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02

Genomic and phenotypic evidence support visual and olfactory shifts in primate evolution

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How does these smell?

Background — Visual Cell to Visual Pigment

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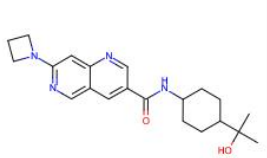
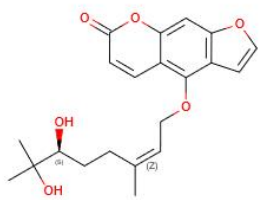
Cone Cells(视锥细胞)

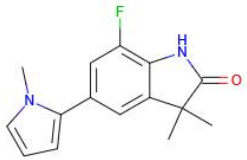
SWS

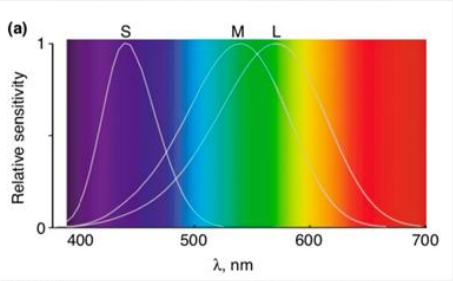


MWS

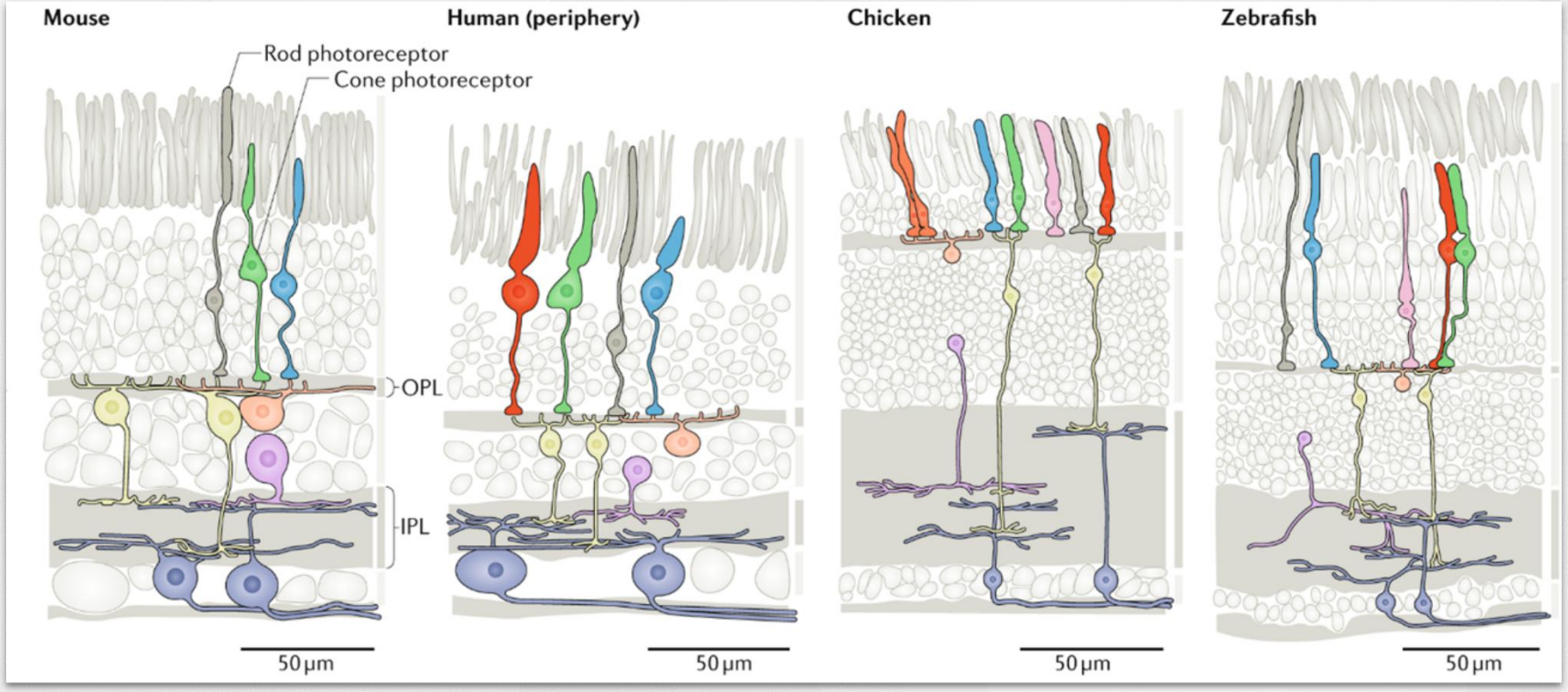


LWS

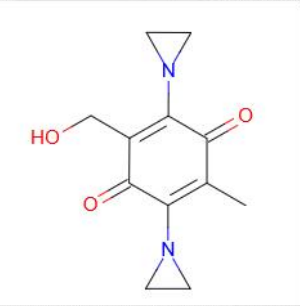




- Perceive colors
- Detects bright light



Rod Cells(视杆细胞)



