Transcriptional interferences ensure one olfactory receptor per ant neuron

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Article

Transcriptional interferences ensure one olfactory receptor per ant neuron

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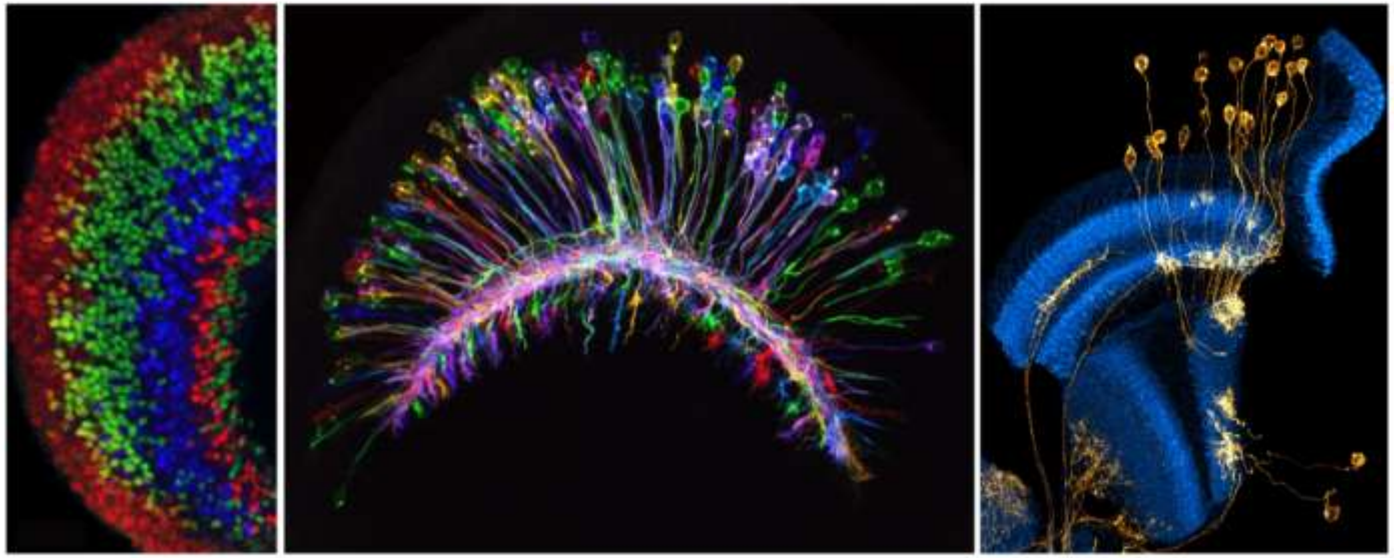
Bogdan Sieriebriennikov[1,2], Olena Kolumba[1,3], Aurore de Beaurepaire[1], Jennifer Wu[1], Valentina Fambri[1,3], Eva Bardol[1], Yuwei Zhong[1], Ildar Gainetdinov[1], Danny Reinberg[4]✉, Hua Yan[2]✉ & Claude Desplan[1,3]✉



Welcome to the **Desplan Lab**! Our lab focuses on issues of neural development and aging in *Drosophila* and in ants:

