

# 3D vision in the animal kingdom

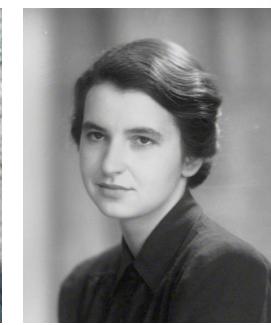
Which species, at what cost, and for which advantages?

# Many species, of different taxa



... have stereovision

# Many species, of different taxa



... have stereovision

# Many species, of different taxa



... have stereovision

# Ingredients for stereovision

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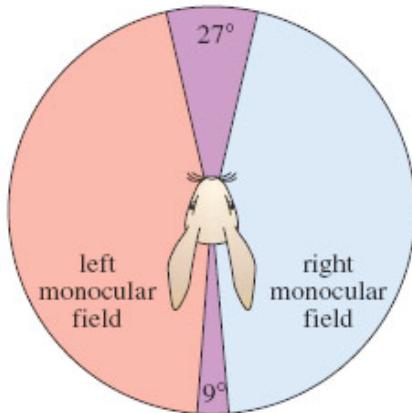
- Binocular overlap



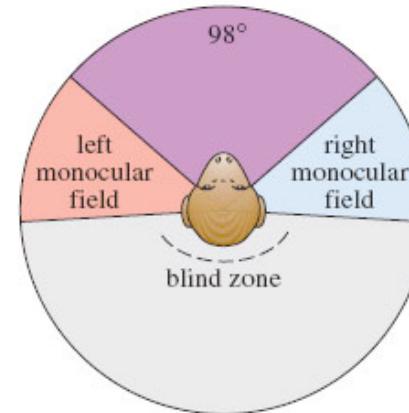
# Ingredients for stereovision

- Binocular overlap

Trade-off: Spotting predators (panoramic viewing)  
vs discerning preys (reduced field of view)



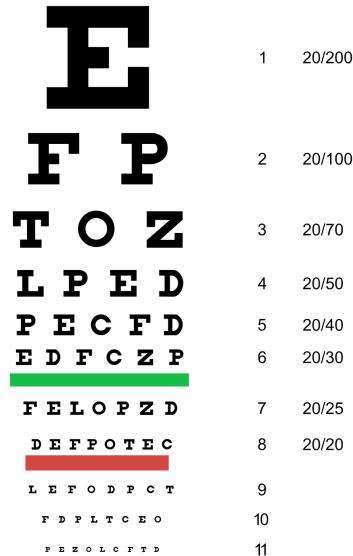
(a) rabbit



(b) monkey

# Ingredients for stereovision

- Binocular overlap
- Good acuity in both eyes



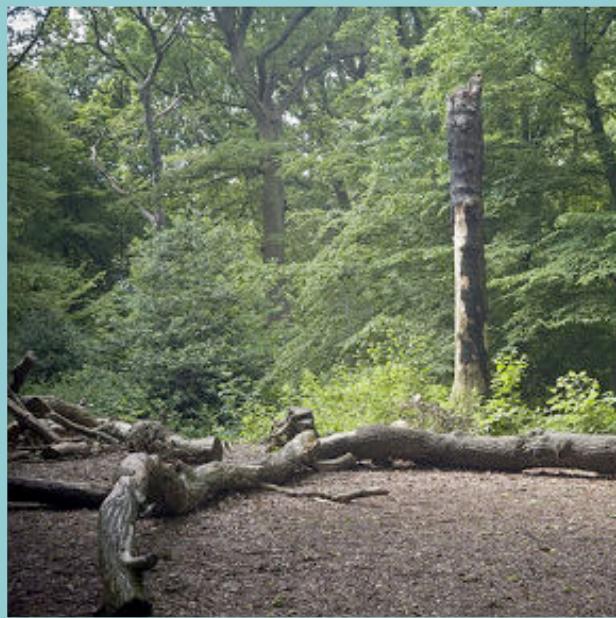
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- Binocular overlap
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- Accurate co-ordination between two eyes in all directions of gaze



# Ingredients for stereovision

- Binocular overlap
- Good acuity in both eyes
- Accurate co-ordination between two eyes in all directions of gaze
- Ability of the brain to cause fusion of two slightly different images



