Comparing neural responses to Cartesian, Polar and Hyperbolic gratings in the tree shrew visual cortex

Visual Cognition Laboratory, Department of Medicine,
University of Fribourg

Poirot Jordan, De Luna Paolo, Rainer Gregor

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Introduction

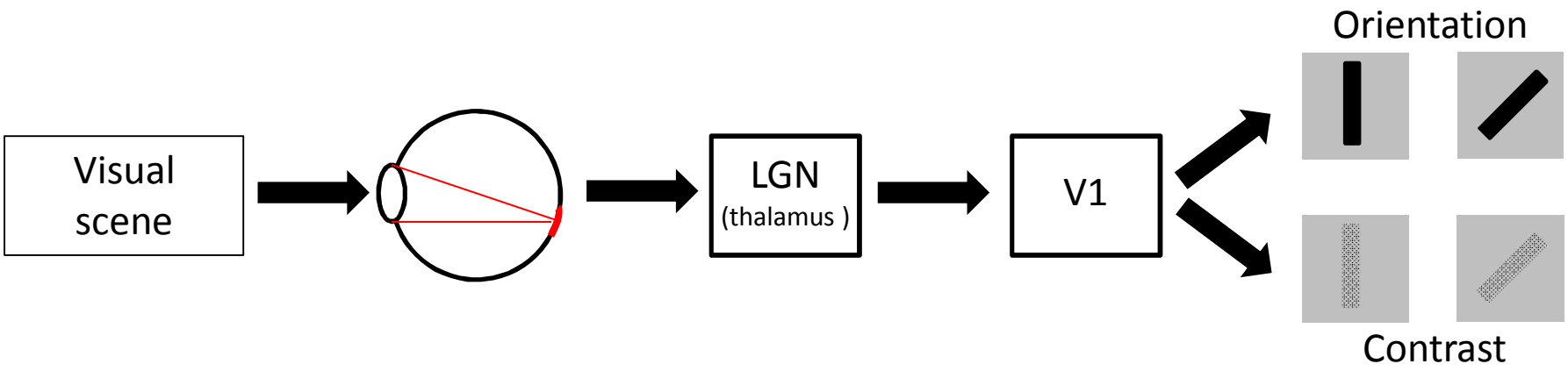
- Visual information flows from the retina through the thalamus to reach the primary visual cortex (V1)

- V1 encodes simple features (orientation, contrast)