Claude Desplan

Silver Professor; Professor of Biology and Neural Science

Top co-authors

Bogdan Sieriebriennikov
New York University

Alba Corman
Karolinska Institutet

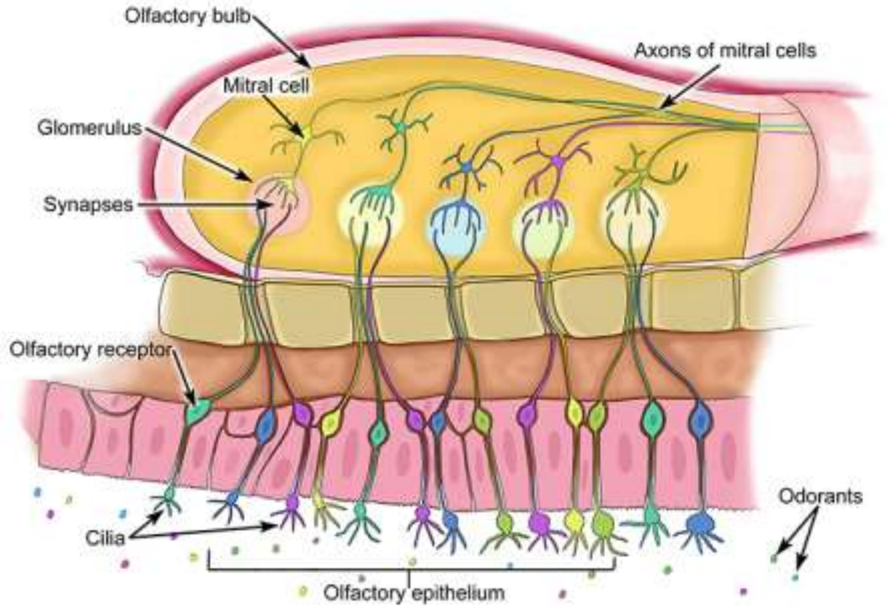
Ildar V Gainetdinov
New York University

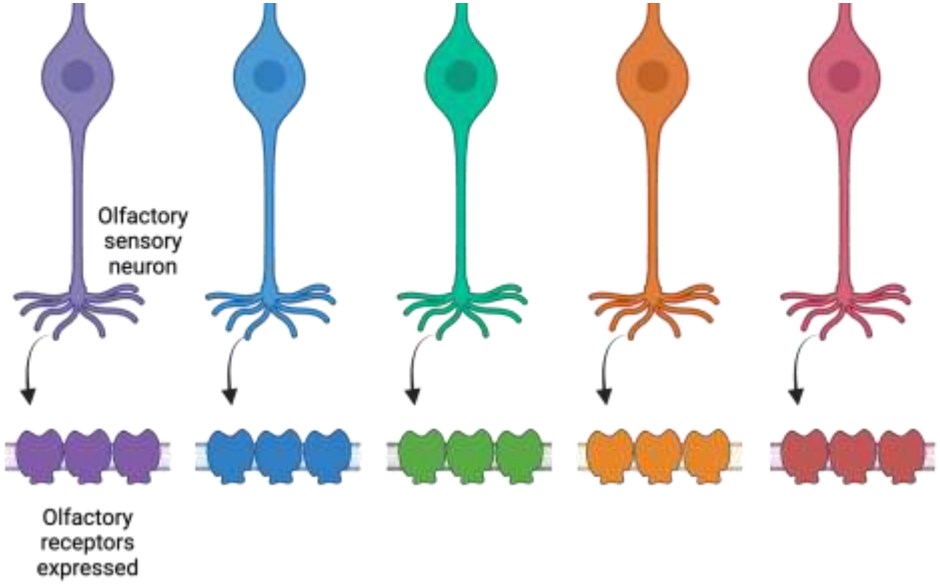
Simon Müller
New York Genome Center

Lu Lu
New York University

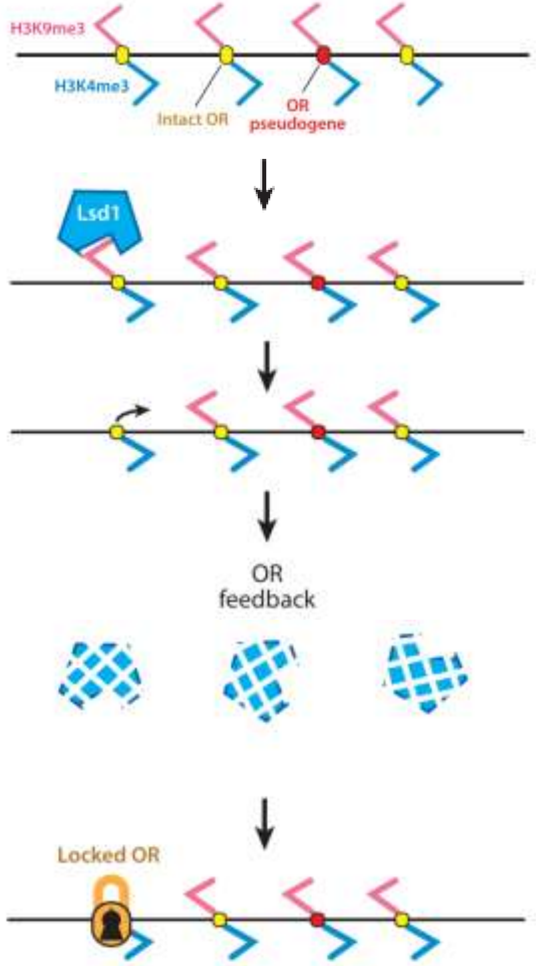
Background

One-Neuron-One-Receptor



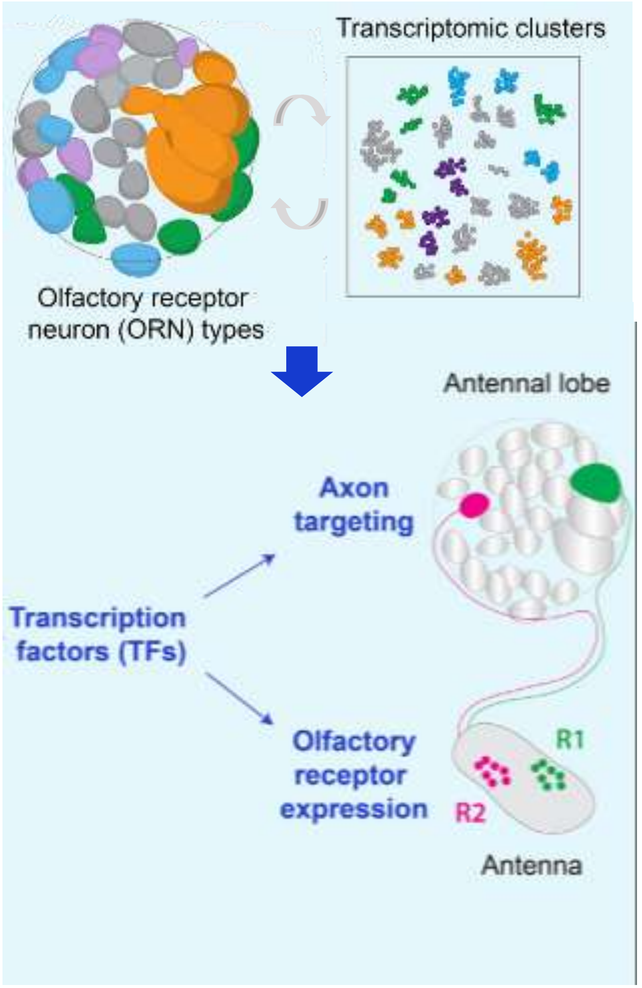


Mouse – over 1,400 Or genes



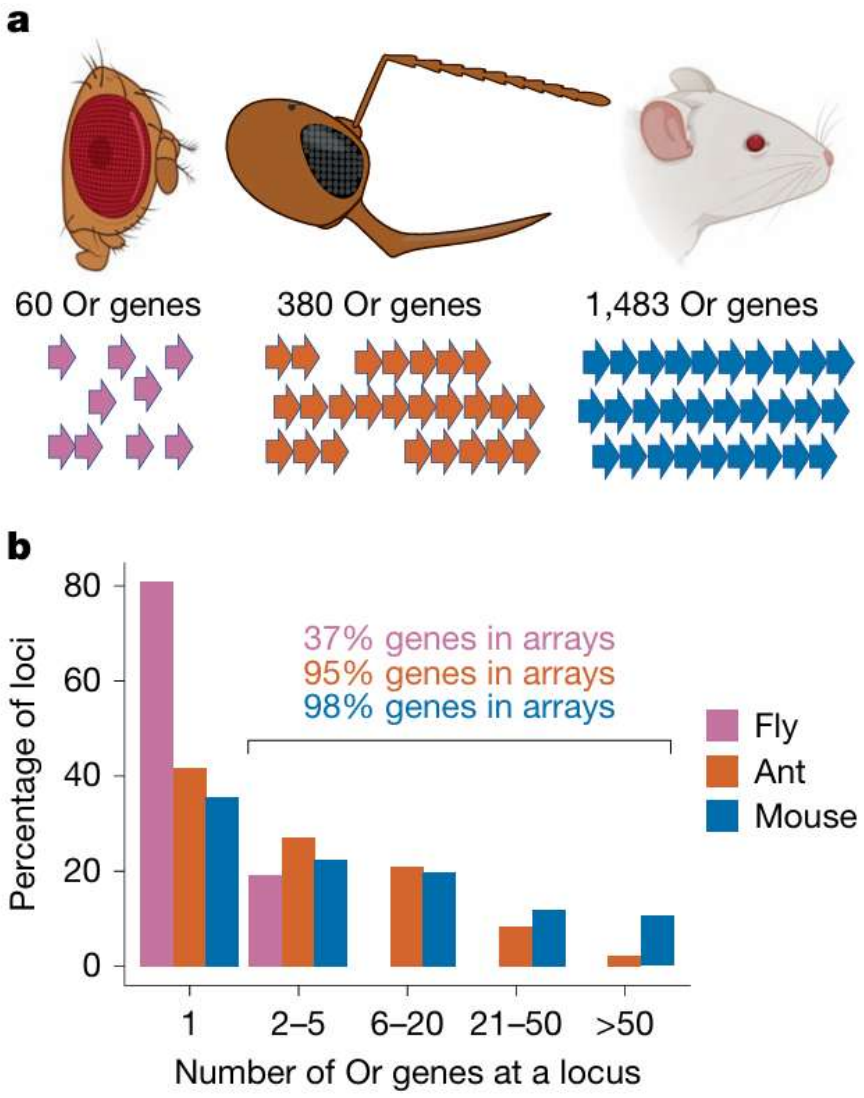
Dalton, R. P. & Lomvardas, S. Chemosensory receptor specificity and regulation. Annu. Rev. Neurosci. 38, 331–349 (2015).

Fly – 60 Or genes



McLaughlin, C. N. et al. Single-cell transcriptomes of developing and adult olfactory receptor neurons in Drosophila. eLife 10, e63856 (2021).