Rhodopsin 1 (Rh1)

- Slow response to light
- Detects dim light
- Unable to perceive colors

Primate Visual Pigment Differentiation

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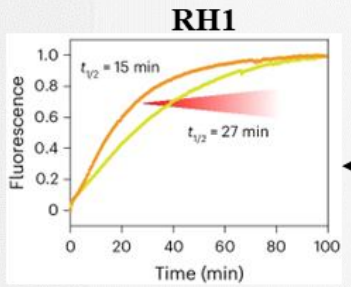
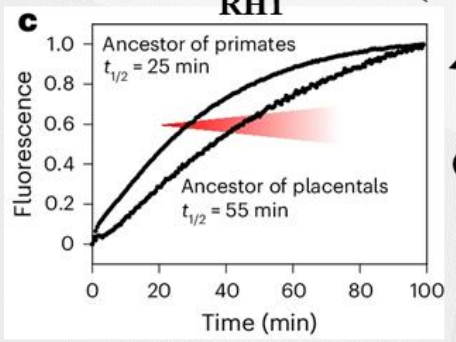
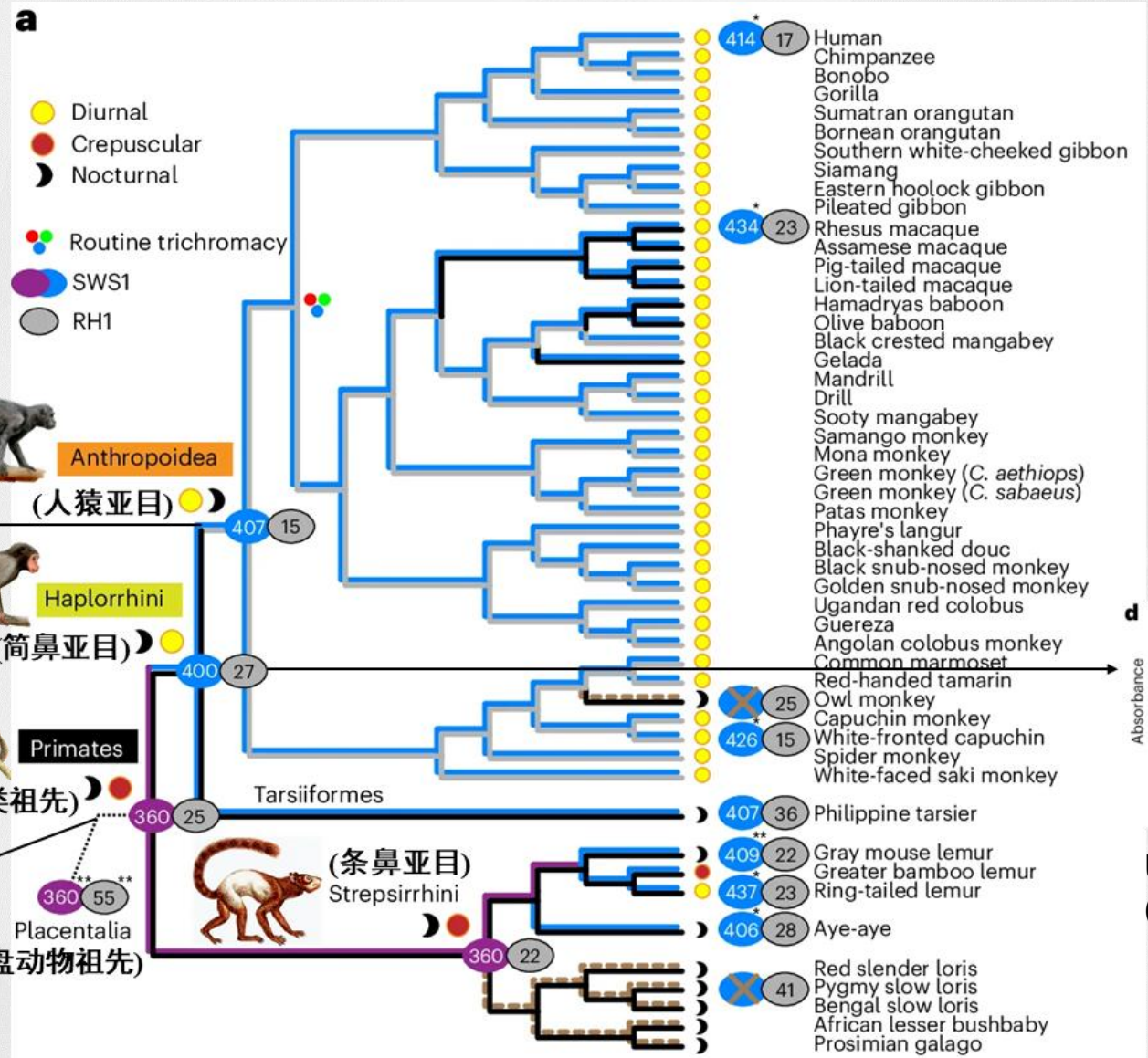
R1 Major Transitions