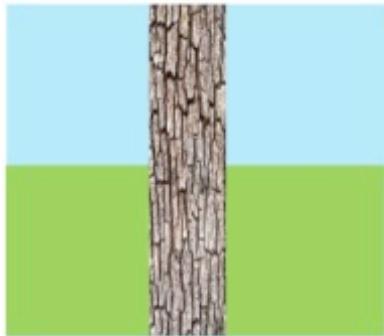
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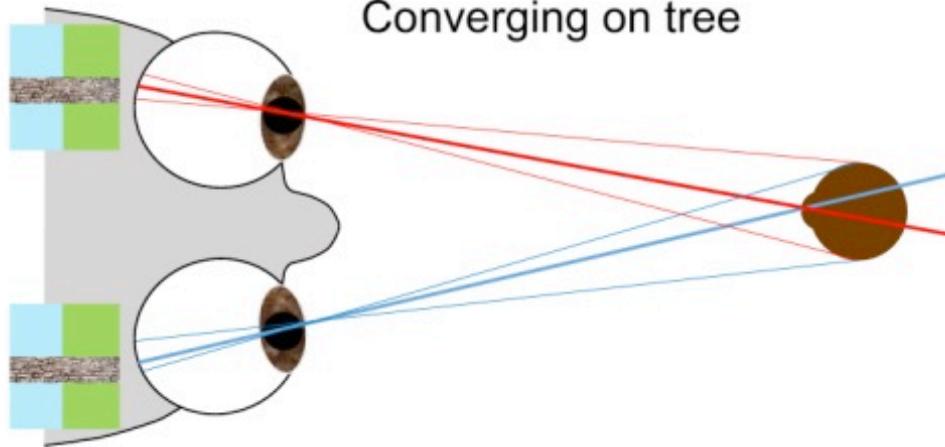


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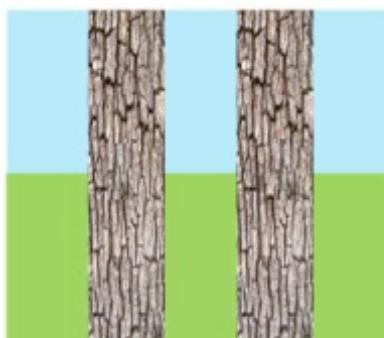
Binocular fusion