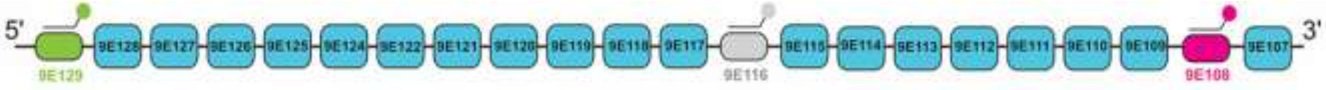
Case in *Harpegnathos.saltator.*

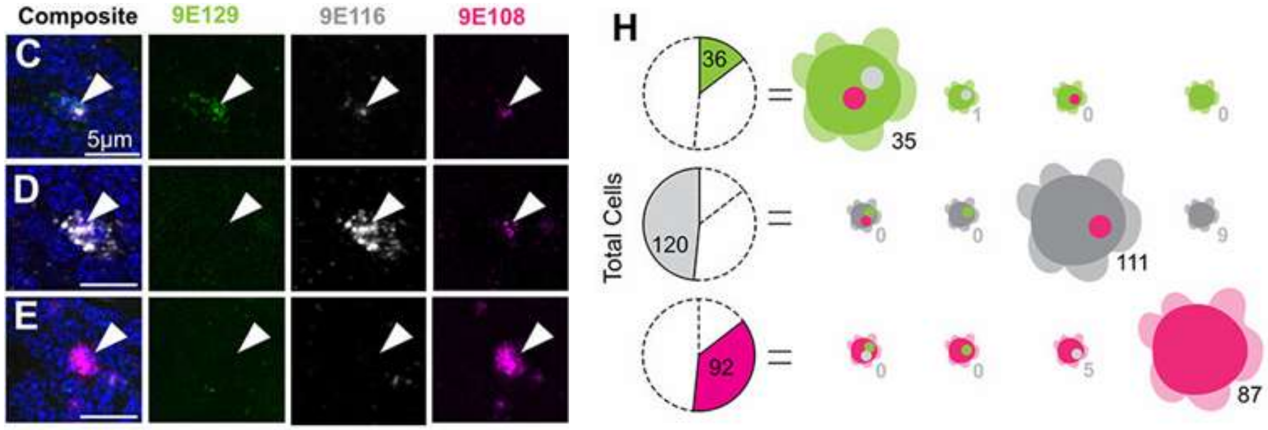


Tandem duplications

Only RNA from a single odorant receptor is exported into the cytoplasm

Transcriptional and post-transcriptional control of odorant receptor choice in ants



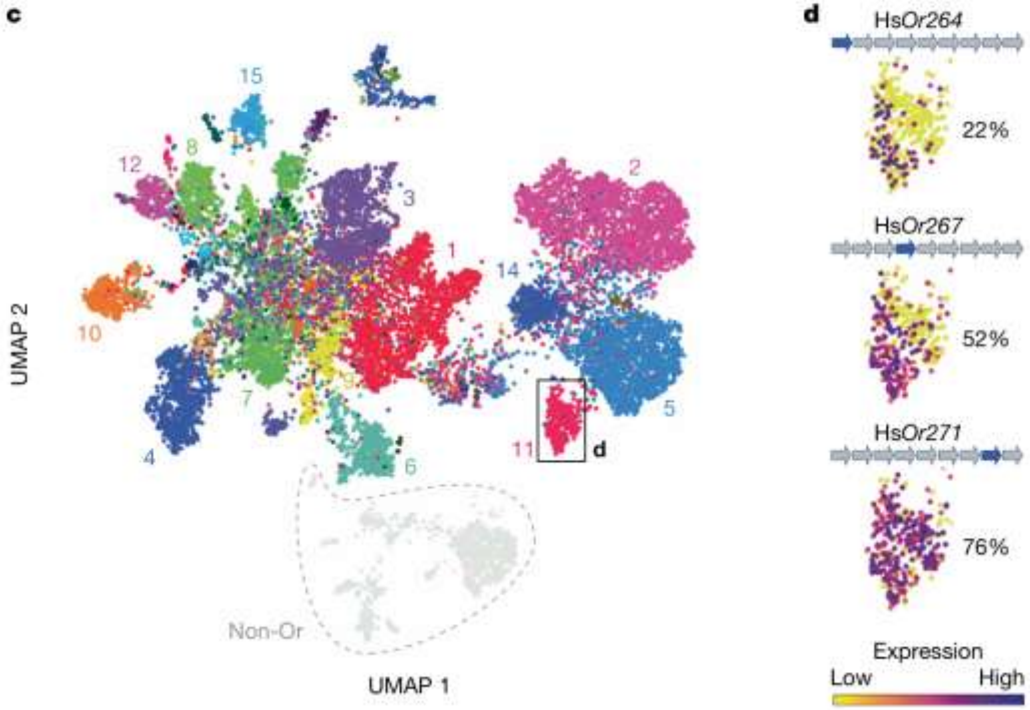


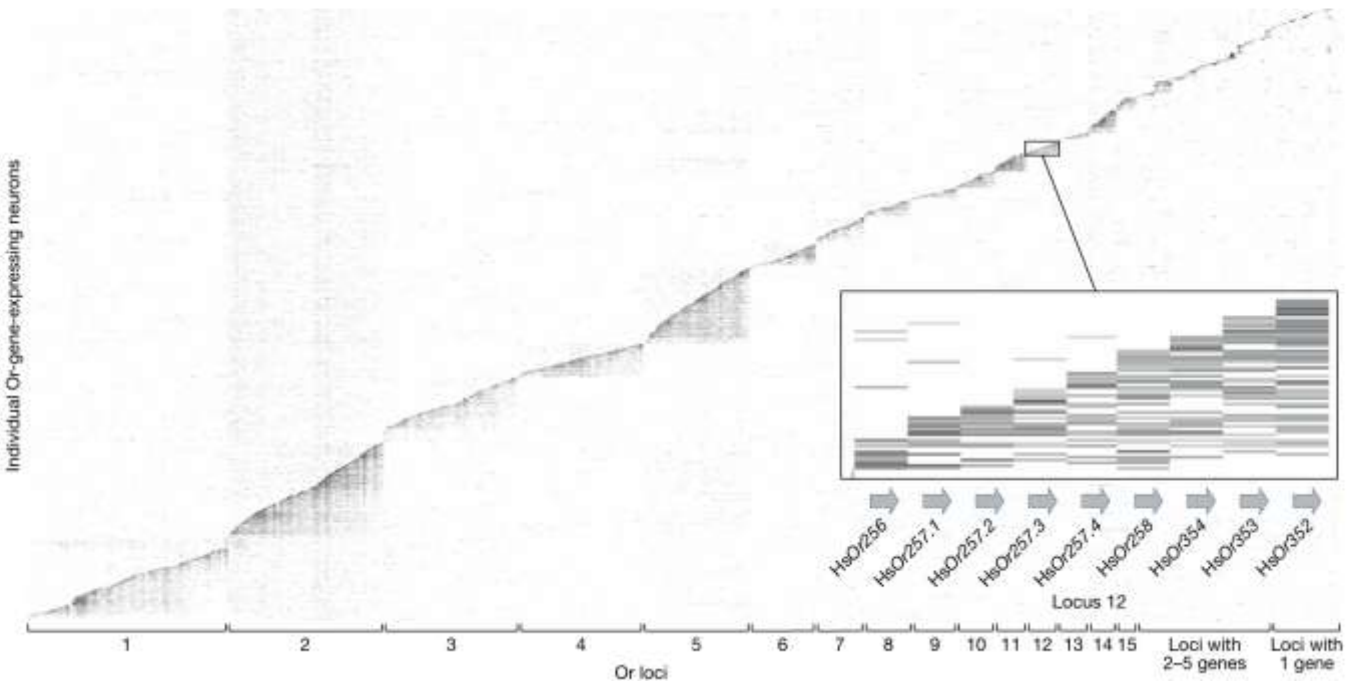
Brahma, A. et al. Transcriptional and post-transcriptional control of odorant receptor choice in ants. Curr. Biol. 33, 5456–5466 (2023).