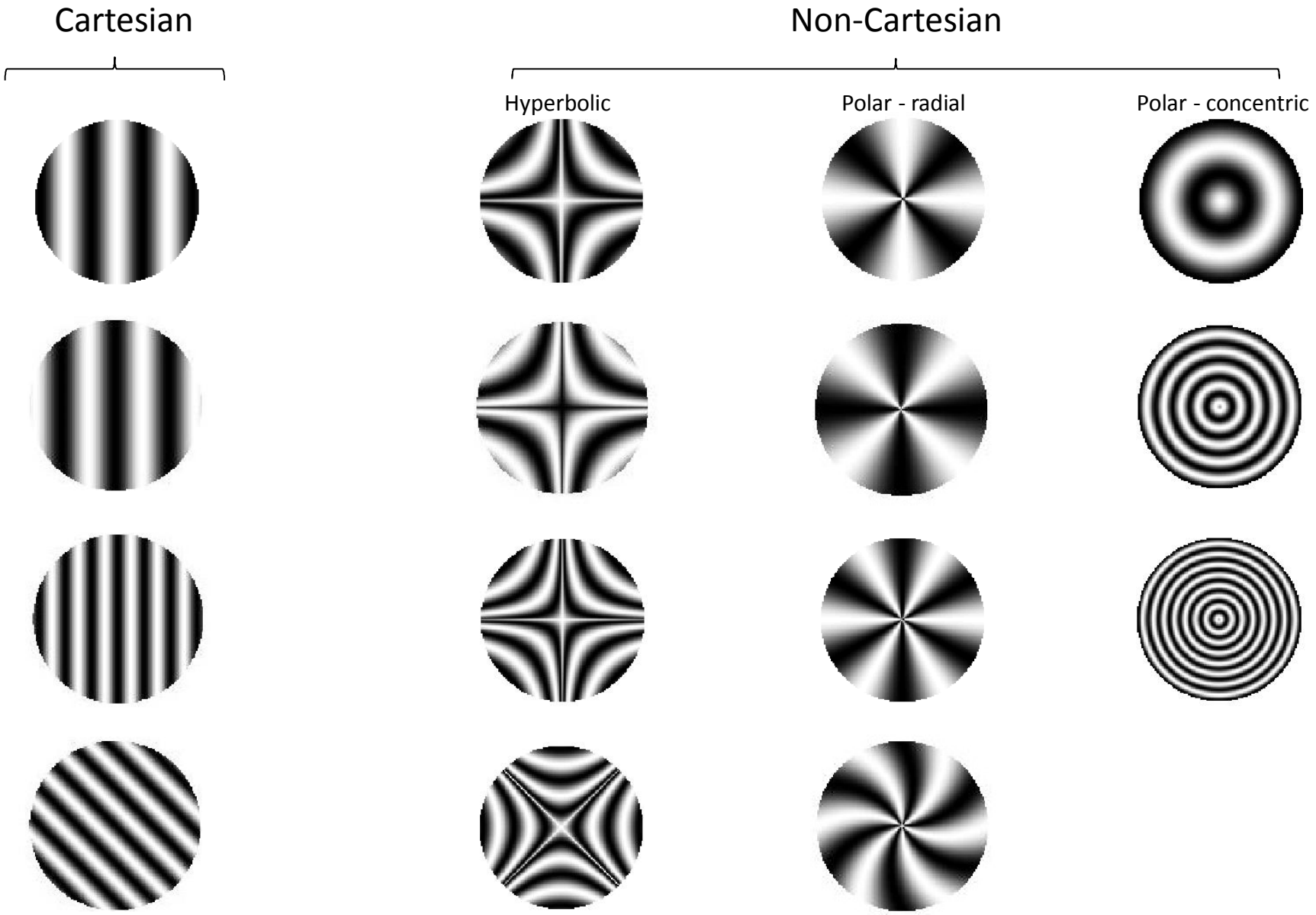
(*Hubel and Wiesel.,1962 ; Campbell and Robson.,1968*)

- Cartesian gratings are largely used to study simple features

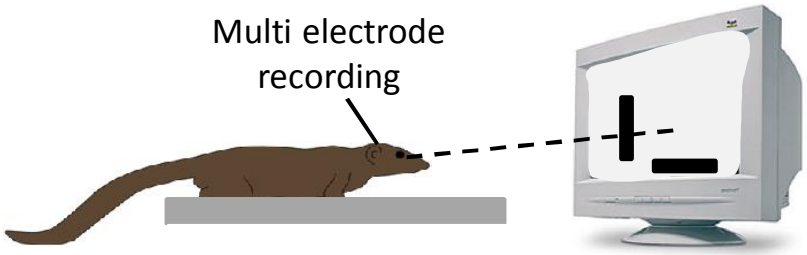
(*Gallant et al., 1996 ; Mahon and De Valois., 2001*)