- Reduced release time
- From Placentalia to Early primates
- From Haplorhines to Anthropoids

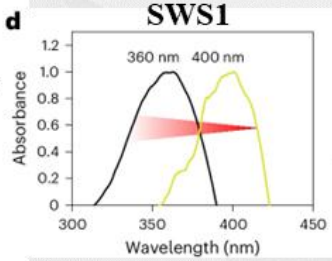






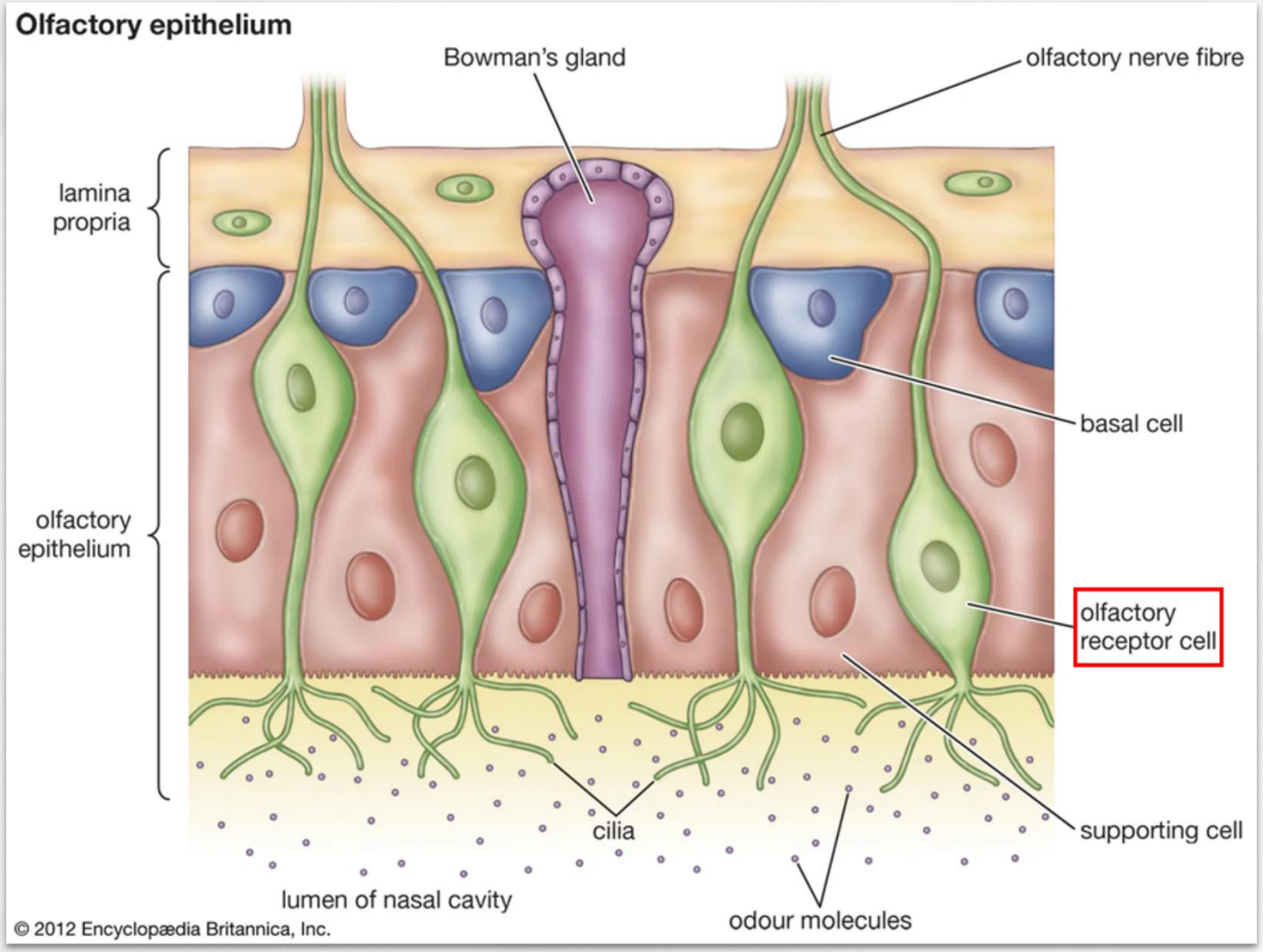
SWS1 Major Transitions

- Wavelength range of light shifted to the right
- From Early primates to Haplorhines