Or – gene expression pattern

Neurons expressing Or genes from the same genomic array clustered together

Stair-step co-expression pattern

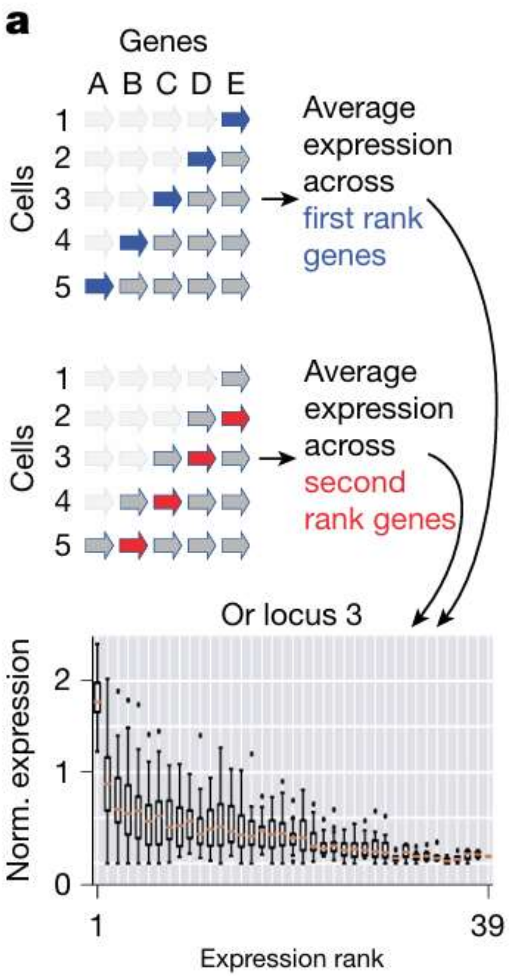


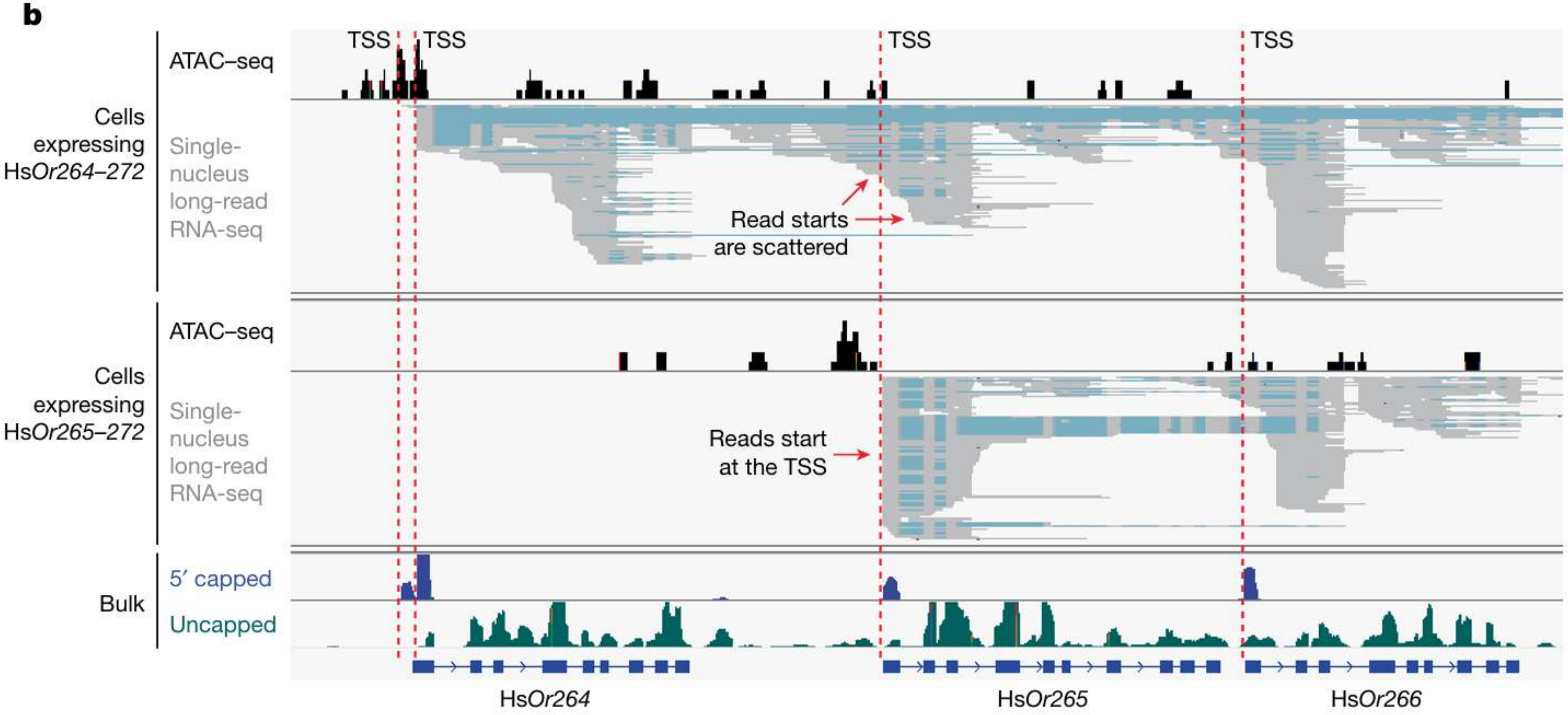


multimodal snRNA-seq and snATAC–seq

Co-transcription through Pol II readthrough

Only the promoter of the first transcribed OR gene in an array exhibited a peak of open chromatin



