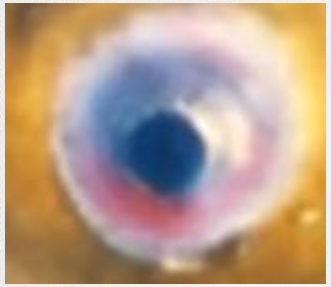
浙江大学
生命演化研究中心

01

Evolution of neuronal cell classes and types in the vertebrate retina

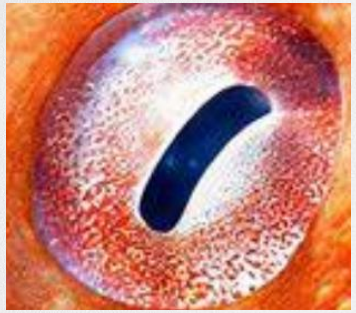
By Yulong

Who am I?



Lampreys(七鳃鳗)

hagfish 盲鳗



Octopus

Tree frog

Antelope

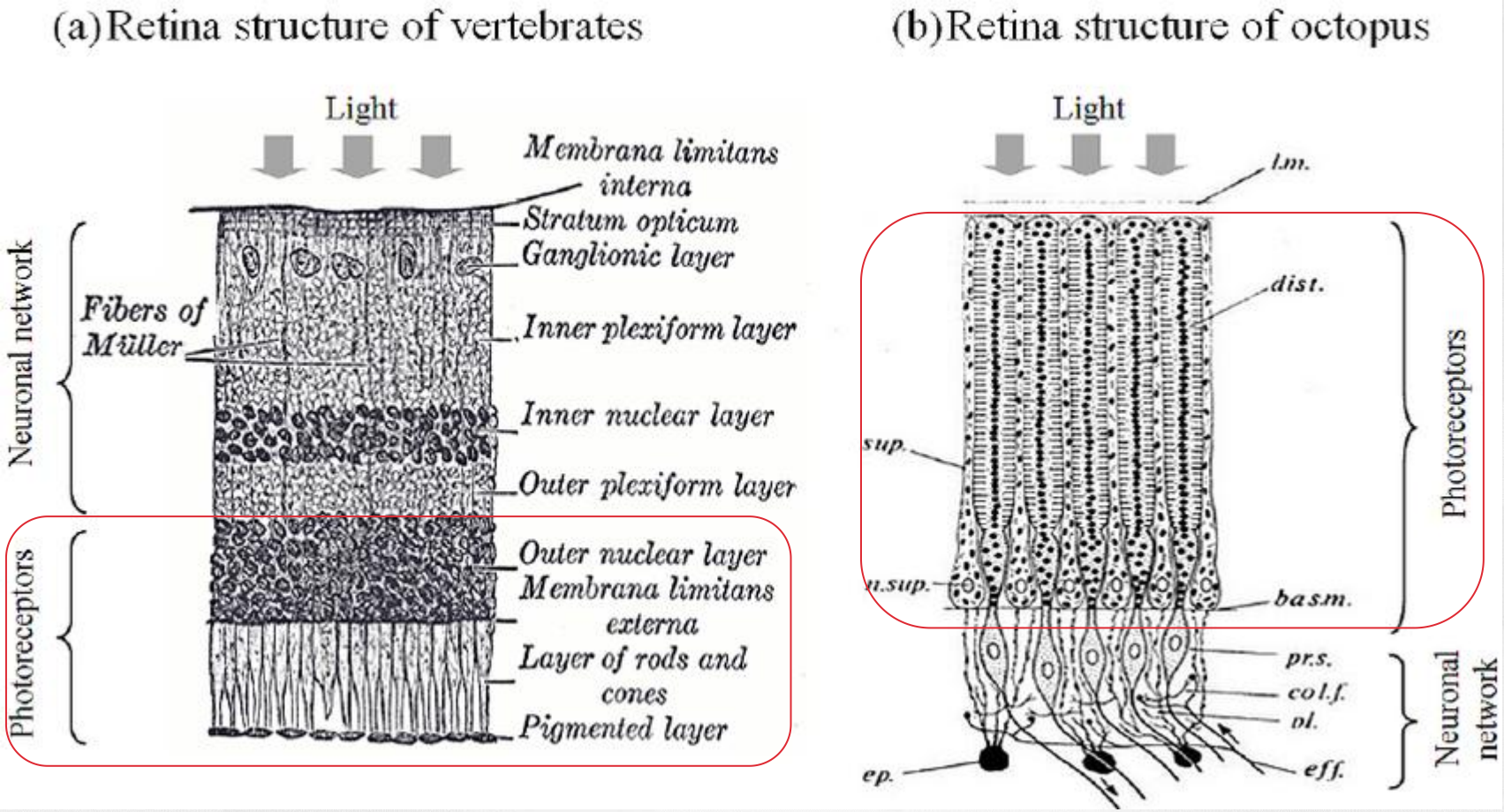
Tips: not Trump…

Pig

Lizard

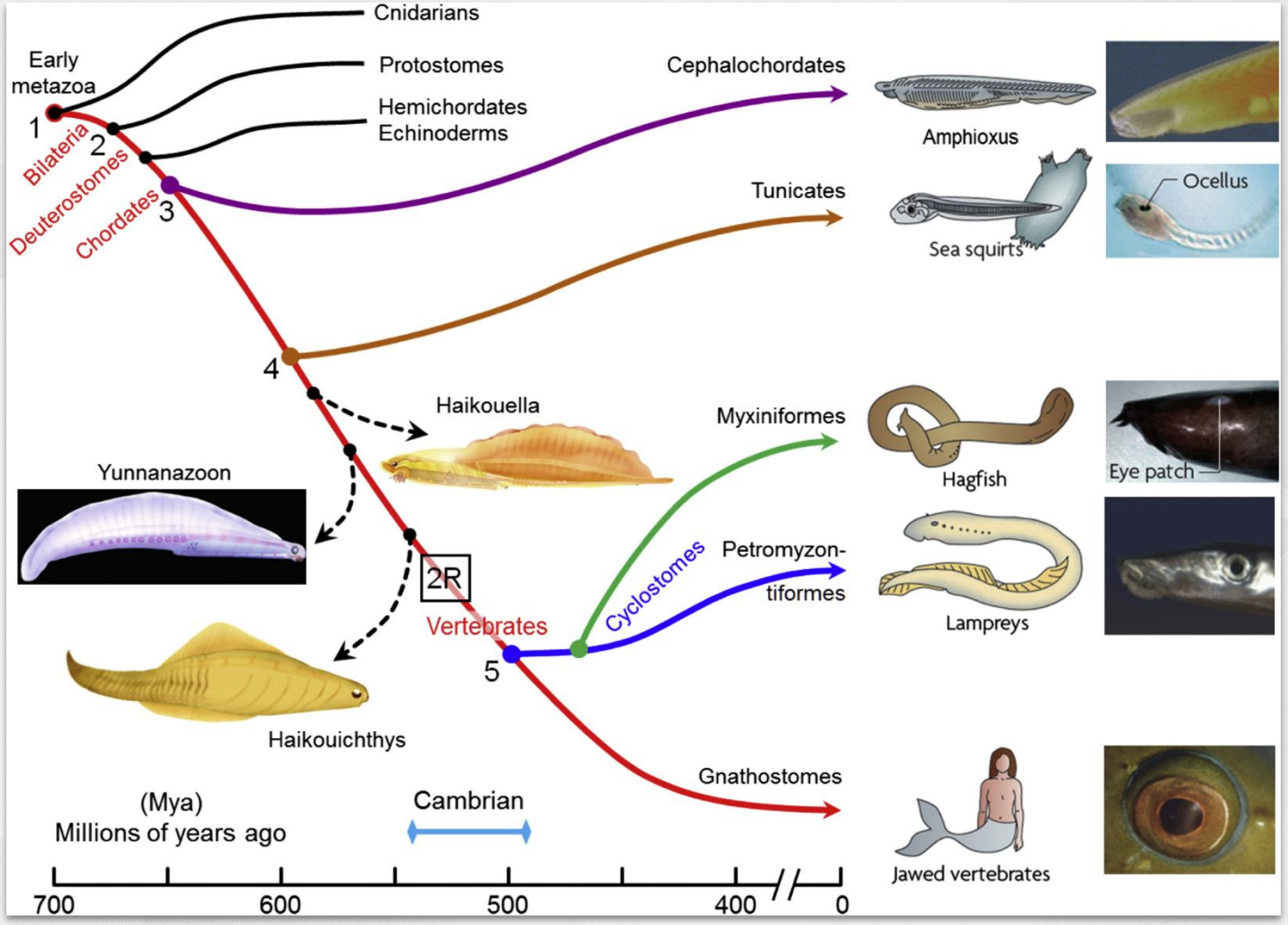
Owl

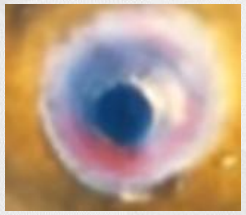
Retina(视网膜) structure comparison between vertebrates and octopus



what patterns do we observe when examining evolutionary relationships **within** vertebrate subclades?