Grating stimuli

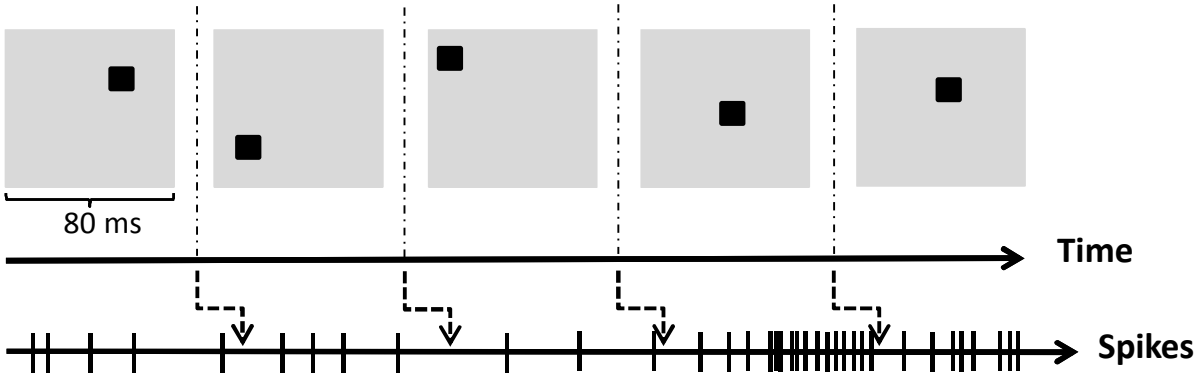


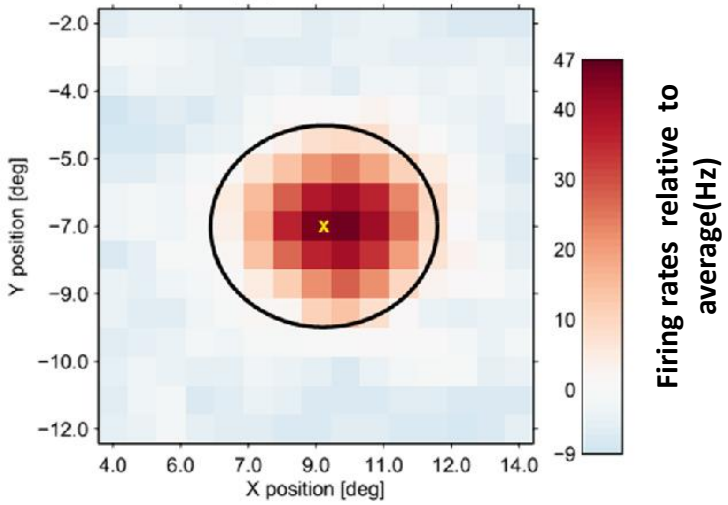
Protocol: RF position



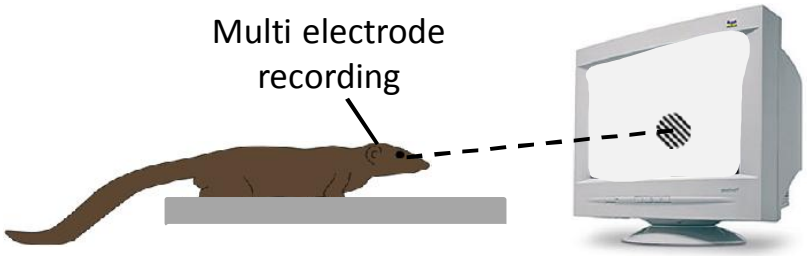
Estimation of the RF