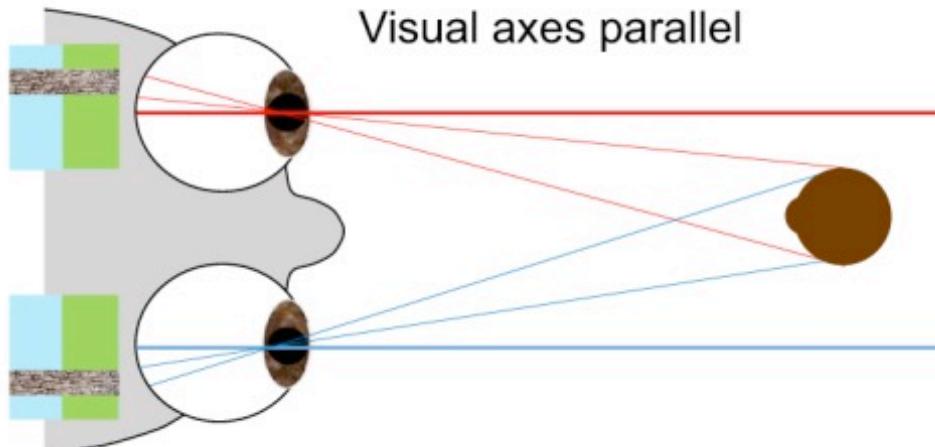
Converging on tree



Double vision

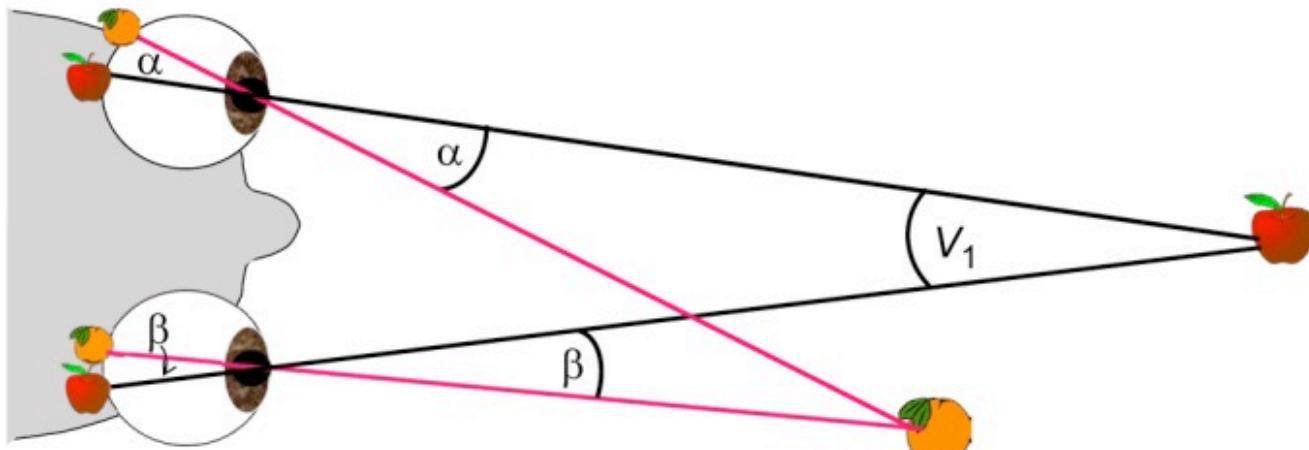


Visual axes parallel

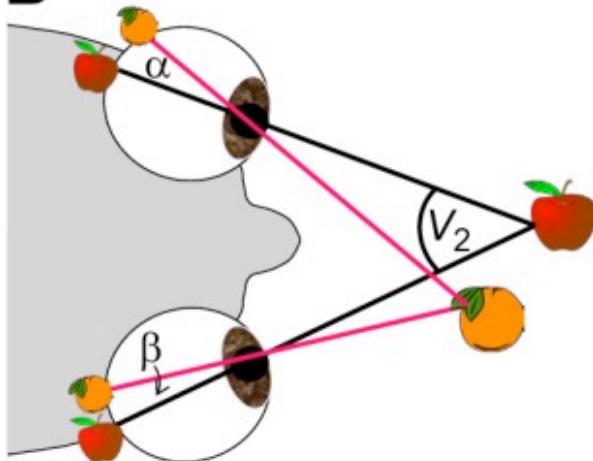


# Triangulation depth cues

**A**

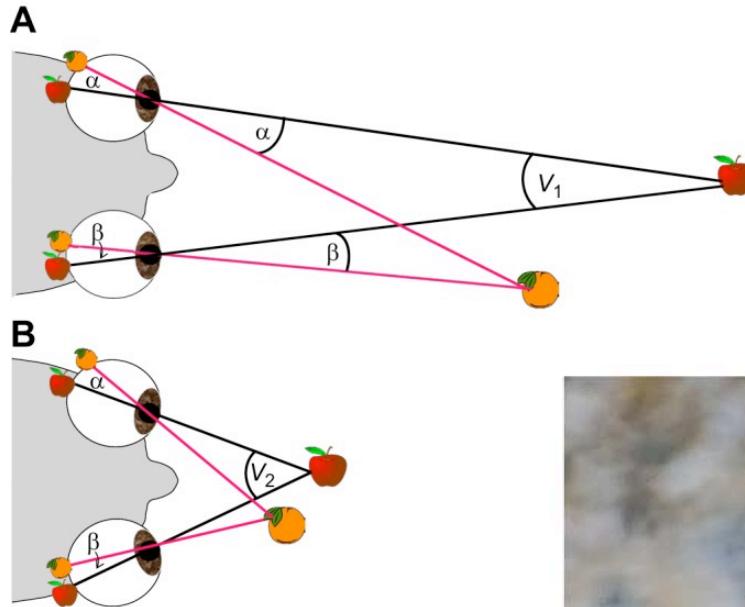


**B**



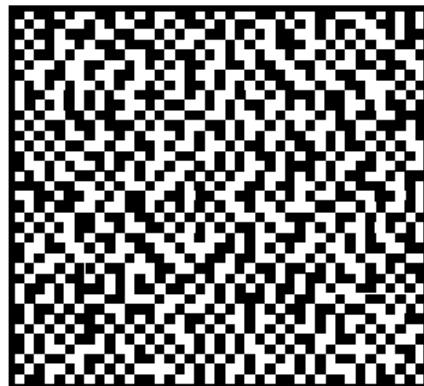
Projection on the retina  
+ angle of vergence