Evolution of Chordates Visual System





Evolution of Vertebrate Animals' Visual System

Basic structure of vertebrate visual system evolves from 550 ma. to 500 ma.

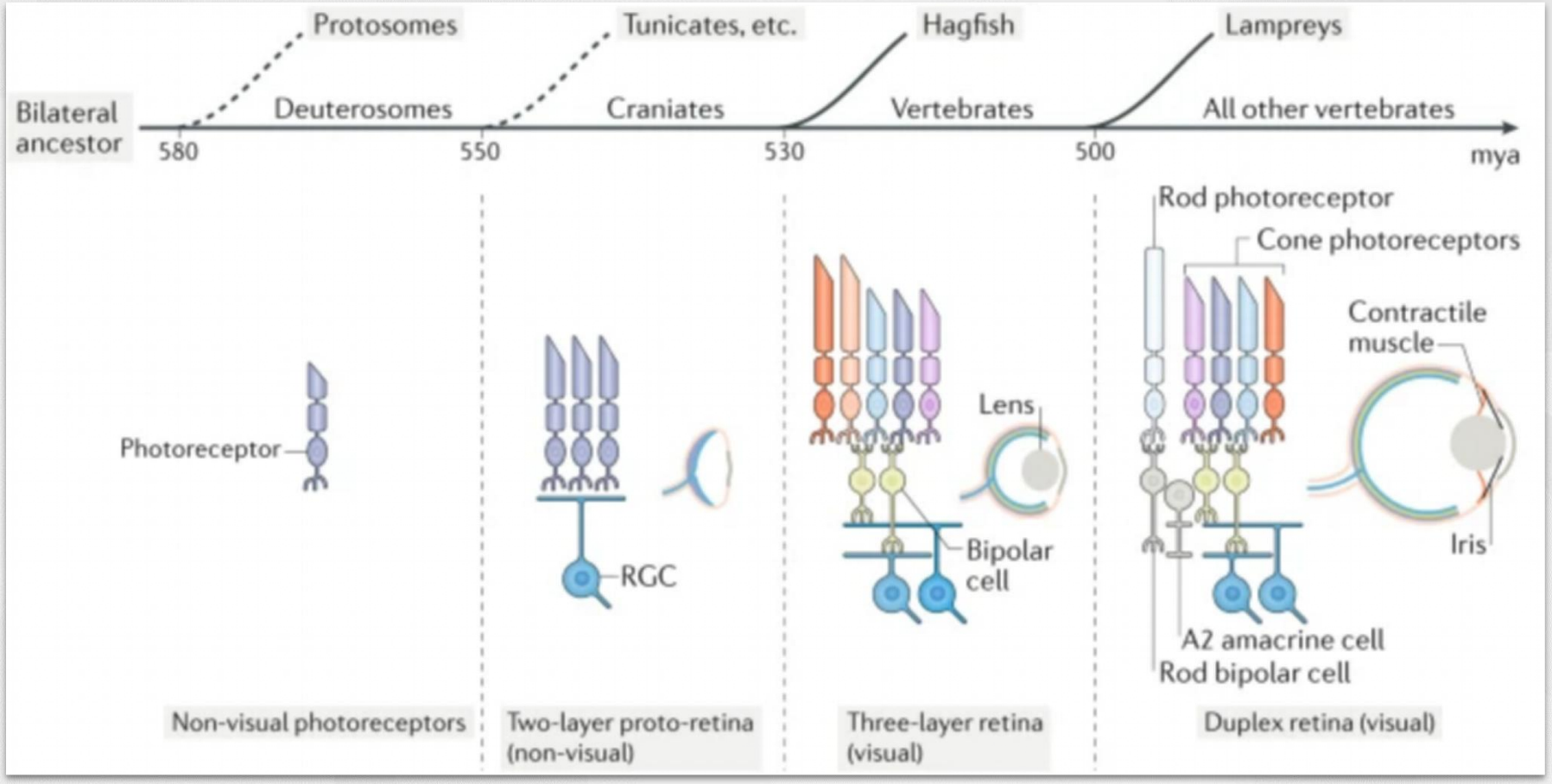
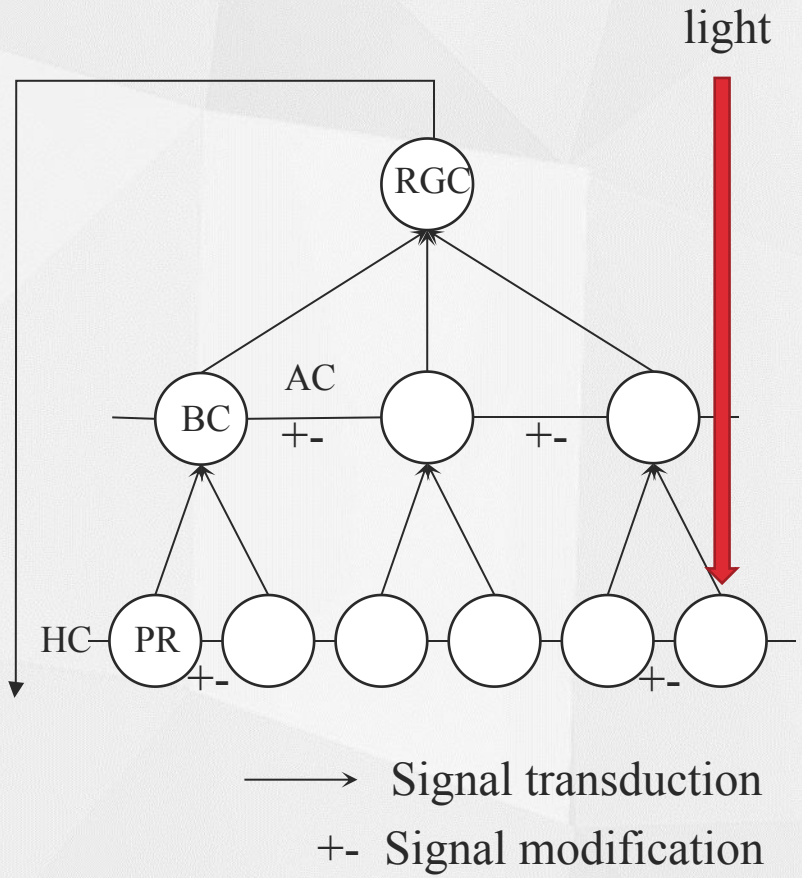
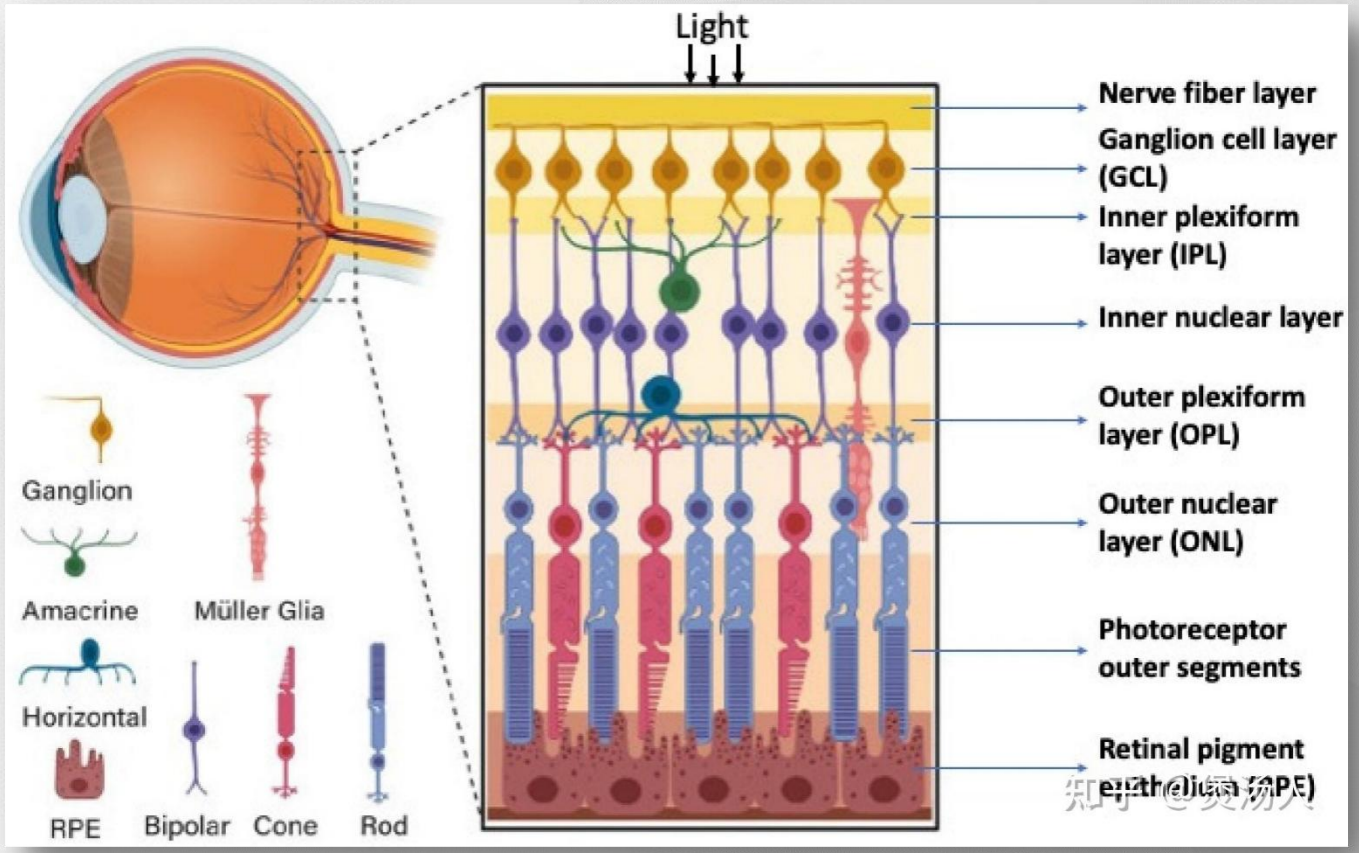