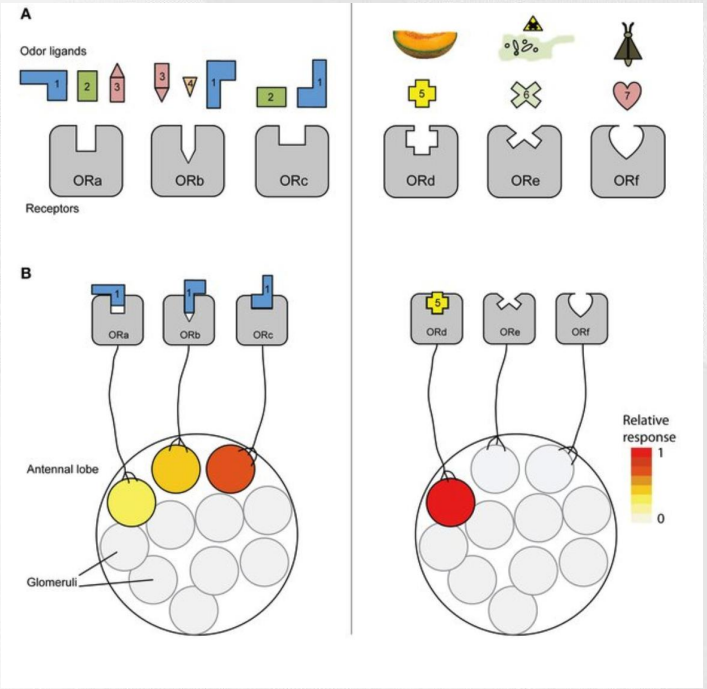
Ultraviolet
(紫外线)