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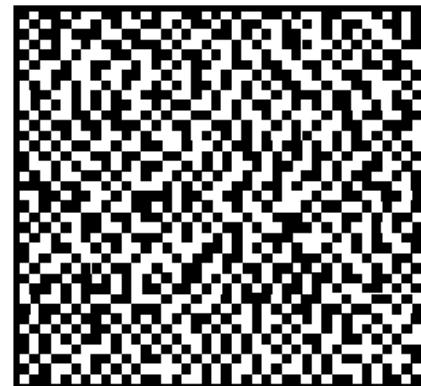


# How do we test stereopsis?

- Behavioural demonstration: Random-dot stereograms (Julesz)
  - Prisms, anaglyph filters, stereoscopes
- Neuron recording



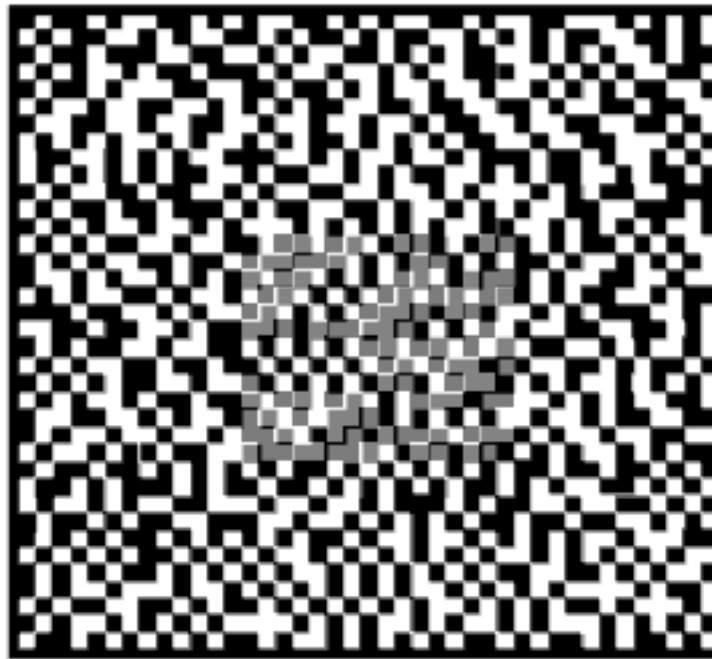
*Left eye*



*Right eye*

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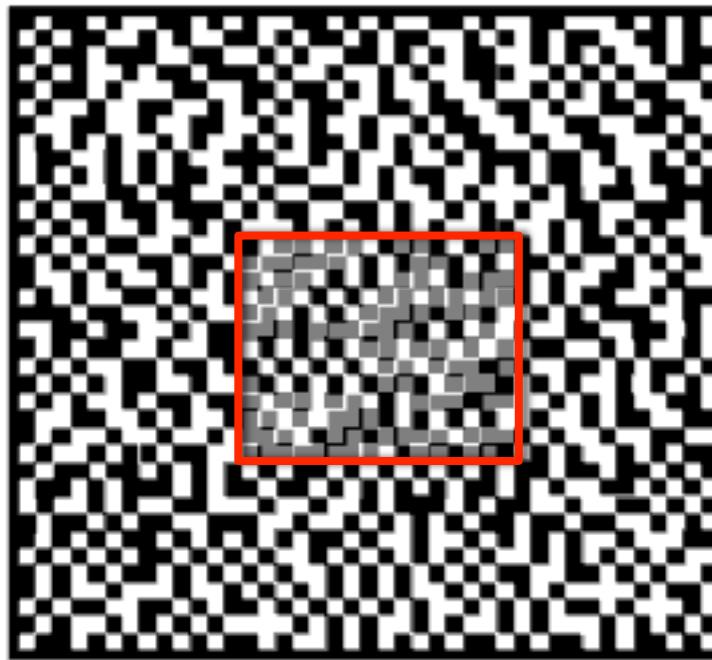
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*Fused eyes*