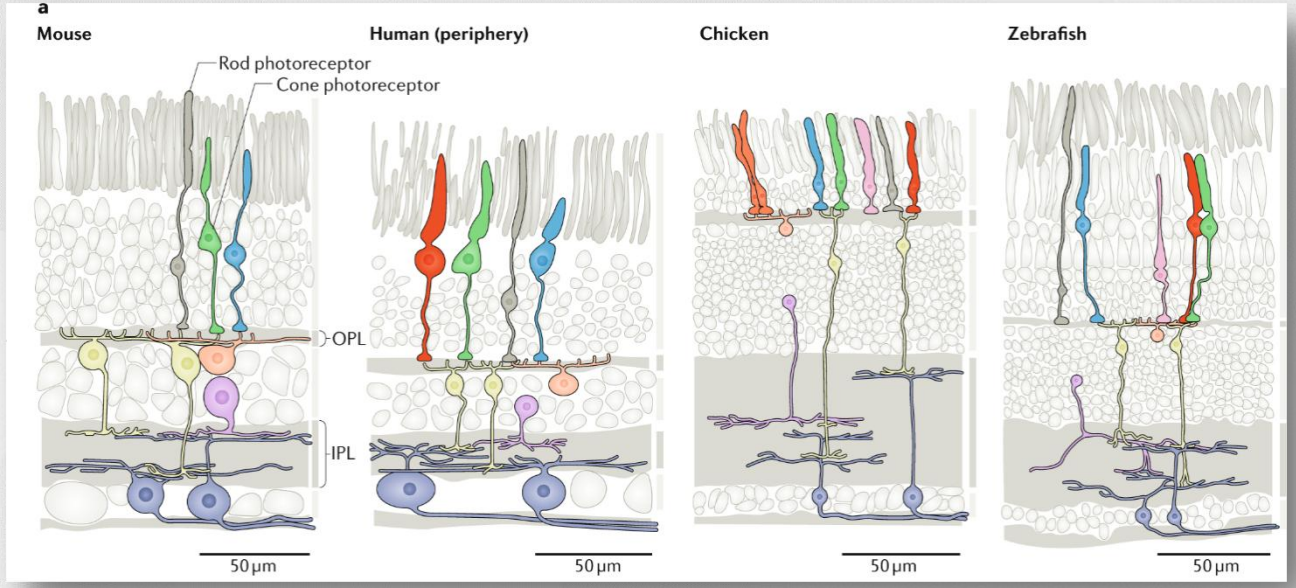
Fig. Source: Baden, T., Euler, T. & Berens, P. Understanding the retinal basis of vision across species. *Nat Rev Neurosci* 21, 5–20 (2020). https://doi.org/10.1038/s41583-019-0242-1

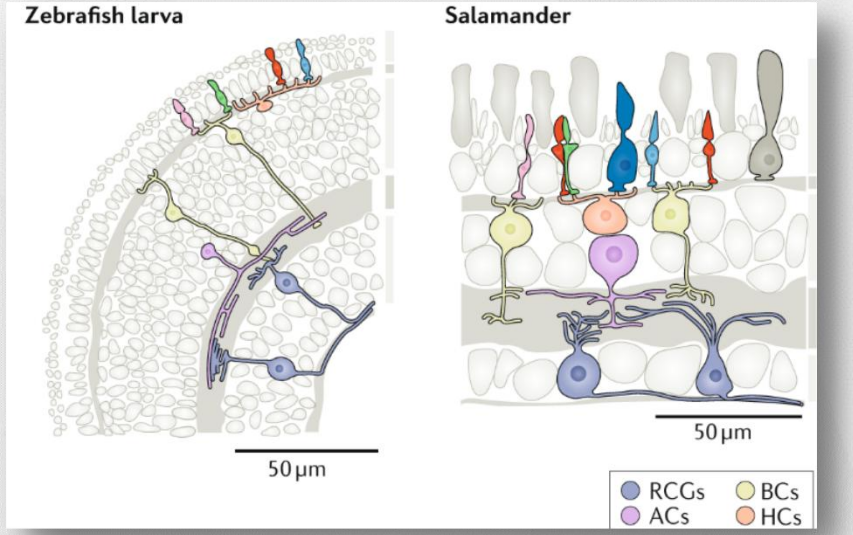
Background — Human Retina structure





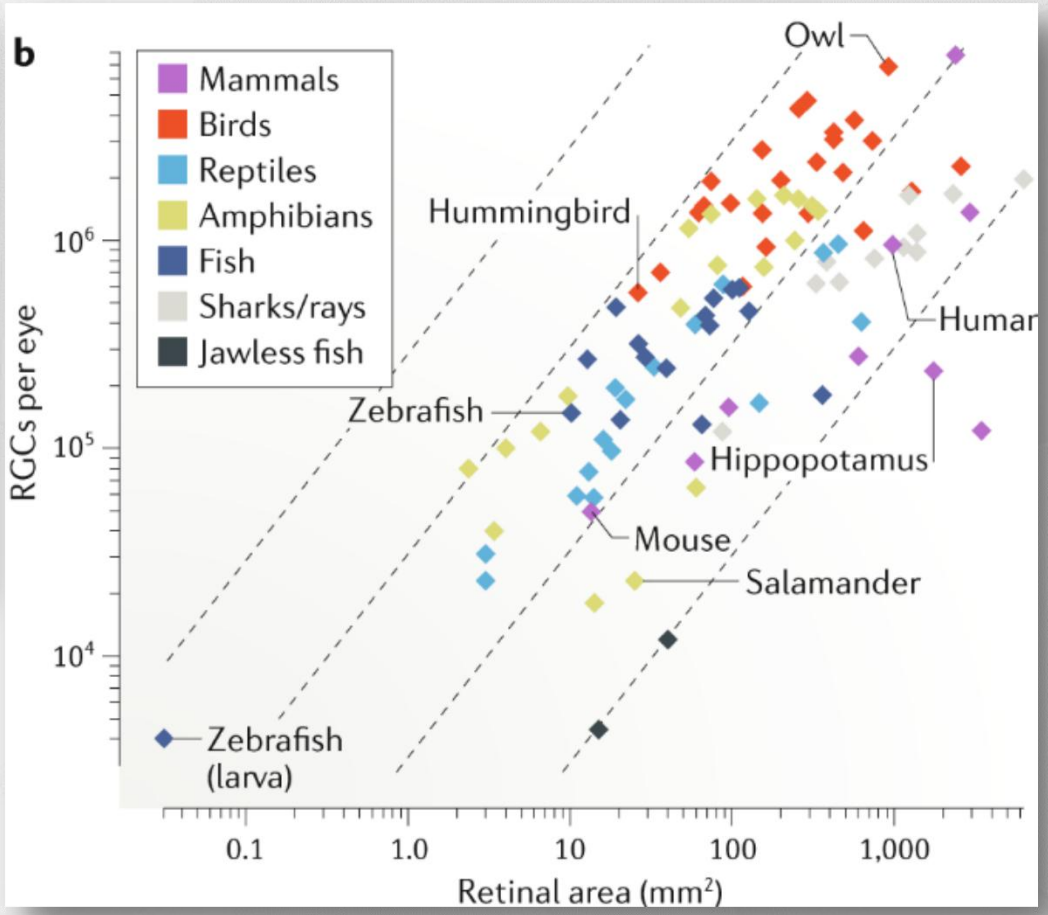
The visual structures of vertebrates exhibit significant differences