Overview of Olfactory Receptor Function

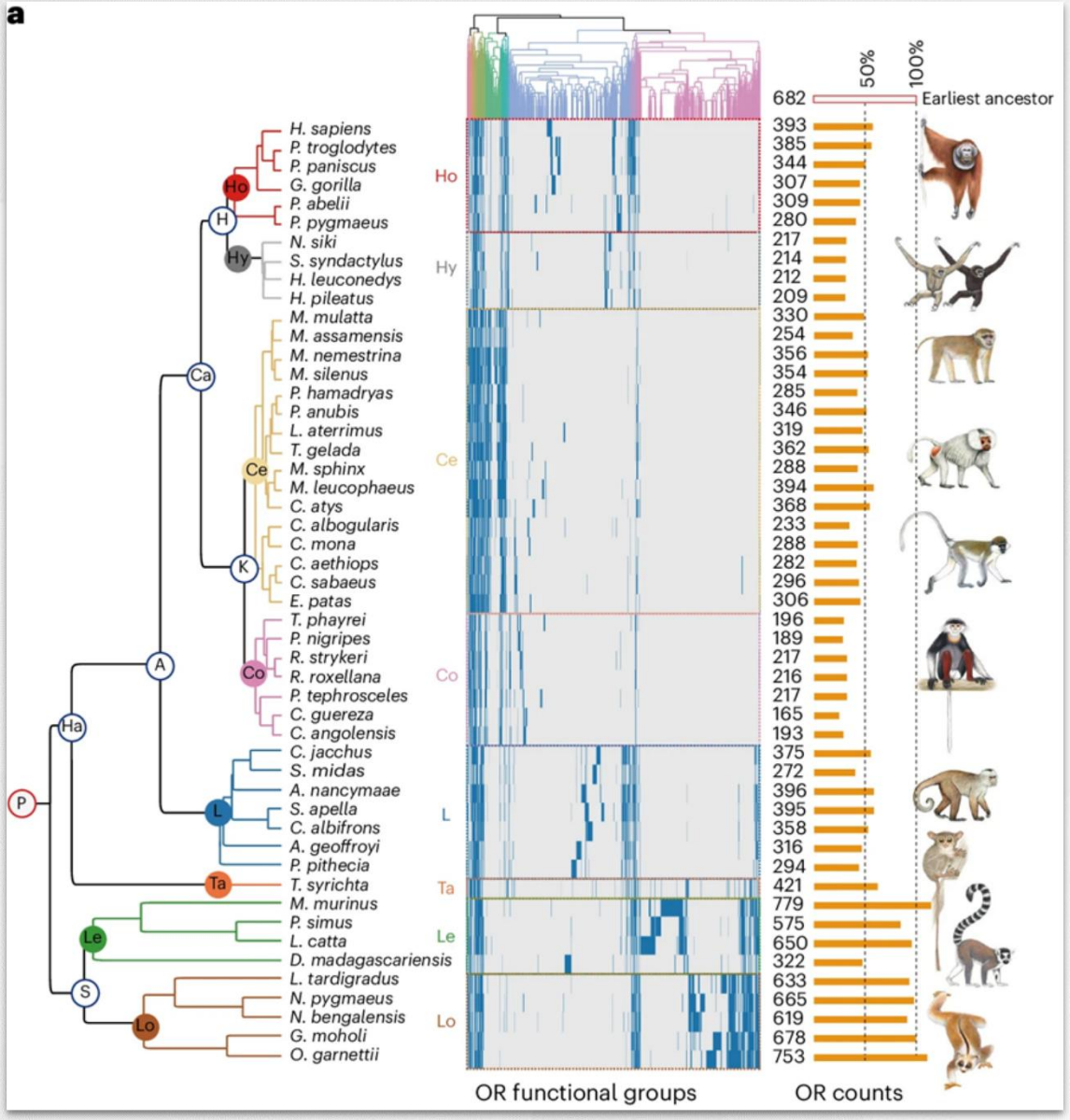


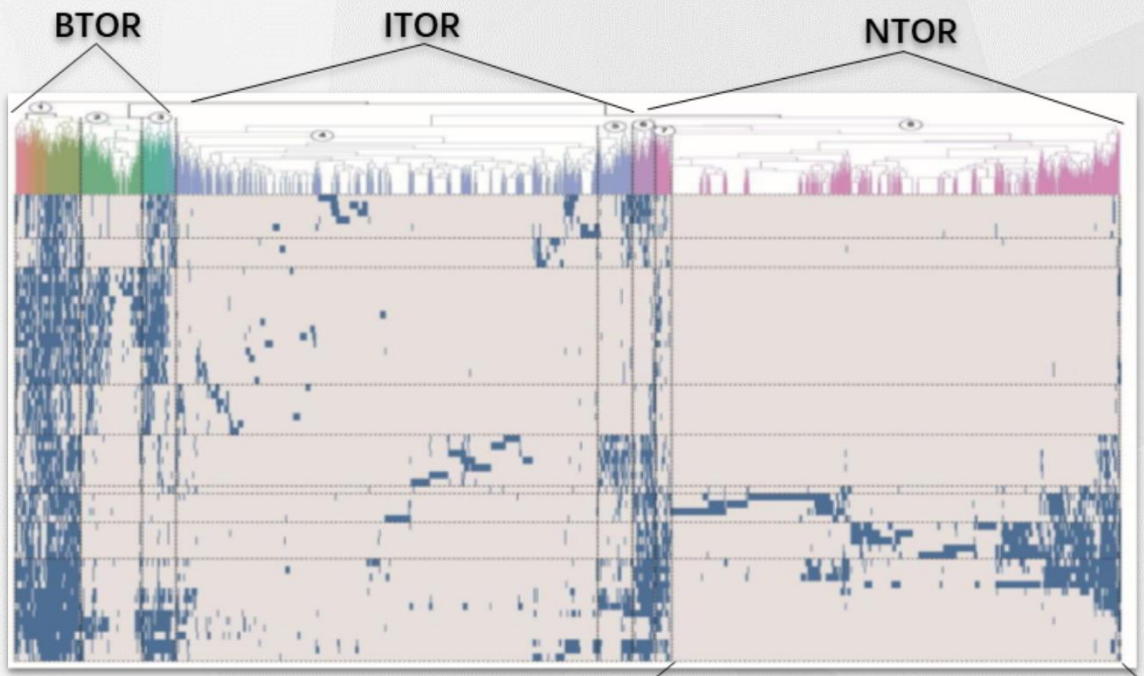
Olfactory receptor cells produce the following olfactory receptors

- BTOR:
  - Shows affinity for a wide range of odors.
- ITOR:
  - Shows affinity for odors in a moderate range.
- NTOR:
  - Shows affinity for a narrow range of odors.