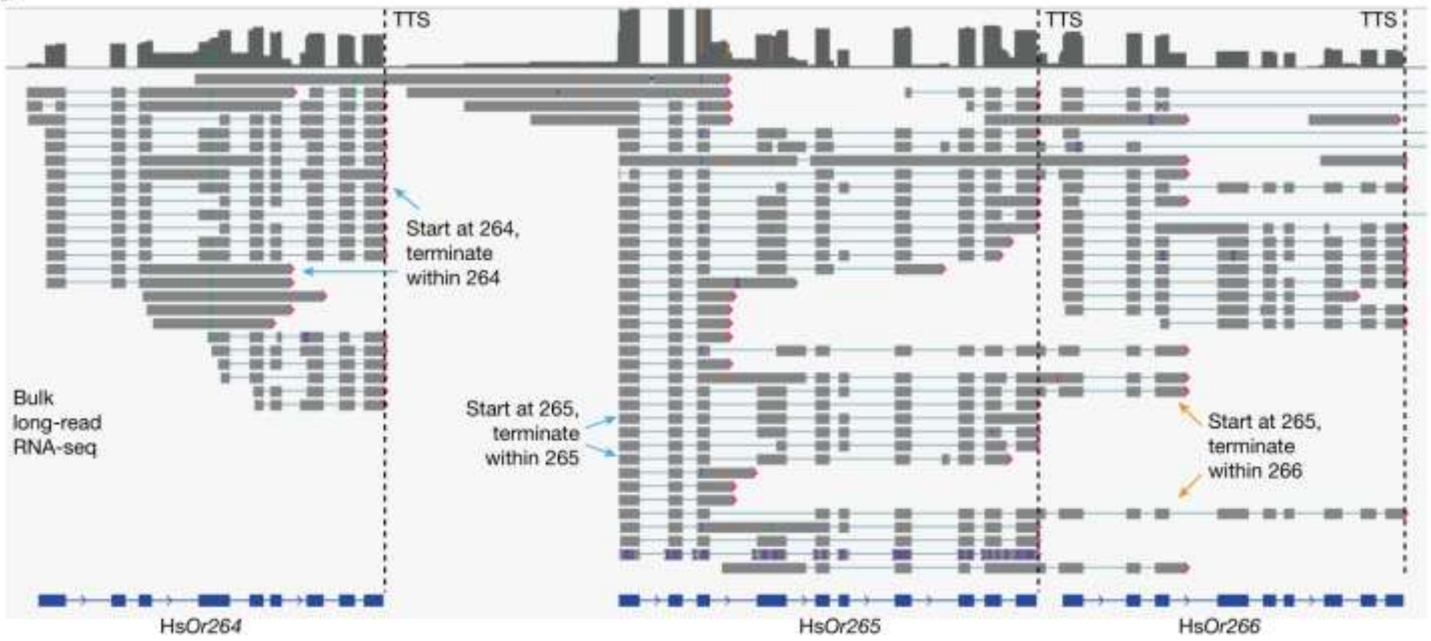


snRNA-seq

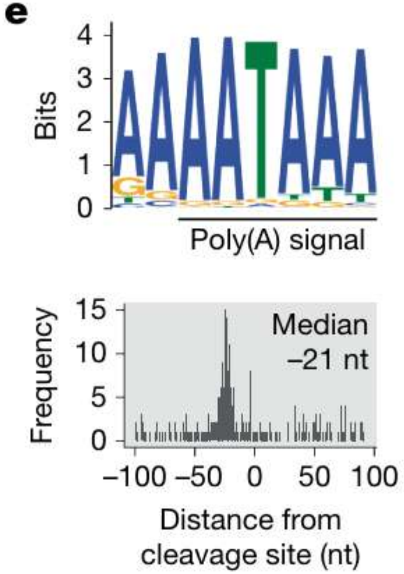
What caused Pol II readthrough ?