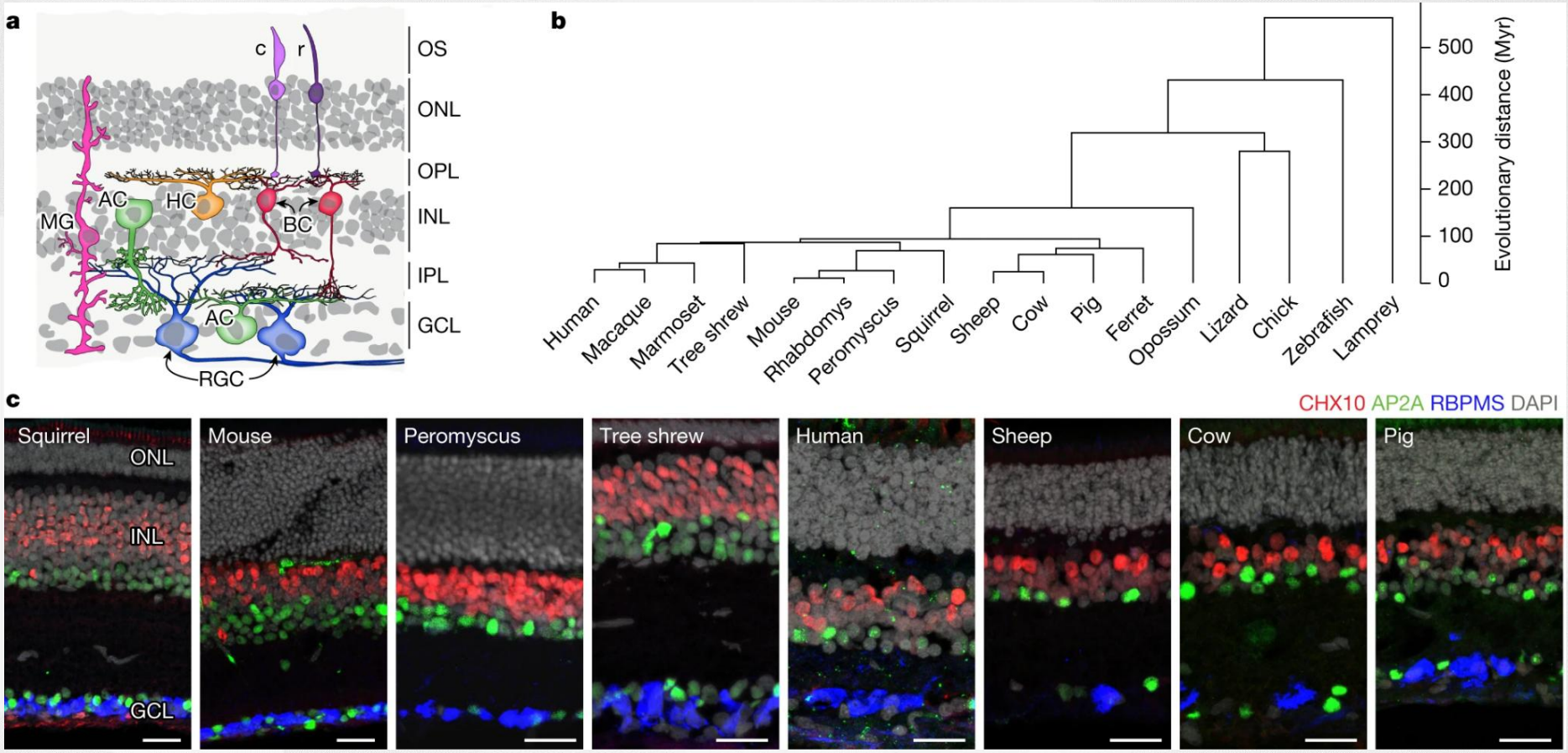
Different animals exhibit a wide diversity of cell **subtypes**.

Animals with **better visual ability** have **higher RGCs density** at same eye size.

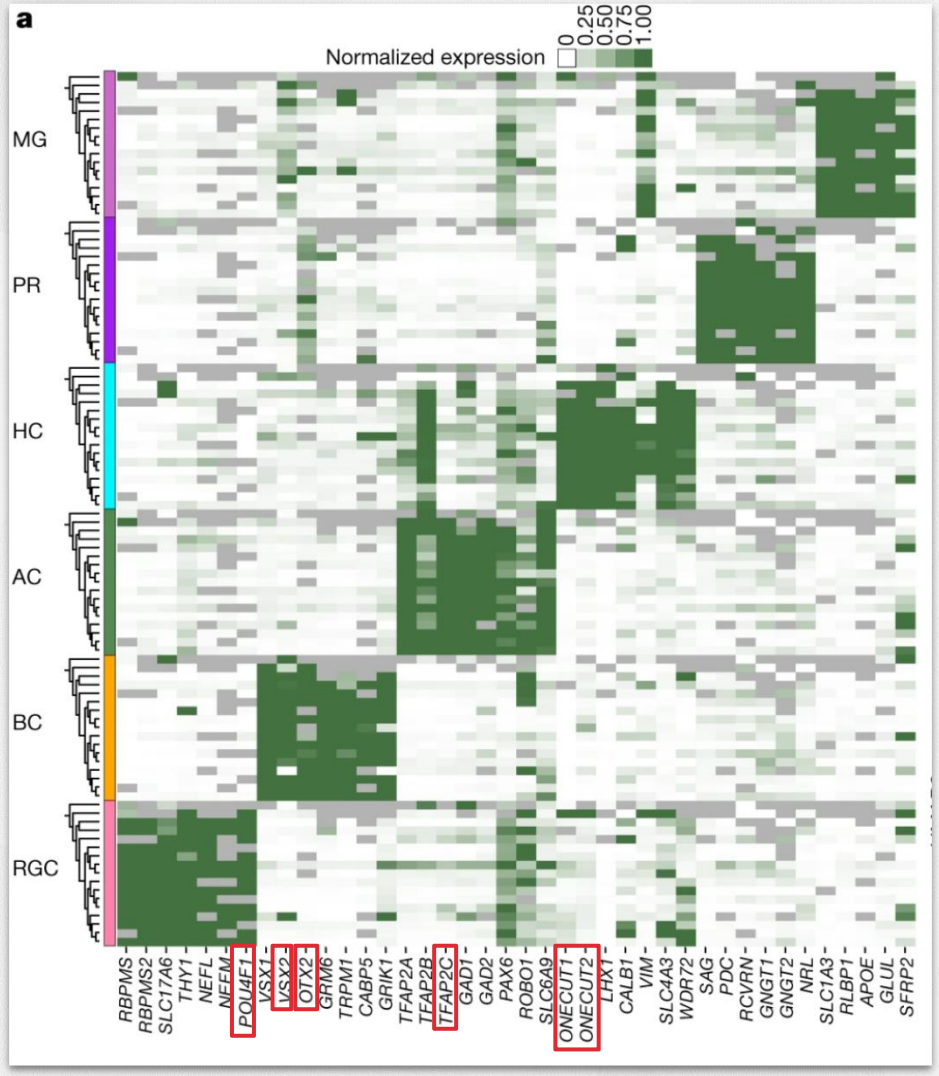


The evolution of vertebrate visual cells is primarily governed by species identity?

