Getting to know you:
how do animals recognise each other and us ?

- Individual recognition by smell, voice and sight

- Most animals have the necessary acuity

- Genetic similarity represents a considerable challenge

- Requires expansion of brain attentional and memory systems

- Evolving large-scale individual recognition skills has a high cost

Individual recognition skills

- Not always essential for survival

- Recognising categories can be enough
  (your species, males vs. females, social familiars)

Individual recognition skills

- May have initially evolved as a reproductive aid

- Recognising only one or two individuals can be enough (sex partner or baby)

Individual recognition skills

- Individual recognition and social evolution

-

Individual recognition skills

- Individual recognition and social evolution

- Different types of interactions occur with different individuals




Individual recognition skills

- If you can recognise individuals
    - You can develop a sense of individual identity
    - You can imagine them in their absence and miss them
    - You should have a superior intellect

Individual recognition by smell

- Can mice recognise each other using smell ?

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Individual recognition by smell

- Can mice recognise each other using smell ?

- Importance of the MHC complex for recognition

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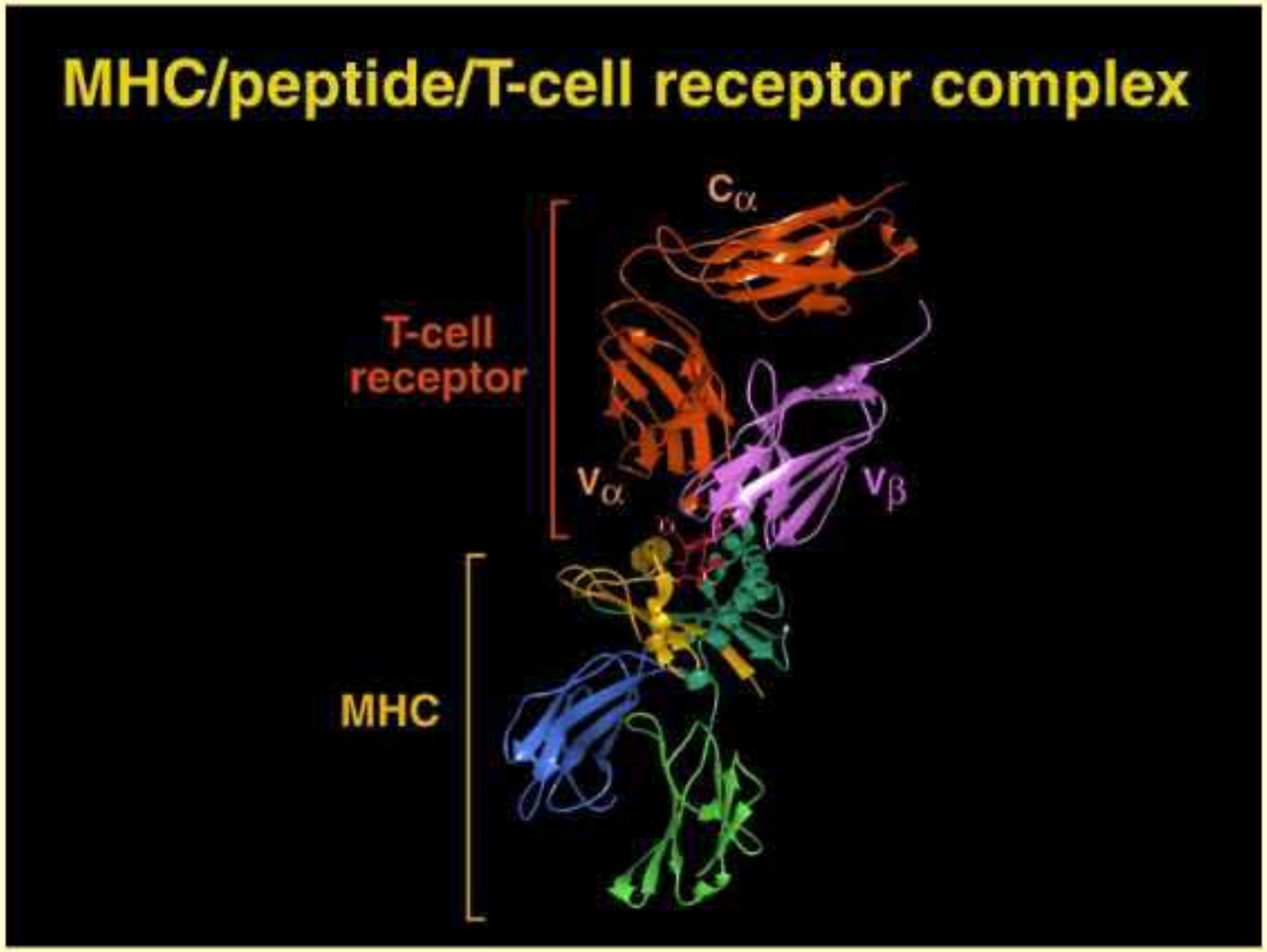