Lack functional polyA signals? --Normal 3′ cleavage and polyadenylation

d

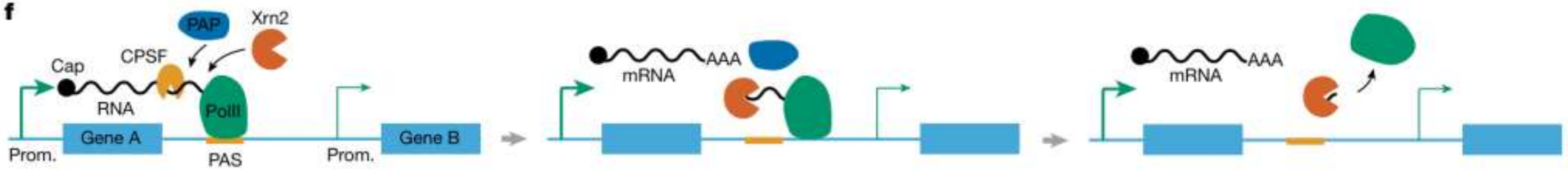


e

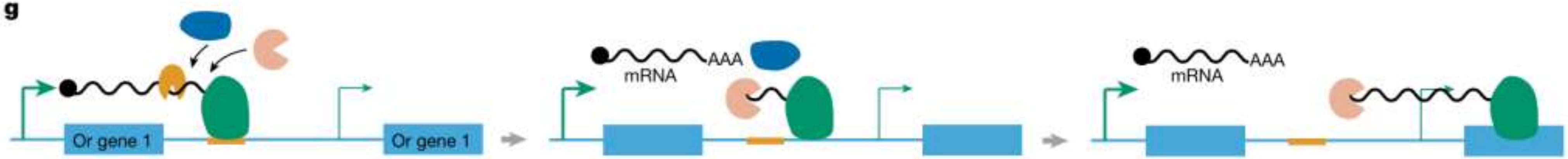


Defective transcription termination

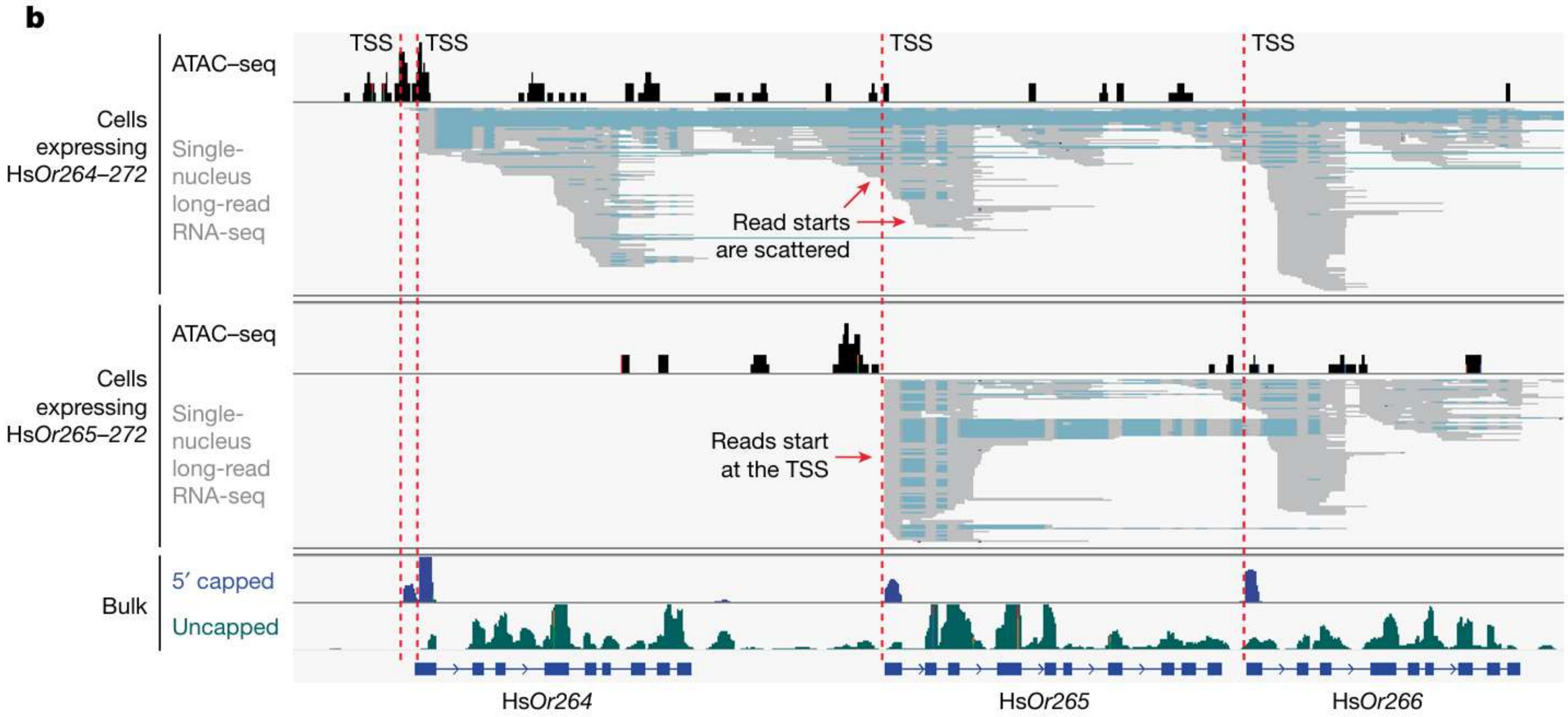
f



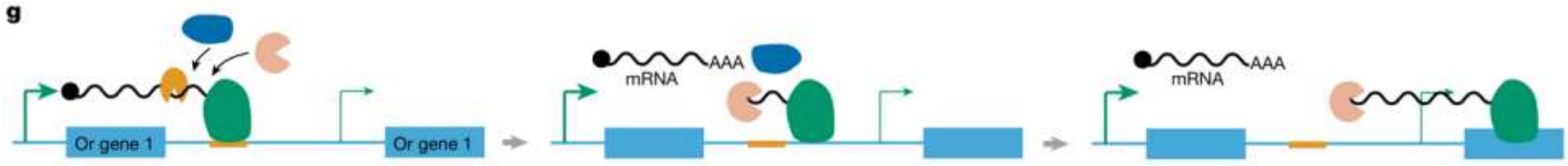
g



What caused Pol II readthrough ?



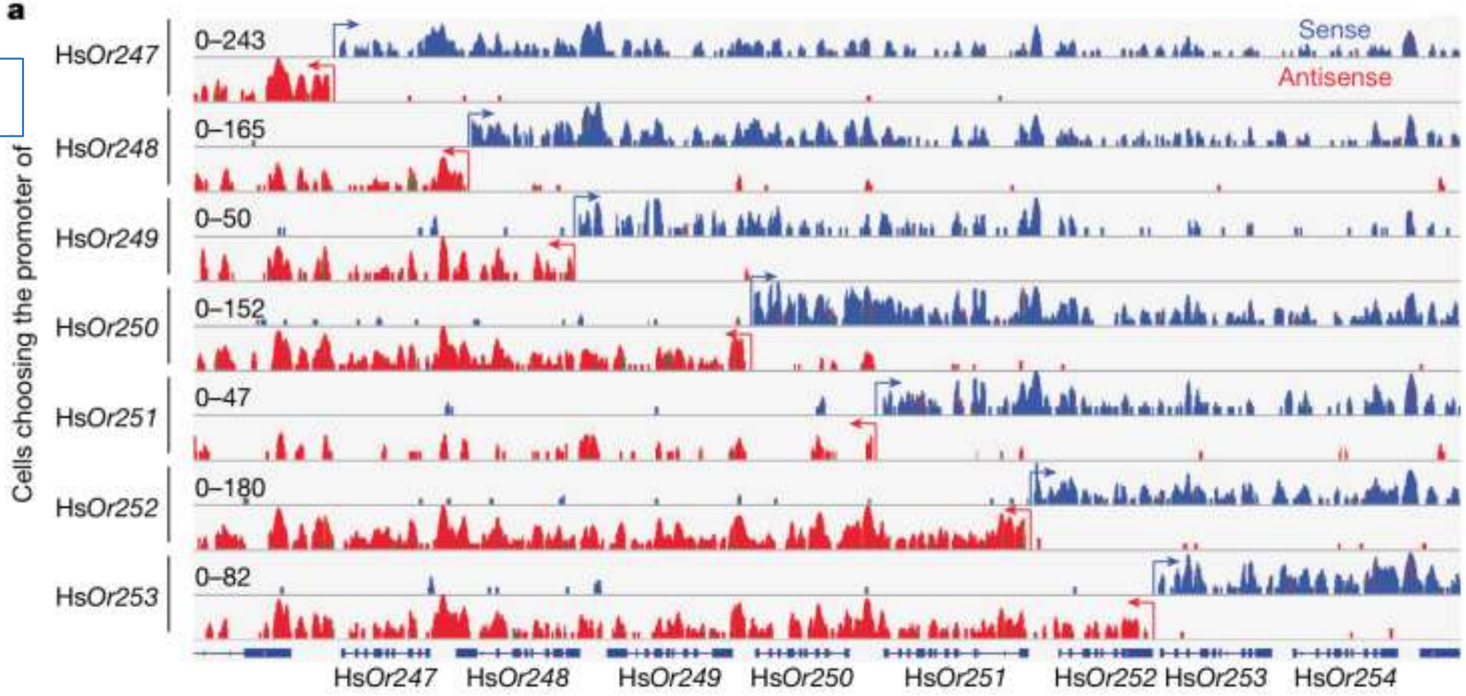
Defective transcription termination



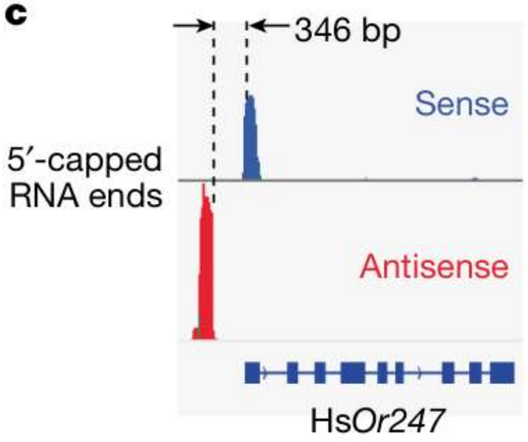
Or promoters produce antisense RNAs

The entire locus was covered by either sense or antisense transcripts that were mutually exclusive

