U successfully breaks through GPT-4, New Bing and Bard.