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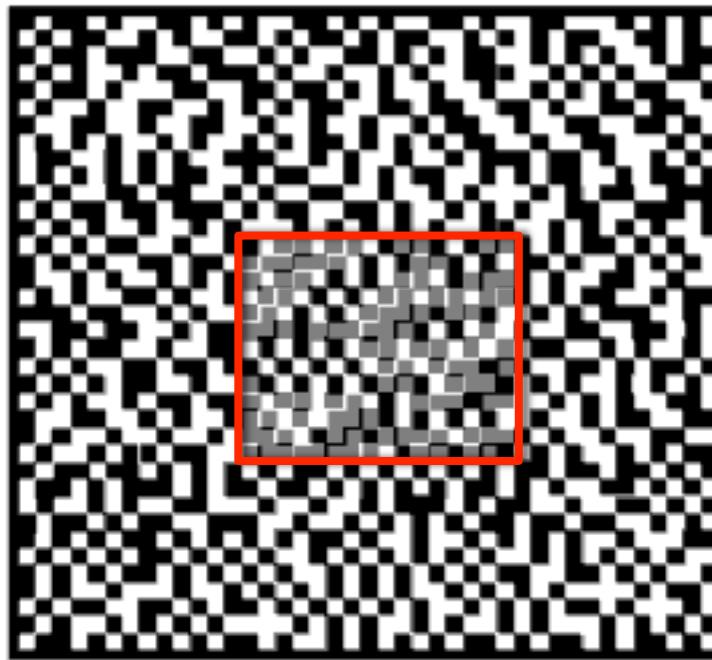
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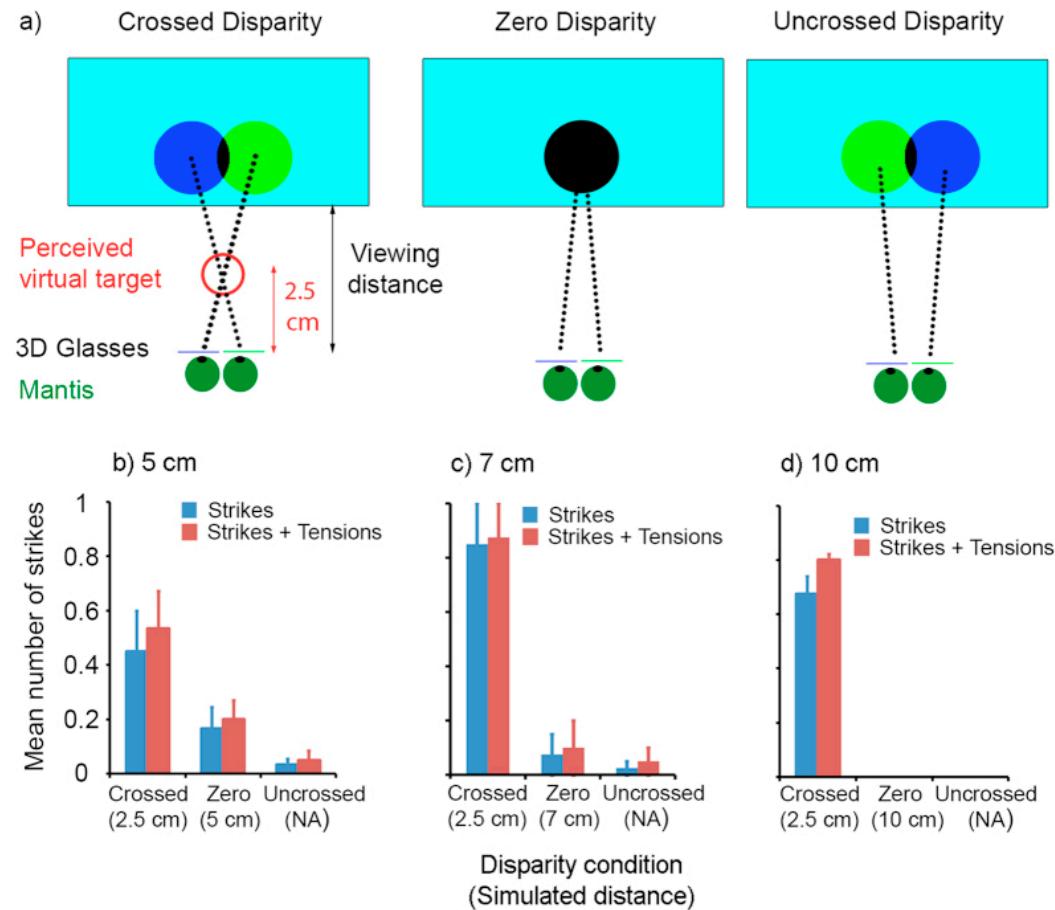


*Fused eyes*



*Visual percept*

# A behavioural study example



Nityananda, V., Tarawneh, G., Rosner, R., Nicolas, J., Crichton, S., and Read J. (2016). Insect stereopsis demonstrated using a 3D insect camera. *Scientific Reports*, 6, 18718.



<https://www.museum.toulouse.fr/-/evolution-et-vision-le-vivant-a-de-la-profondeur->