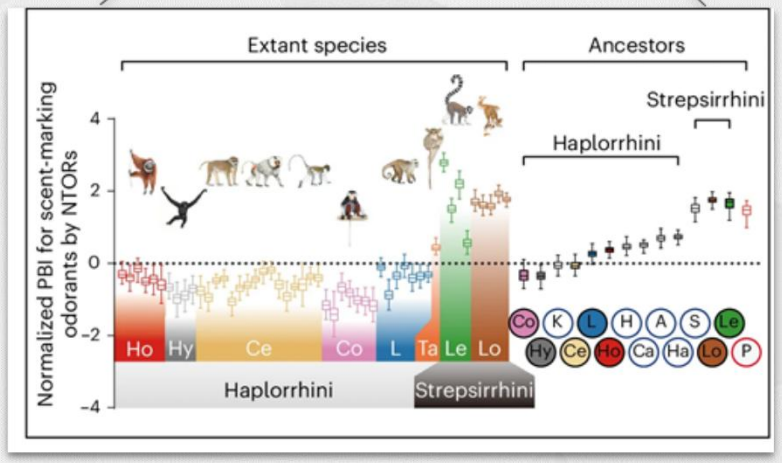


Primate Olfactory Receptor Differentiation

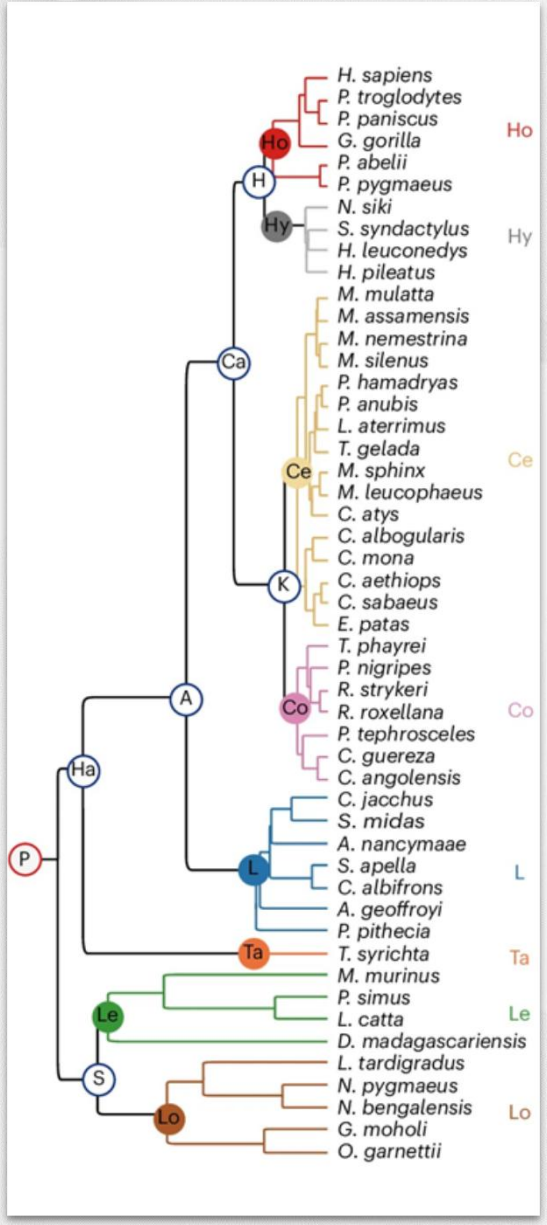


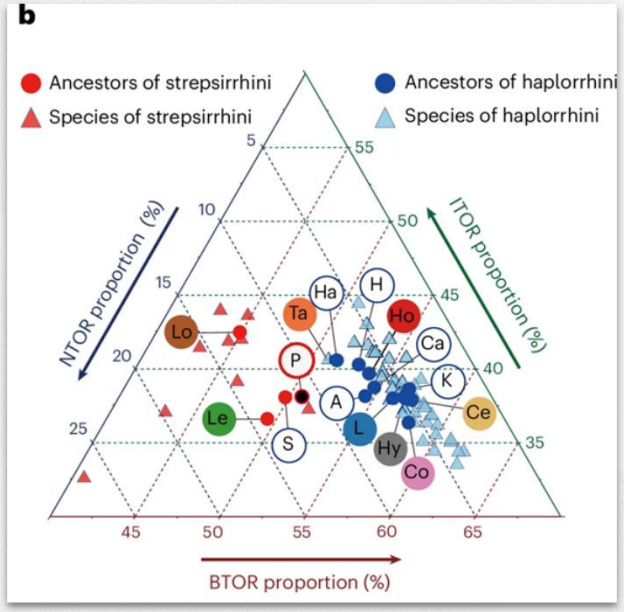


- In NTOR:
  - The number of olfactory receptors in Strepsirrhines is significantly higher than in Haplorhines.



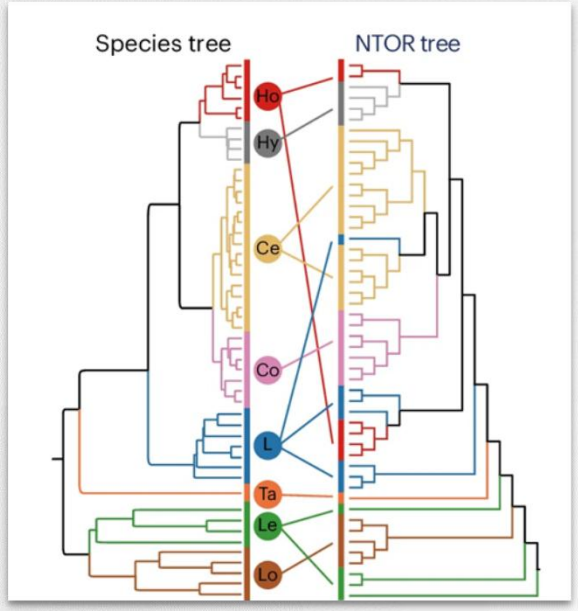
Olfactory Receptor Clades in Phylogenetic Tree