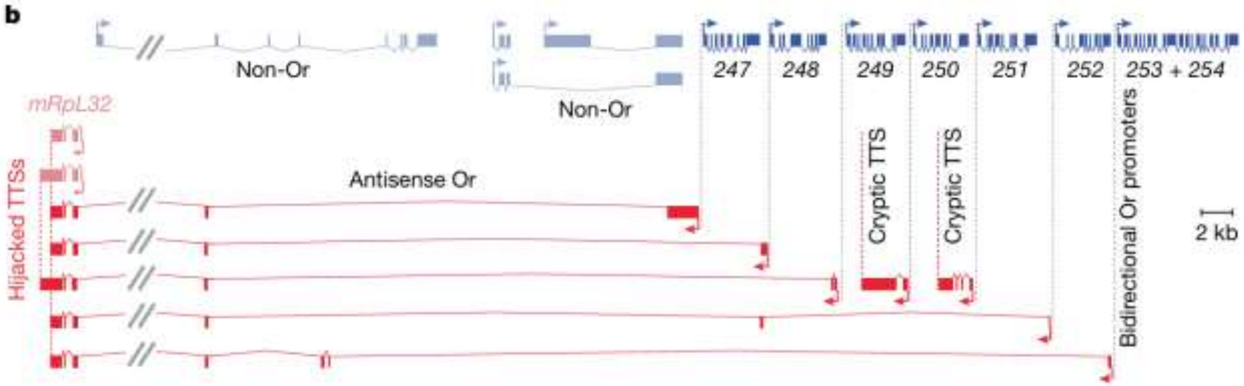
snRNA-seq

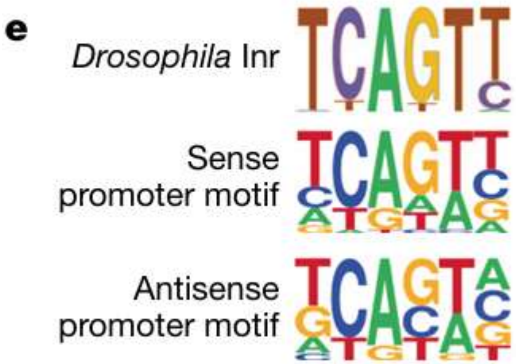


bulk RNA-seq of 5′-capped transcripts



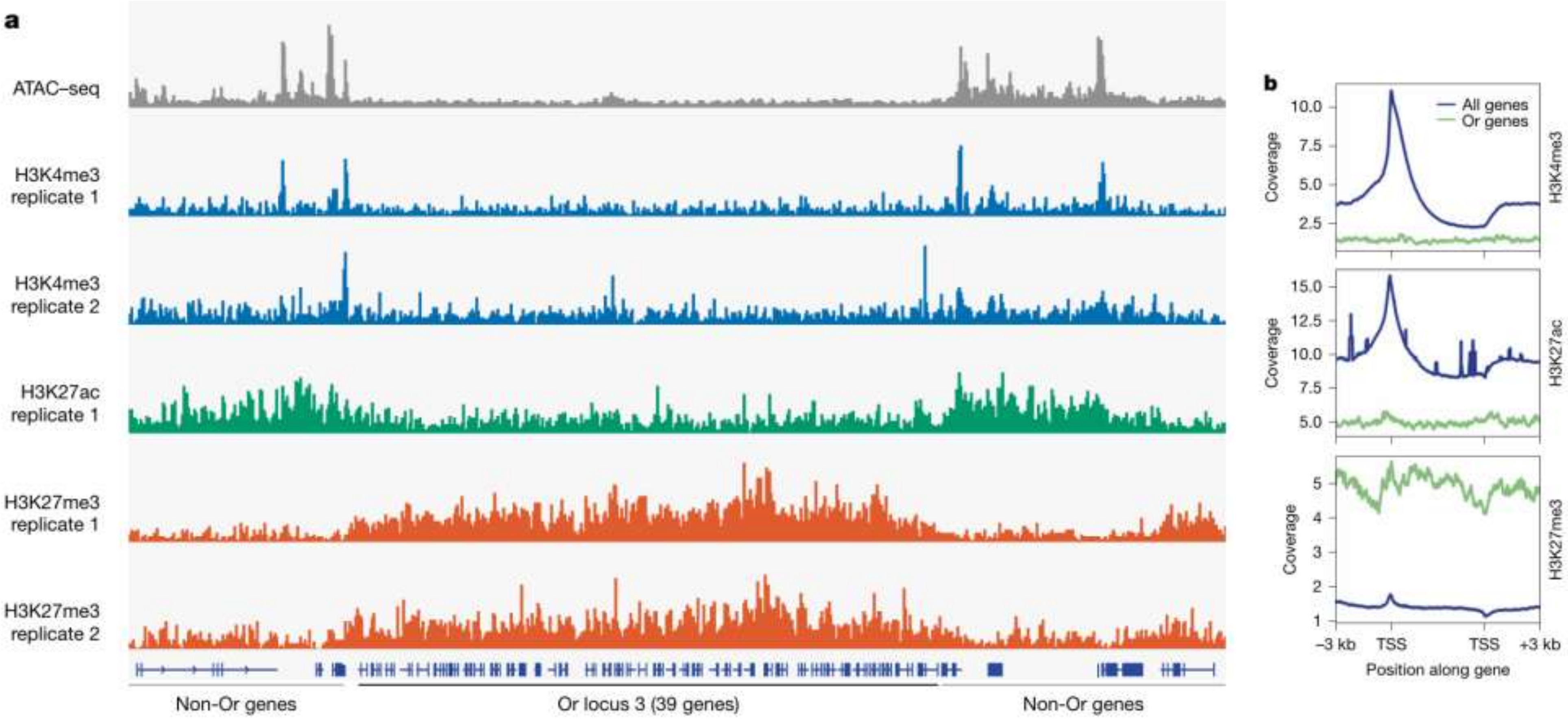
bulk Iso-seq





No obvious shared enhancers in Or gene arrays

Or genes are transcriptionally silent in most cells



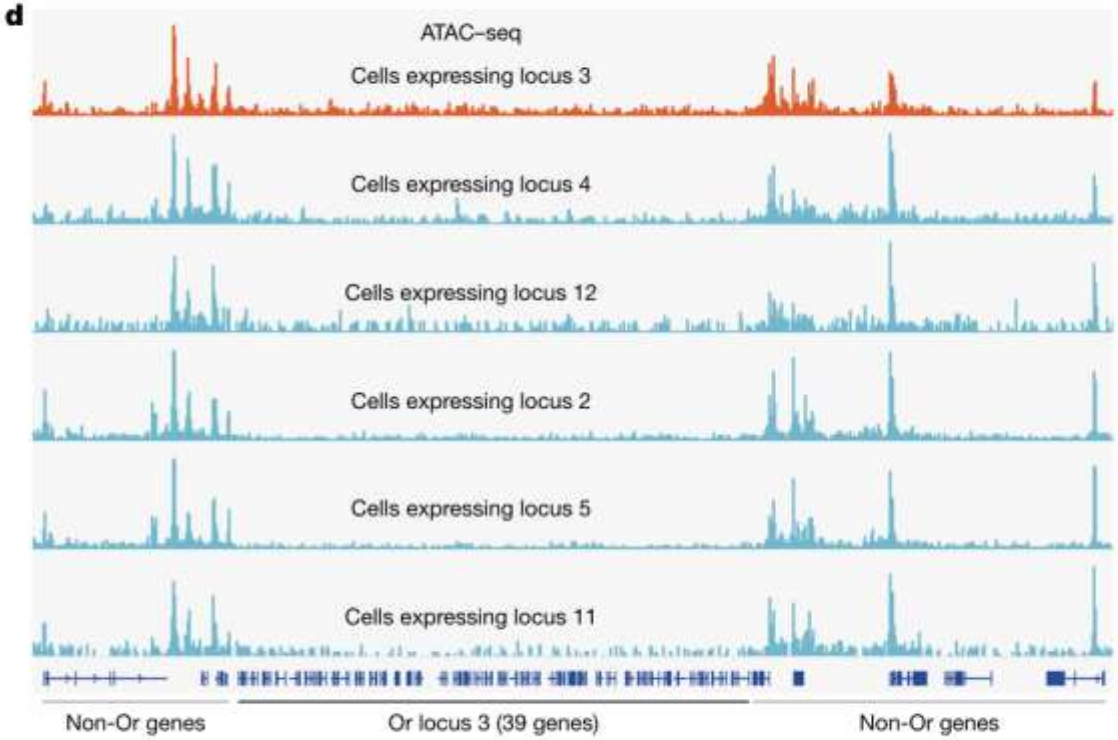
active mark

repressive mark

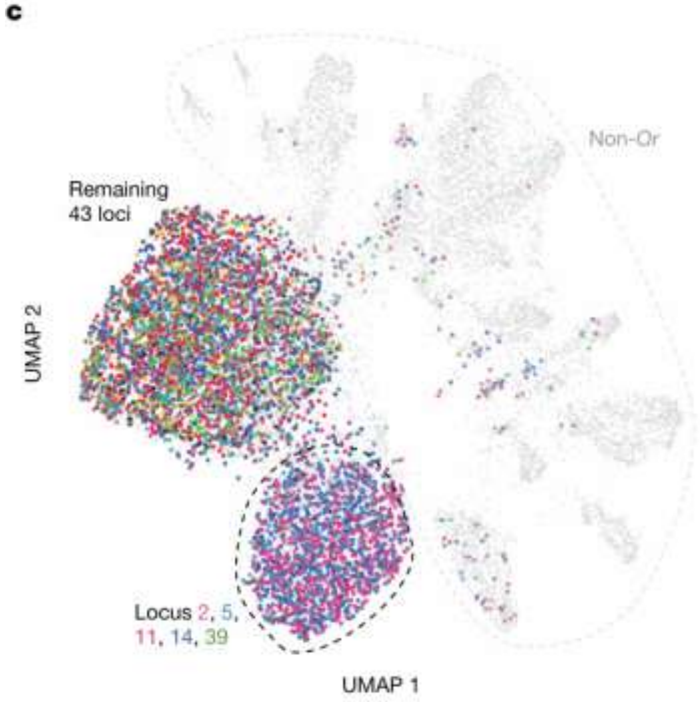
Pseudobulk snATAC-seq and bulk CUT&RUN

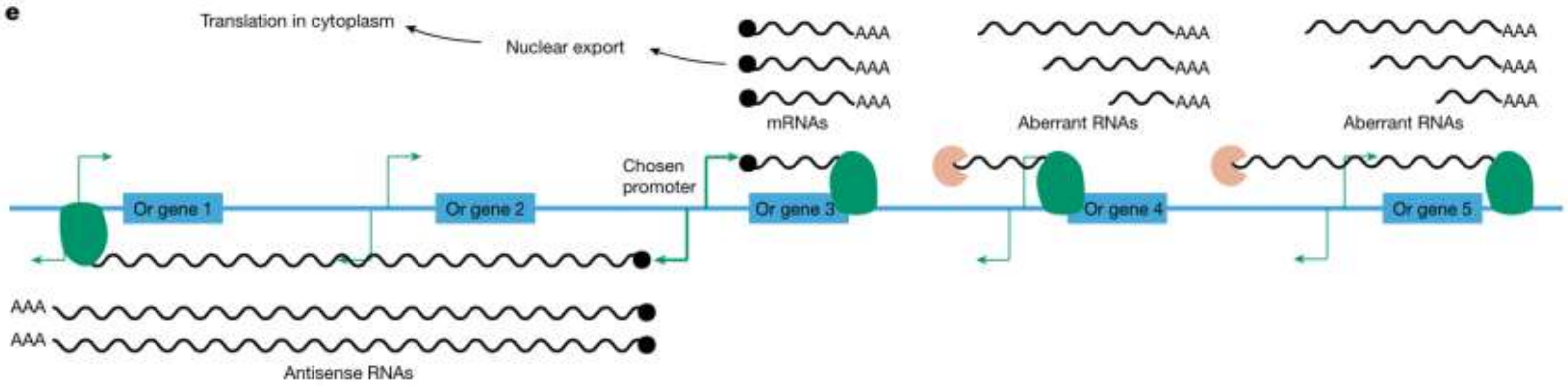