Sparse Noise protocol

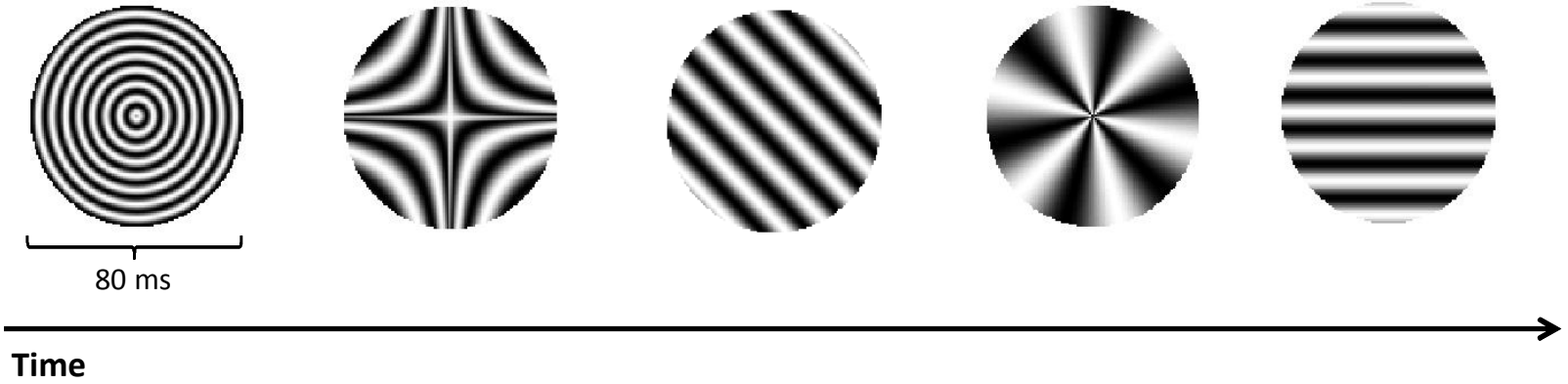




Protocol: Gratings presentation

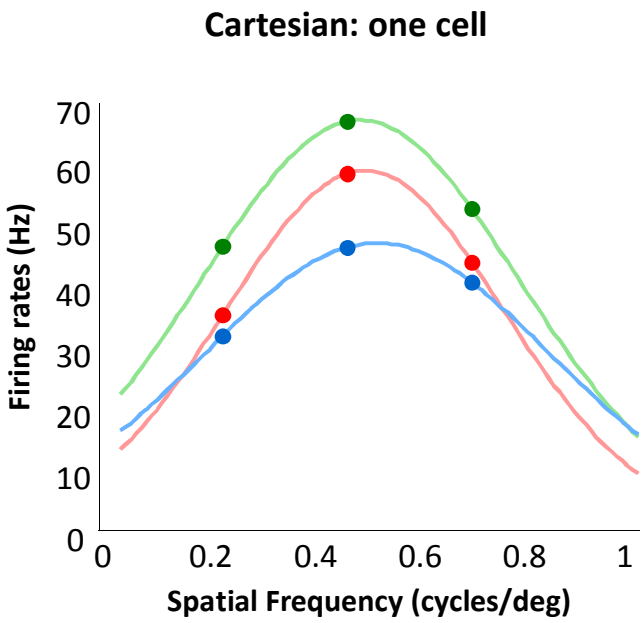


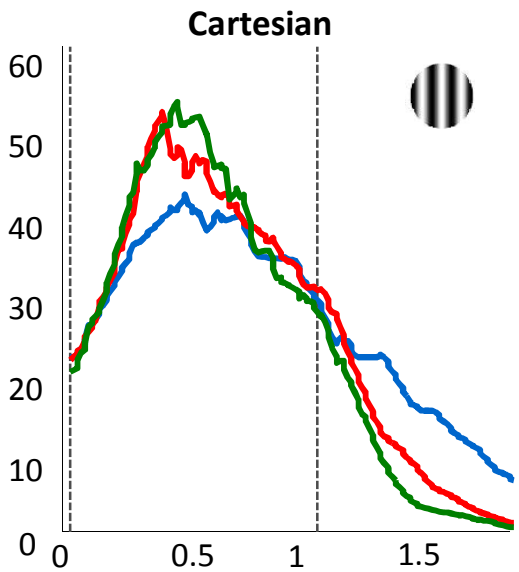