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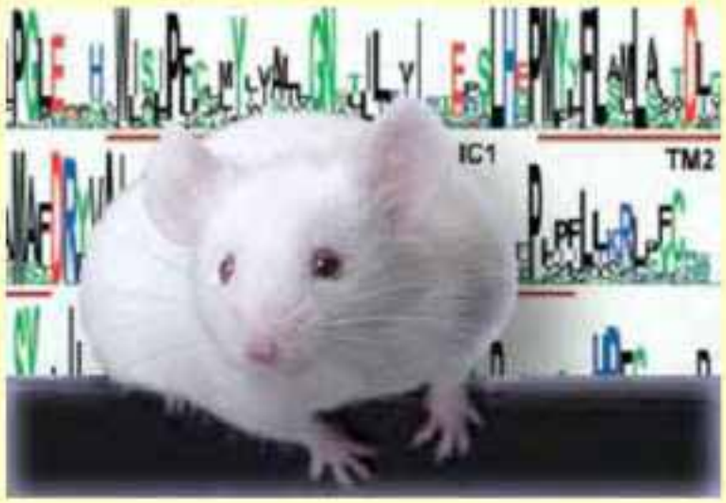
- Importance of the MHC complex for recognition

- Importance of major urinary proteins (MUPS)

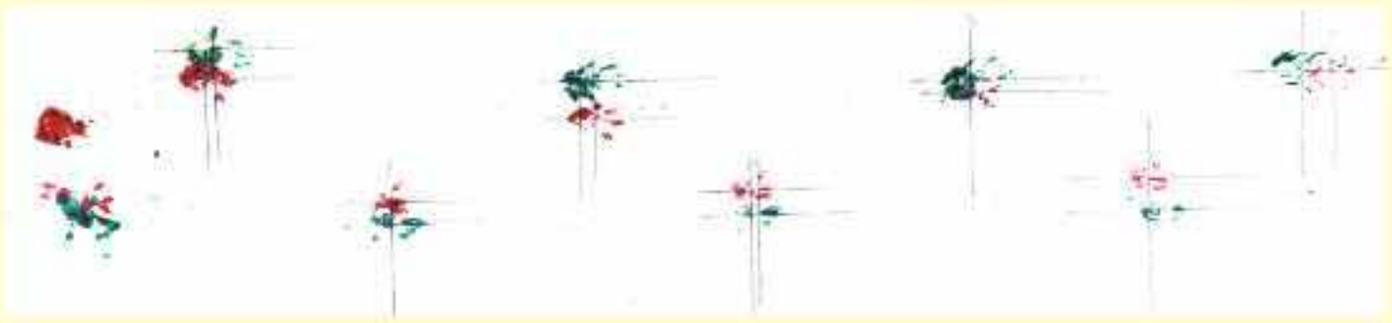


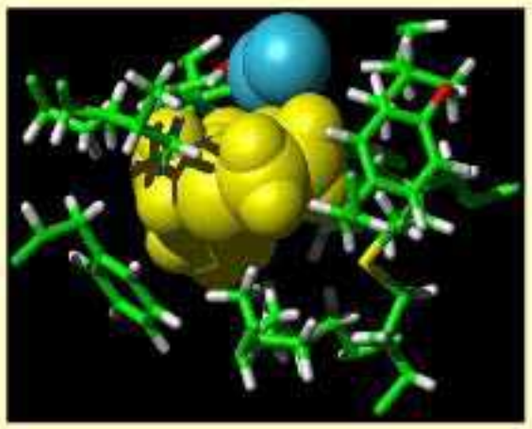
Animal behaviour

How mice make their mark

Peter Brennan

The social behaviour of many animals relies on their ability to use odour cues to distinguish among individuals. Studies of