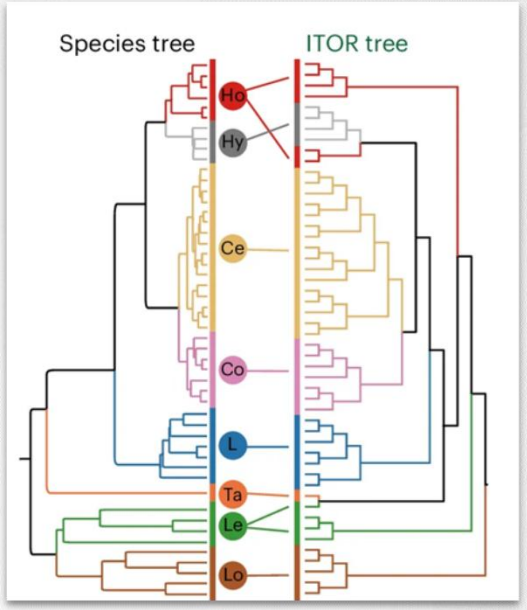


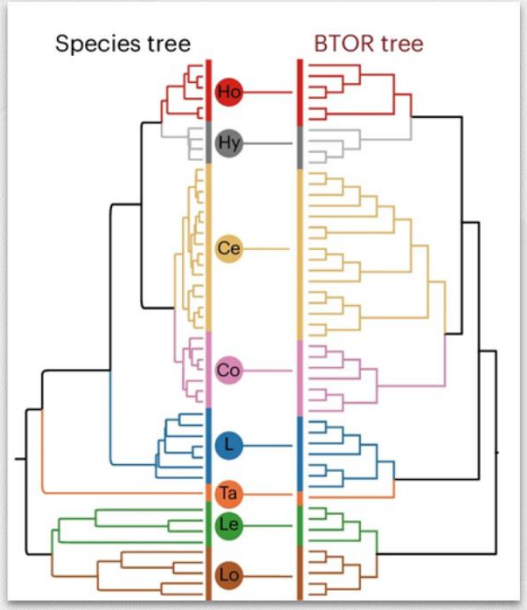


- The proportion of BTOR receptors in Haplorhines is significantly higher than in Strepsirrhines.

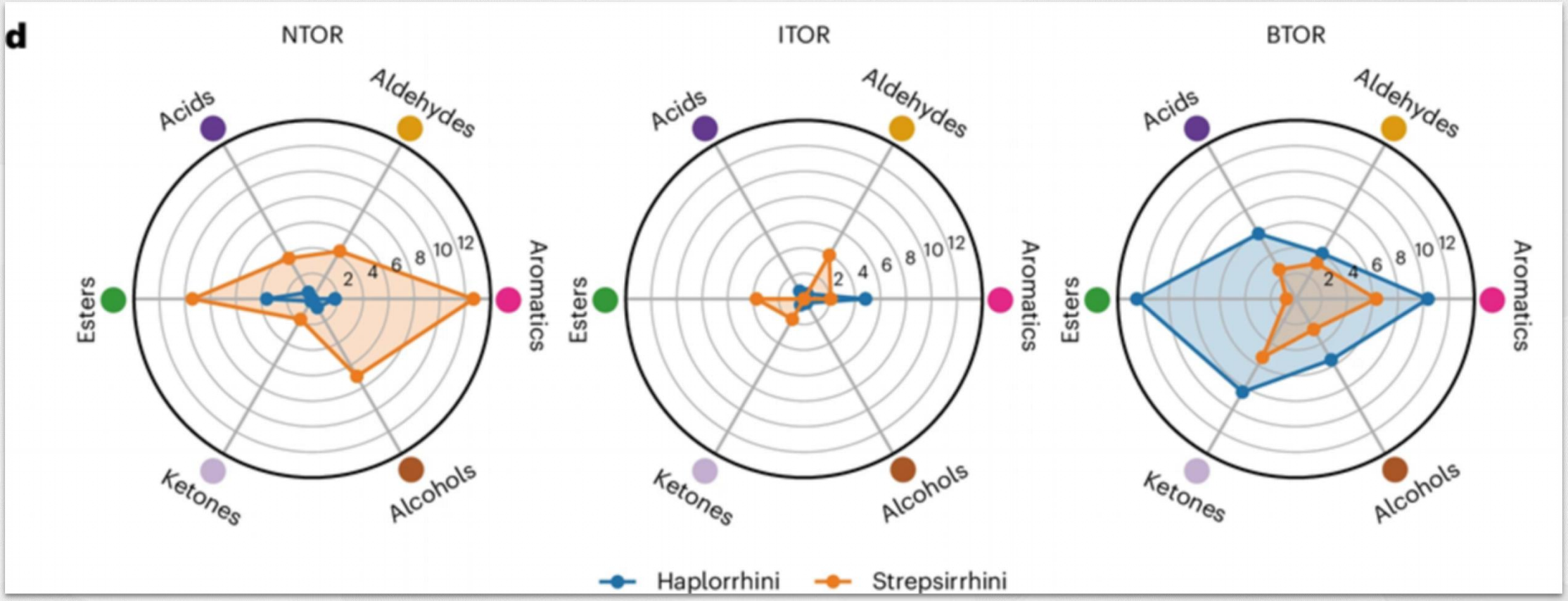
- Among the three types of OR receptors
- BTOR receptors fully align with the primate phylogenetic tree







Primate Olfactory Functional Preferences



- Strepsirrhines have a stronger perception ability in a narrower range of odors (NTOR).
- Haplorhines have a stronger perception ability in a broader range of odors (BTOR).

- There are significant differences in odor perception abilities across different odor ranges in primates.