Gratings presentation at the RF center

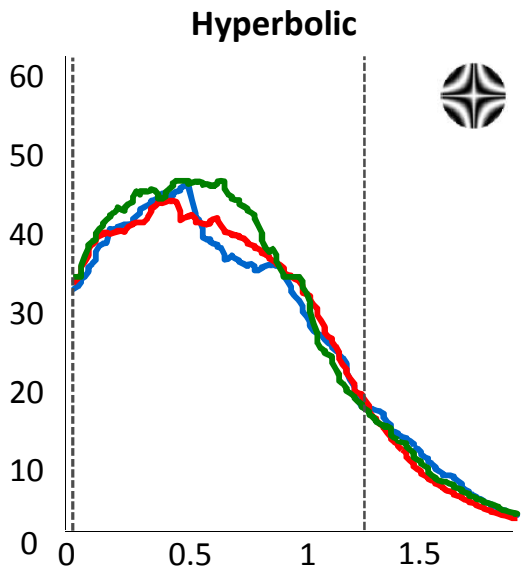


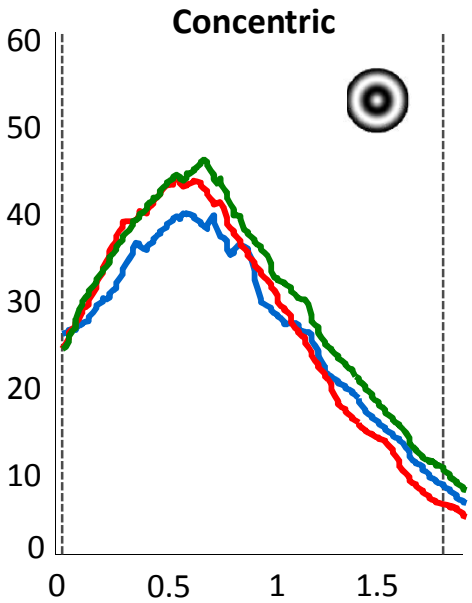
- 3 sizes, 1,2 or 4 times the Classical Receptive Field (CRF) size