No obvious shared enhancers in Or gene arrays

no specific, shared regions of open chromatin



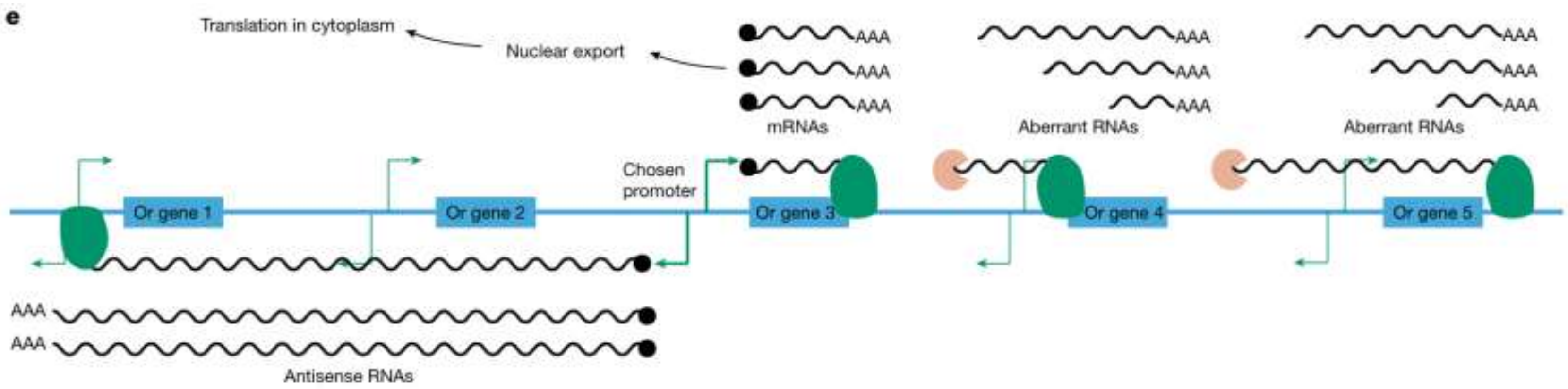
large-scale epigenetic state defines general neuronal function, not the choice of a specific receptor gene.





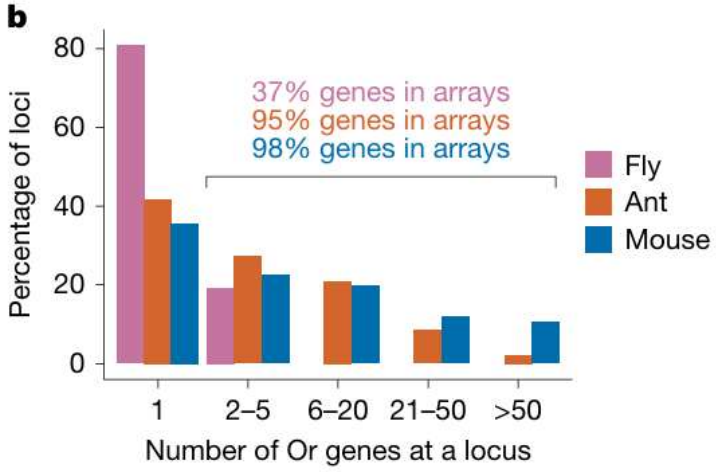
Summary and Discussion

Transcription-interference-based mechanism



Why transcription termination is defective specifically at these loci ?

How the initial promoter is chosen ?



Thanks!

Qiu shihang 20260123