Core issue

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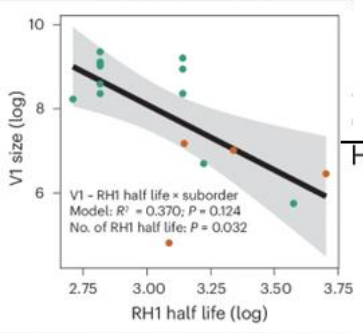
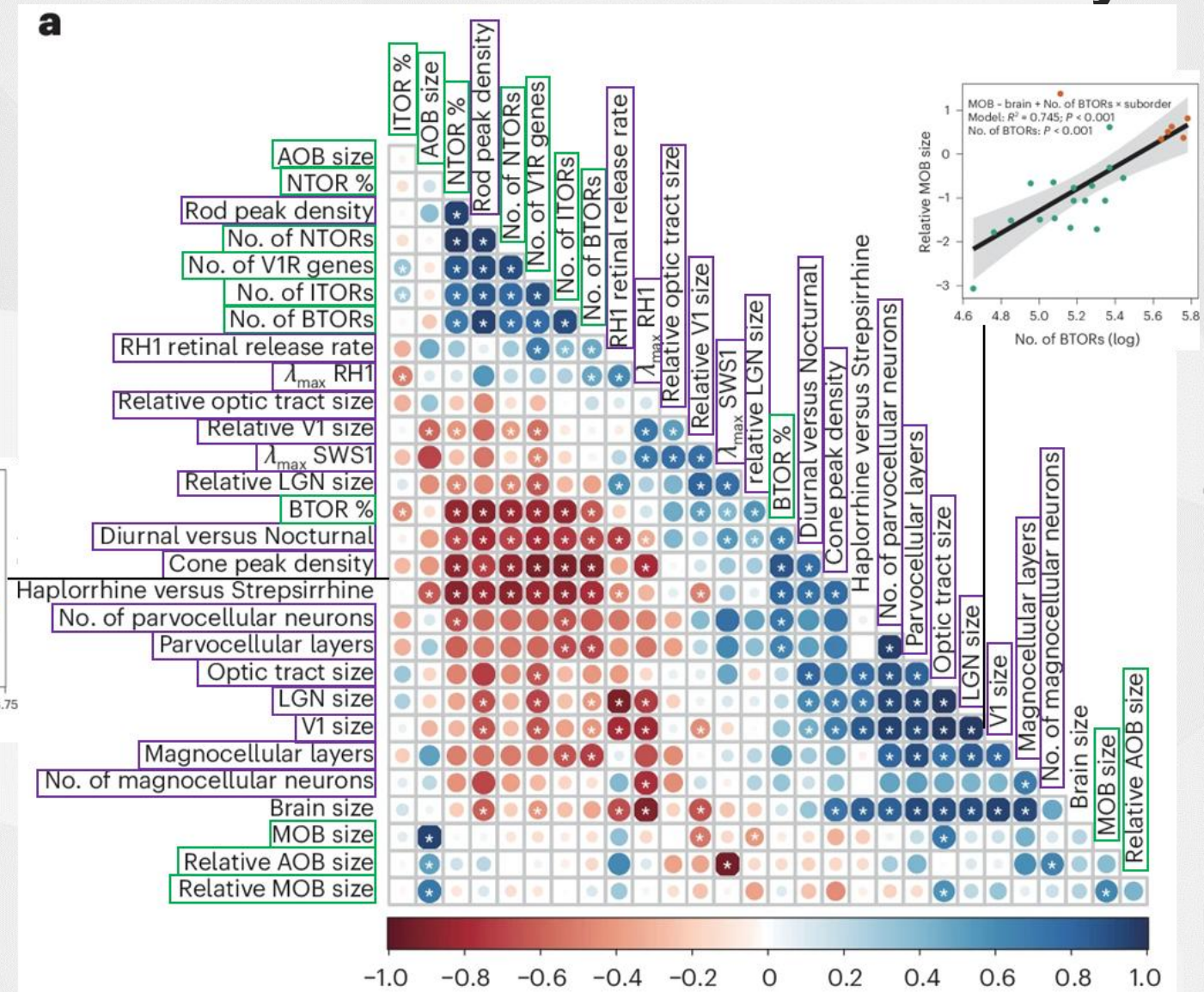
So, is there a correlation between vision and olfaction?

Correlation Between Visual and Olfactory Functions





- The correlation between the visual system and the olfactory system:
  - **Both** visual and olfactory systems are **positively** correlated within each system.
  - There is a **negative** correlation **between** the visual and olfactory systems.

Conclusion

- In primates, the visual system of Haplorhines has been enhanced during evolution, which may be related to their diurnal behavior.

- In primates, the narrow-range olfaction of Strepsirrhines has diverged during evolution, which may be related to their dietary habits.

- There is a negative correlation between the visual and olfactory systems in primates, which may be the result of competition between the two systems or a balanced allocation of resources.

Discussion

- **Is there a competitive relationship between the visual system and the olfactory system in primates?**

➢ From the correlation, we found that there is a negative correlation between the visual and olfactory systems in primates. Is this negative correlation due to competition between the two systems during evolution, or is it a result of primates balancing and allocating resources between the two systems?

- **The article has certain limitations, as it does not further explore the potential co-evolution between the visual system and the olfactory system.**

➢ The article stops abruptly after completing the correlation analysis of the two systems. I believe further work can be done by constructing a phylogenetic tree based on the amino acid sequences of visual pigments in extant primates, and then performing a co-evolution analysis with the phylogenetic trees of various OR receptors. This could further determine whether there is a co-evolutionary relationship between the visual and olfactory systems.