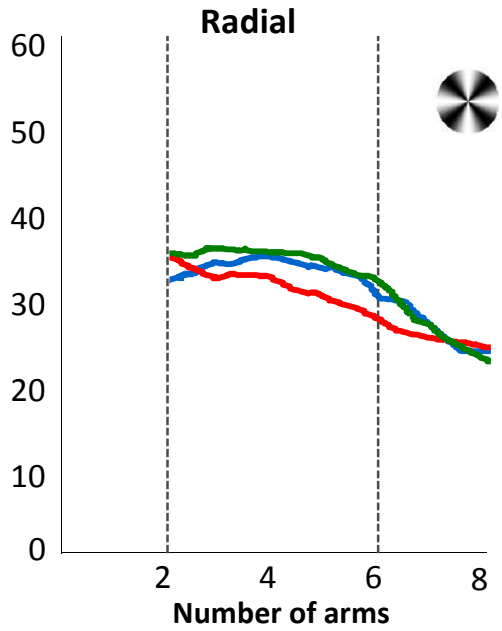
Results : Spatial Frequency







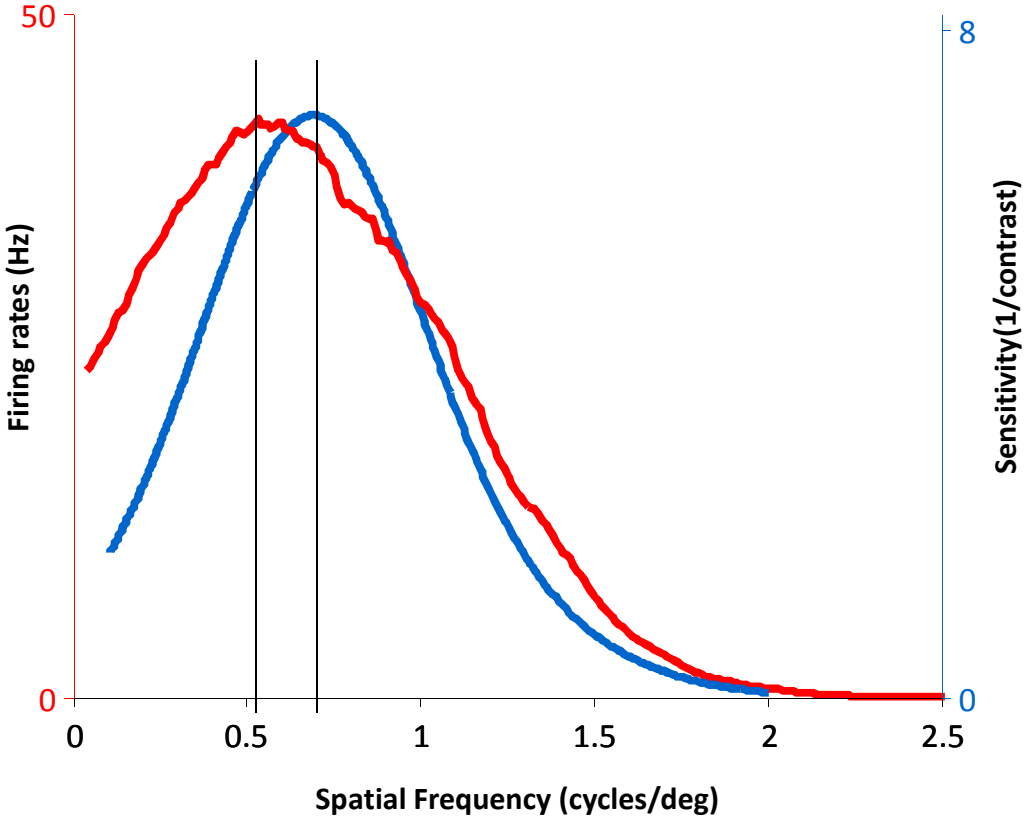


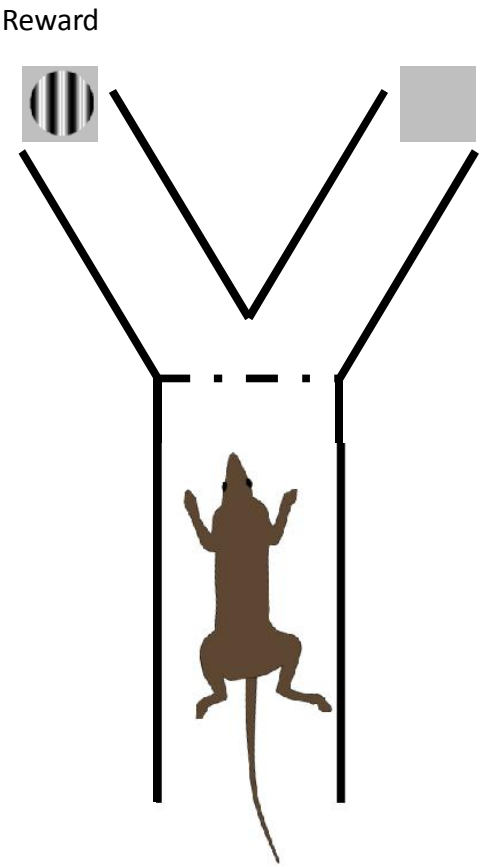


Size 1
Size 2
Size 4

- Typical inverted U curve (Band pass), SF preference at 0.5 c/deg
- Higher response for larger stimuli
- Little modulation of SF for Radial