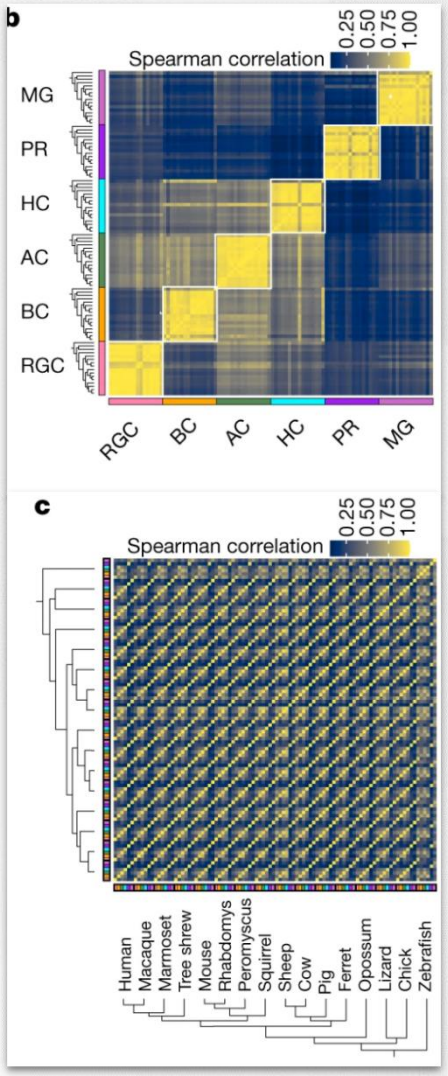
Molecular conservation of neuronal classes

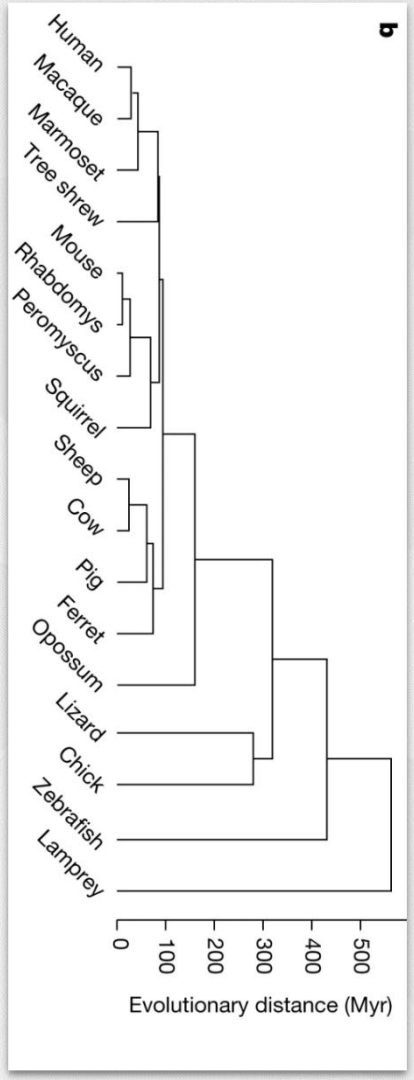


Molecular conservation of neuronal classes — class



lineage-determining transcription factors

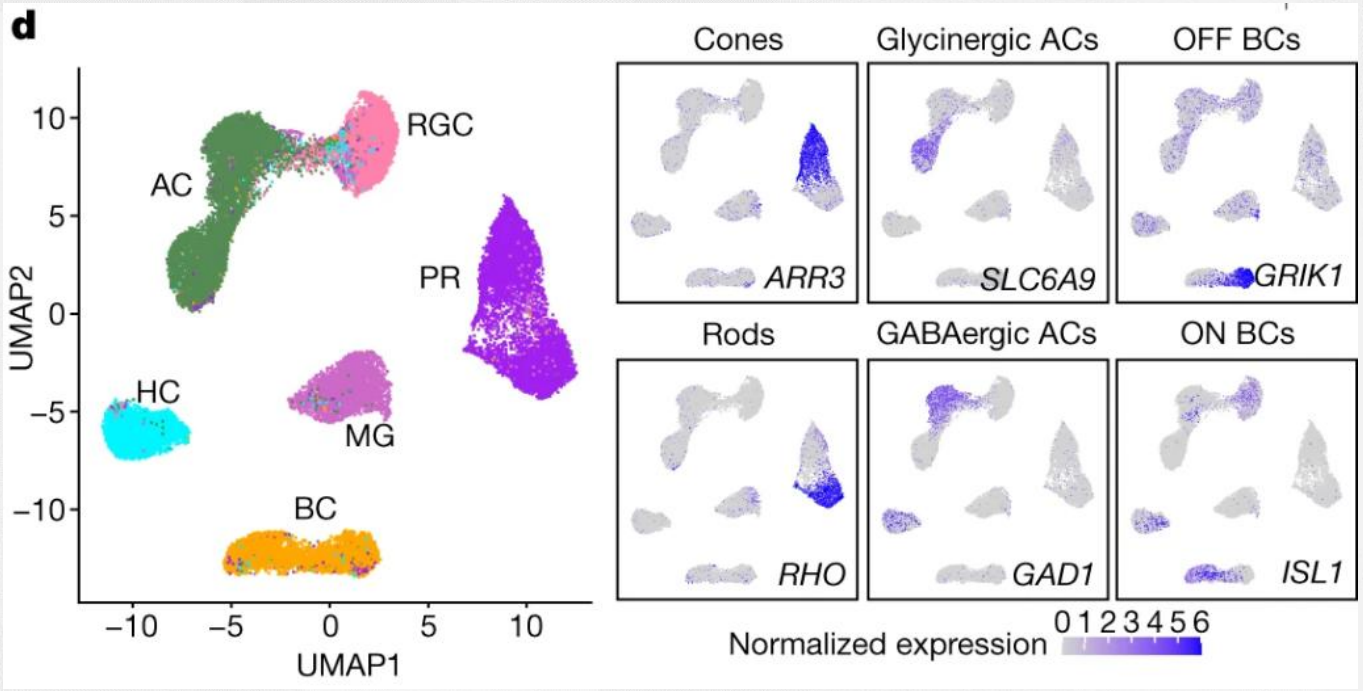


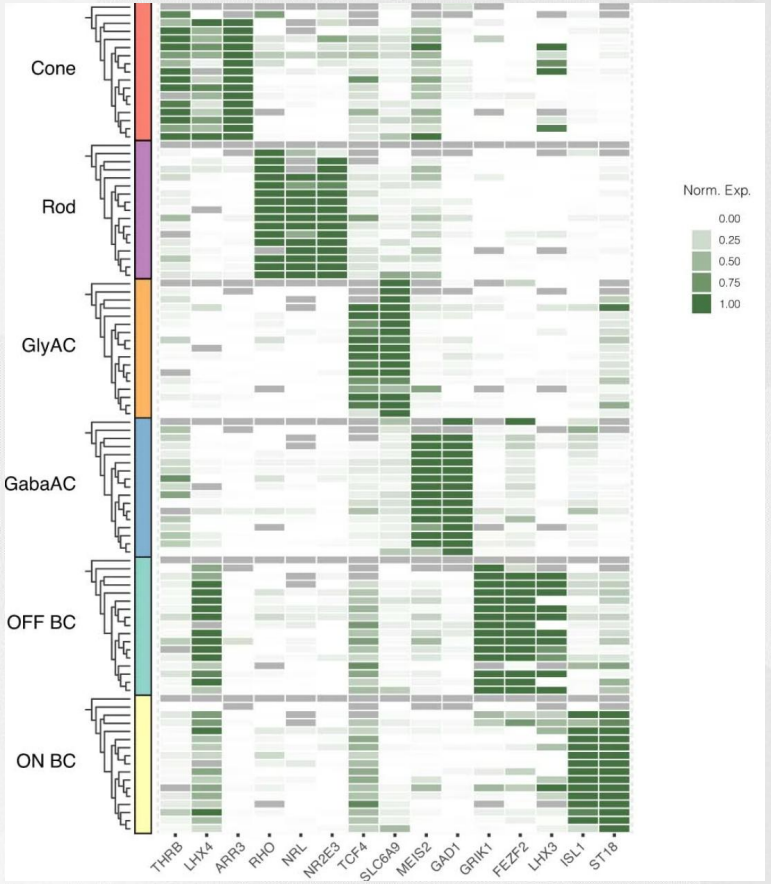


Transcriptome expression analysis reveals that homologous cell types in jawed vertebrates exhibit strong conservation.