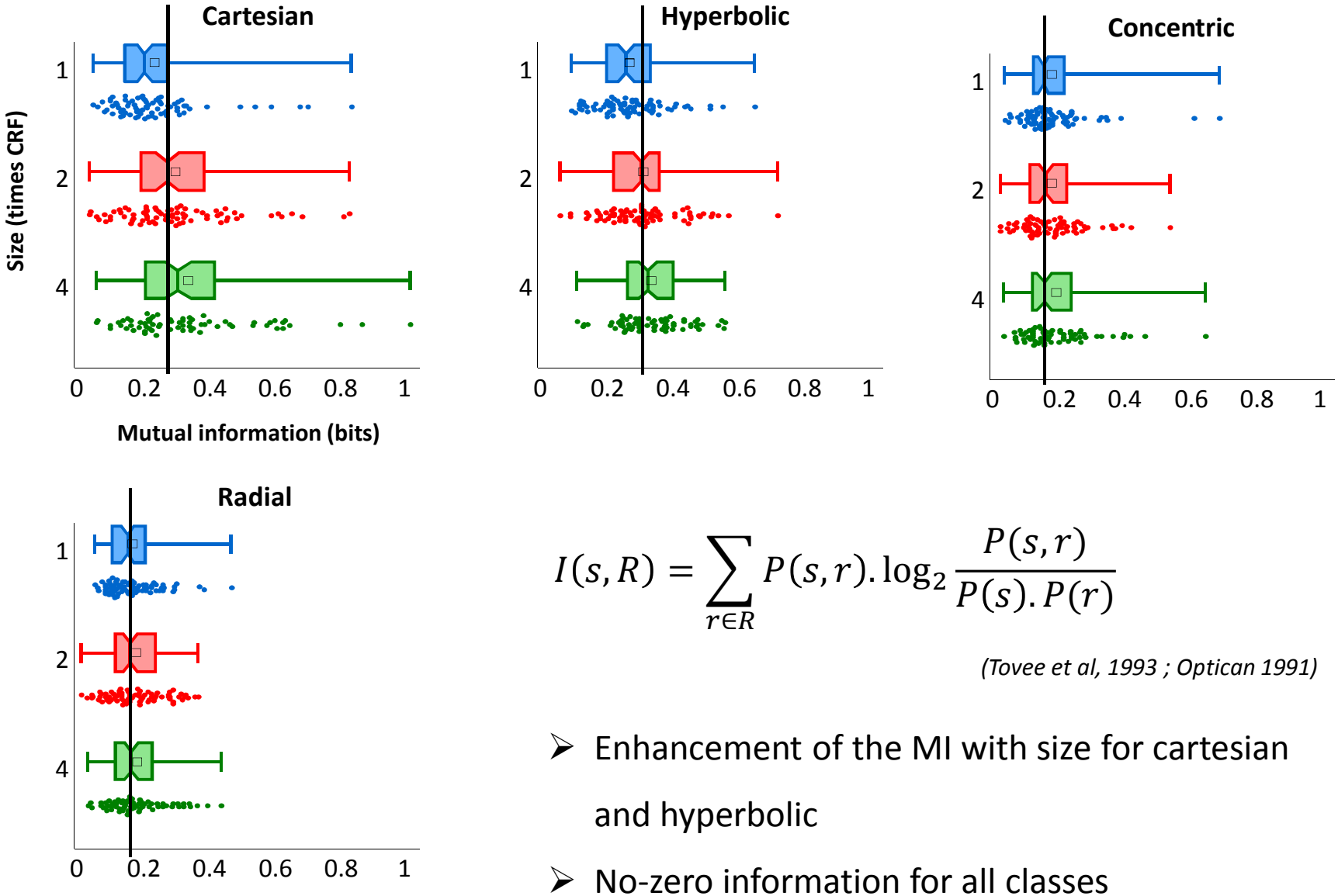
Results : Comparison DATA





- Visual acuity at 2 cycles/degree for behavioral and electrophysiology approach *(Petry et al.,1984)*
- Peak at 0.7 c/deg for behavioral measurements and 0.5 c/deg in our study

Results: Mutual information



$$I(s,R) = \sum_{r \in R} P(s,r).\log_2 \frac{P(s,r)}{P(s).P(r)}$$

(Tovee et al, 1993 ; Optican 1991)

- Enhancement of the MI with size for cartesian and hyperbolic
- No-zero information for all classes

Conclusion

- ✓ A SF preference at 0.5 c/deg comparable to behavioral study in tree shrew *(Petry et al.,1984)*
- ✓ V1 neurons encode Cartesian and Non-Cartesian gratings
- ✓ V1 cells have a preference for Cartesian and Hyperbolic gratings for larger size
- ✓ General enhancement of neuronal activity of primary visual cortex with larger stimuli
  - ➢ Consistent with previous study in tree shrew where presentation of larger bar stimuli increase the neuronal response (*Chisum et al., 2004)*
  - ➢ In contrast with monkey study where neuronal activity is reduced with the visual surround (*Hubel and Wiesel., 1968*)

Thank you for your attention.

References

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