Class identity > Species identity

Molecular conservation of neuronal classes — subclass





The evolutionary conservation of cell classes extends to subclasses

RGCs are the most varied cell types

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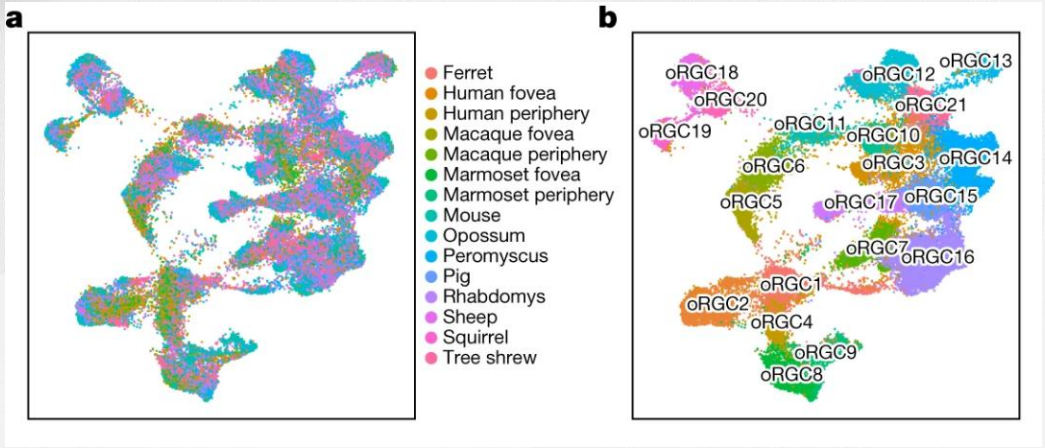
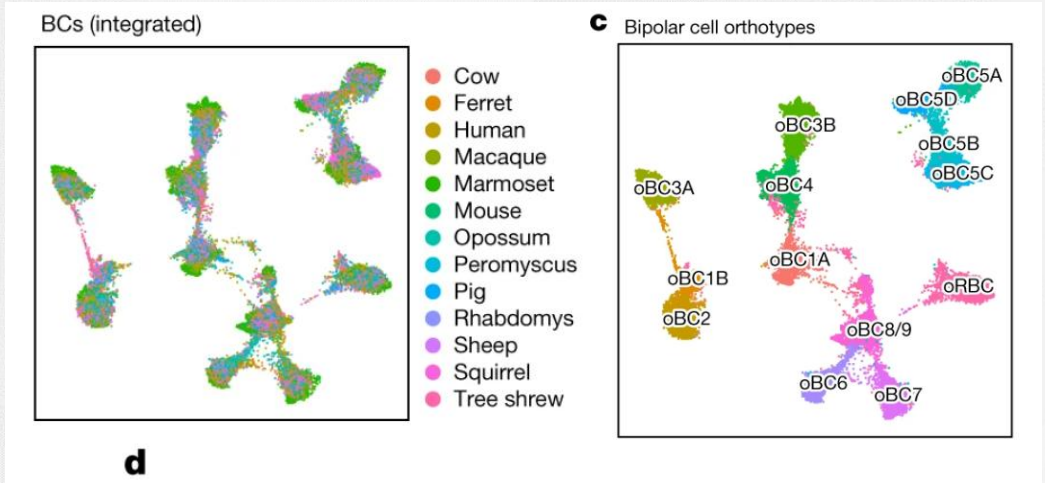
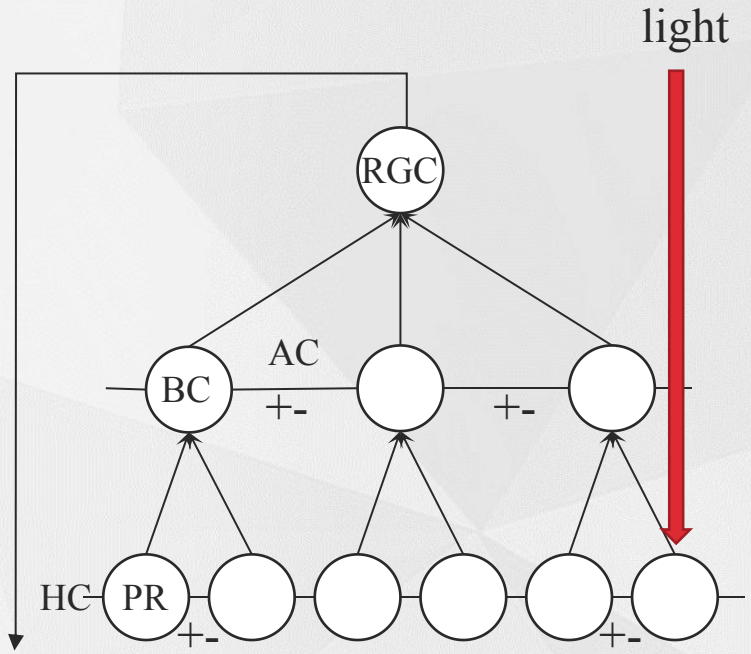


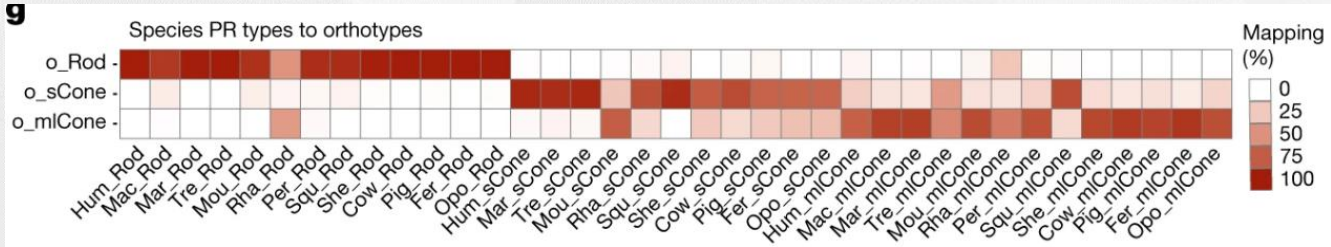
RGCs

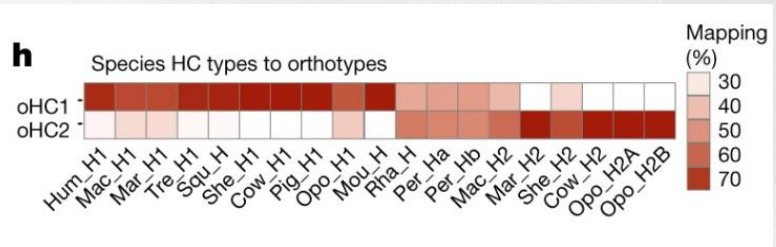


BCs

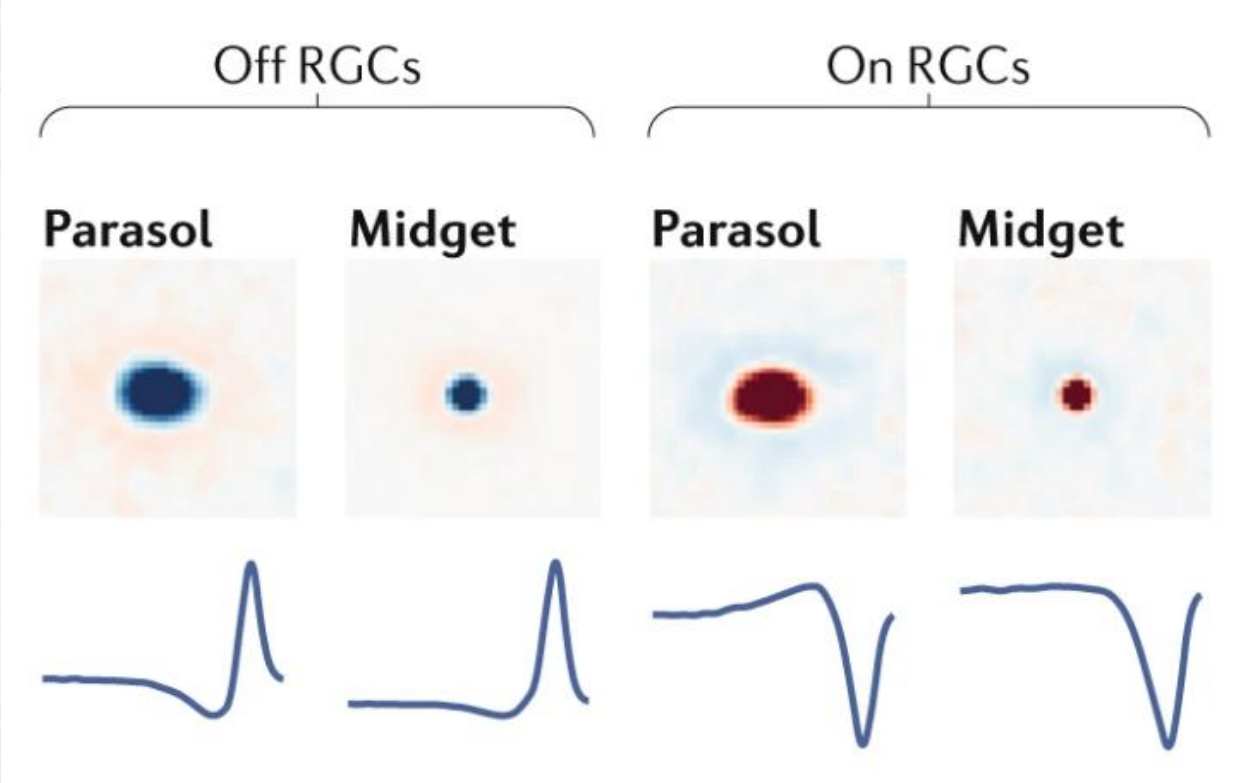


Divergence: HC<PR<BC<RGC

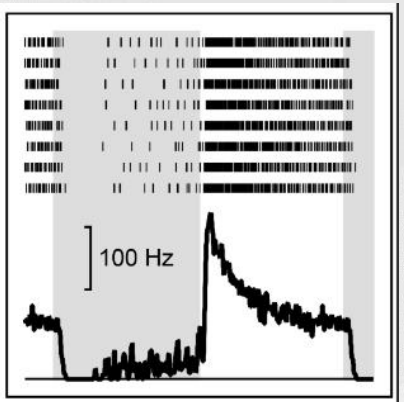


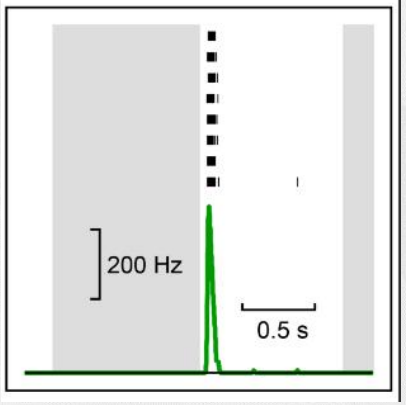


Midget & Parasol RGCs



Off Parasol





Off Midget

Primate “specific” RGCs are not alone

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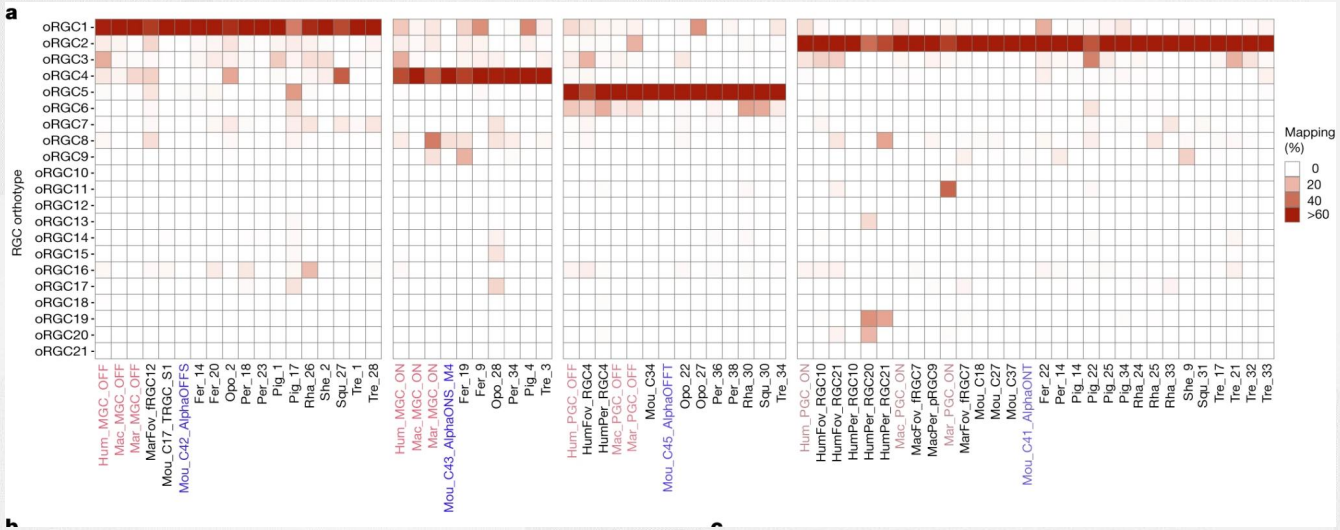

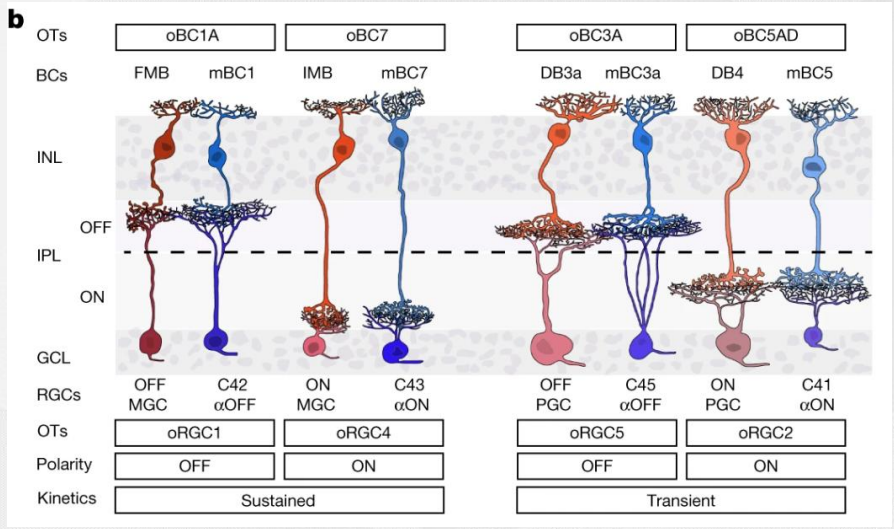

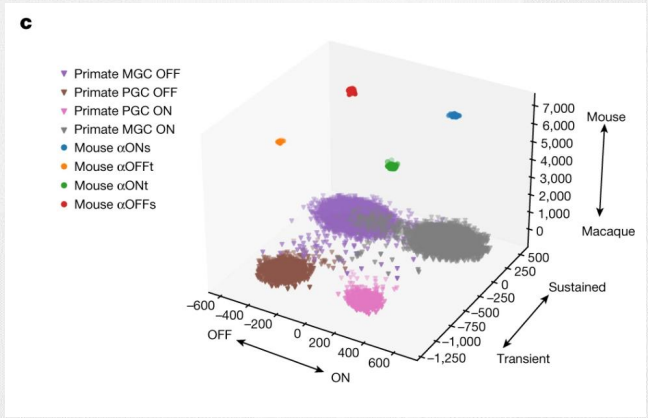

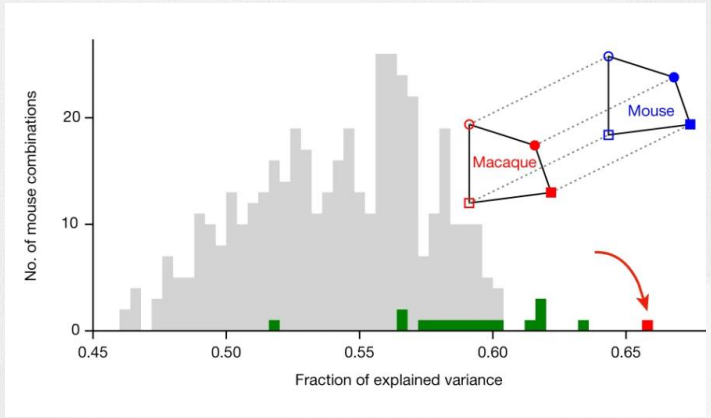

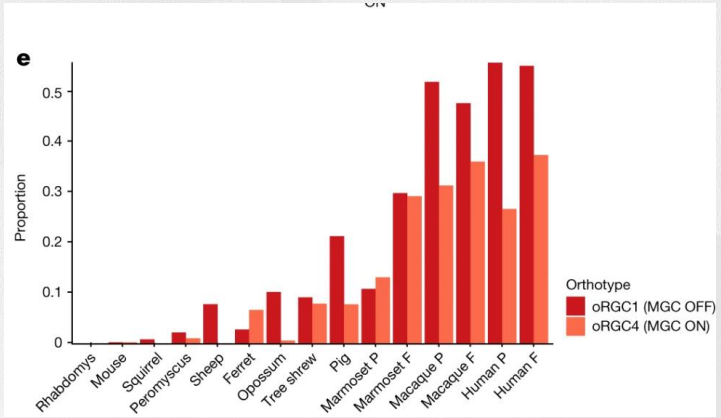

Primate “specific” RGCs are not alone

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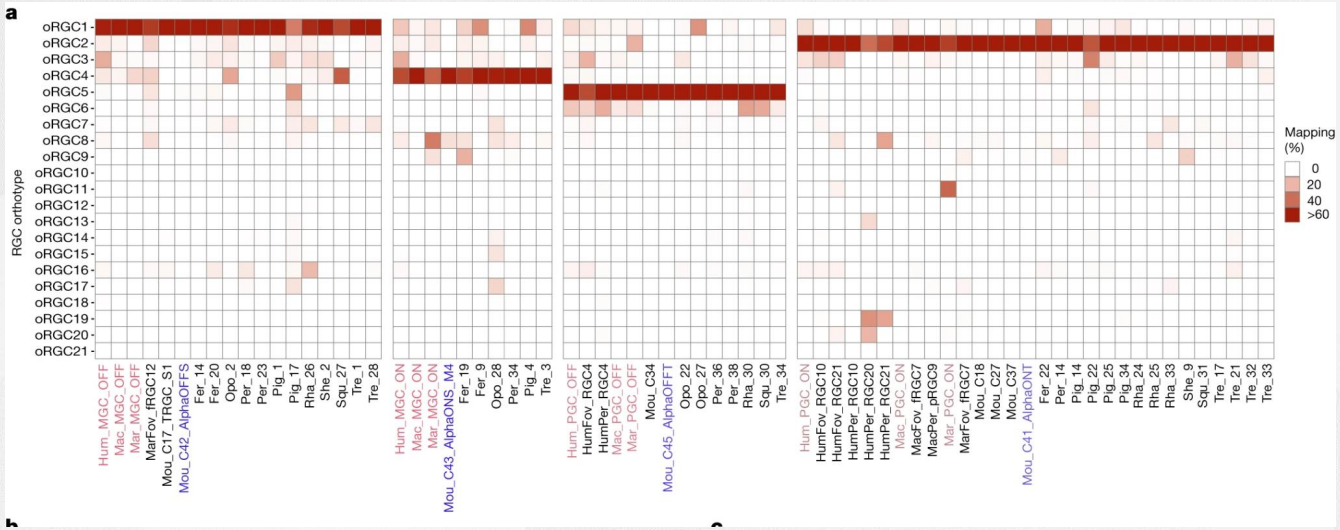

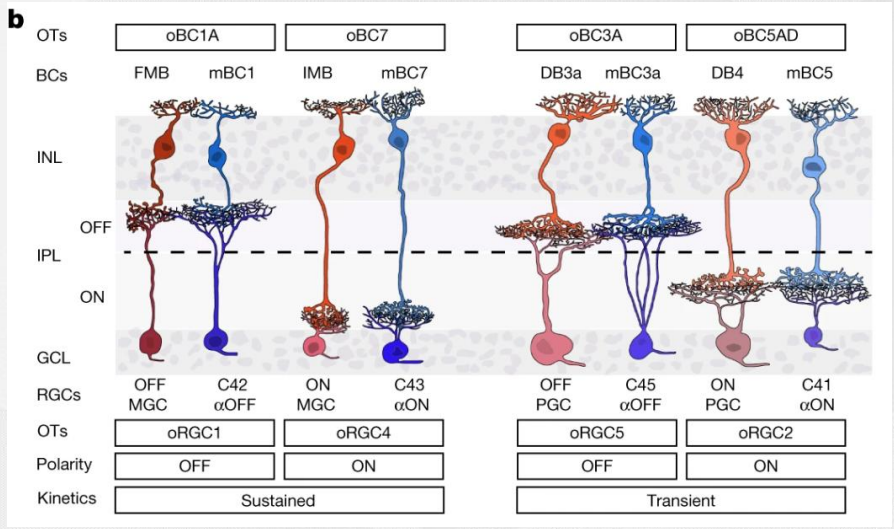

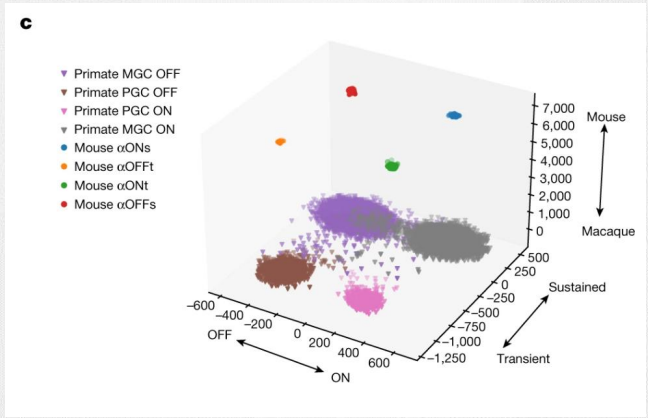

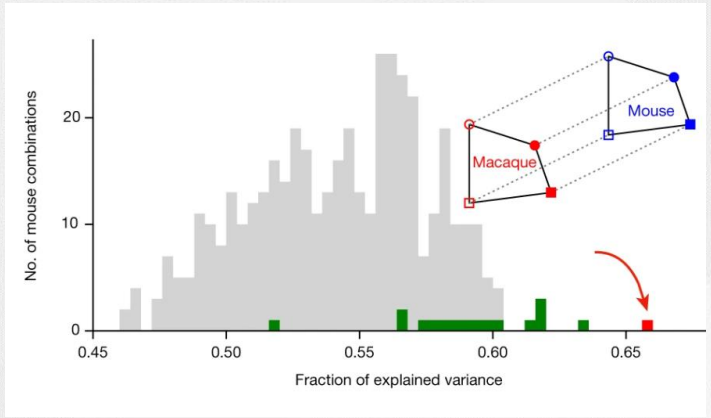

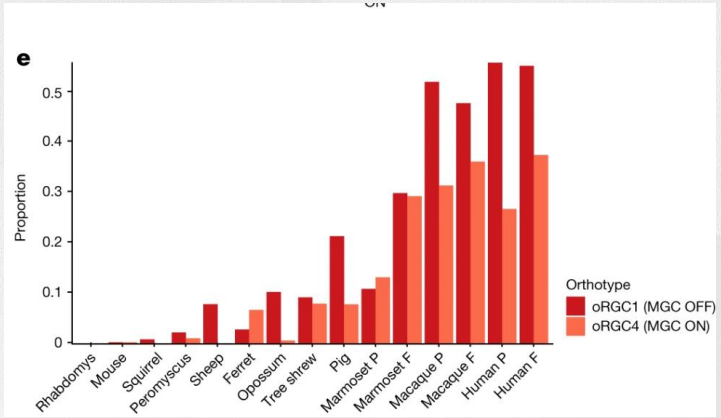

Conclusion

- Despite the evolution of complex and diverse visual systems in jawed vertebrates, our visual cell classes are homologous and conservative after experiencing 500 ma. evolution (Lampreys are lack of homologous genes).

- Class and subclass identity drives transcriptomic similarity more than species differences. RGCs showed highest subtype diversity, which could affect visual ability most.

- Primate-specific midget and parasol RGCs were successfully traced to mouse α-RGCs . Geometric gene analysis confirmed orthology, proving these "primate-specialized" cells originated in early mammals.

Discussion

1. That inspires me that more exploration in the Ave vision system could possibly further our understanding into the limit of the vision system.

2. I think this article places too much emphasis on the homology of visual evolution in vertebrates, while the diversity of the visual system across vertebrate species which correlated with their adaptive evolution is not well discussed. As a result, the overall manuscript lacks the appeal of exploring scientific questions.