mice highlight the importance of urinary proteins in this complex signalling system.





Individual recognition by smell

- How does one establish individual scent recognition ?

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Individual recognition by smell

- How does one establish individual scent recognition ?

- The habituation dishabituation test

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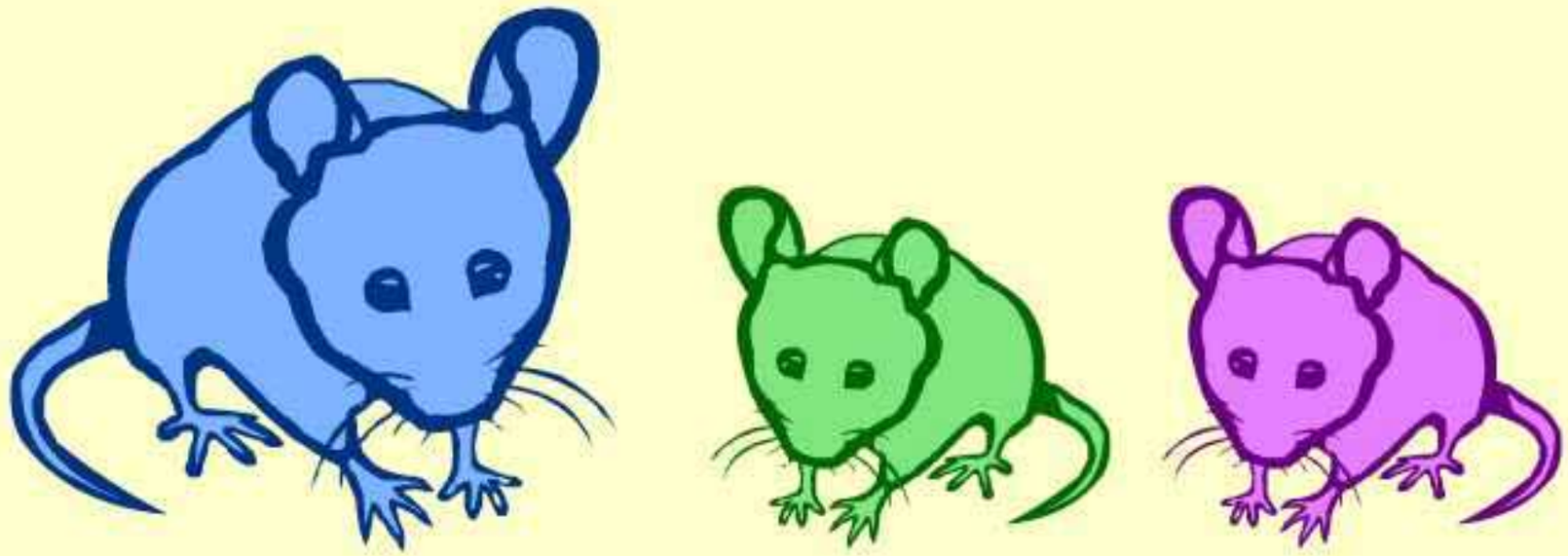
-

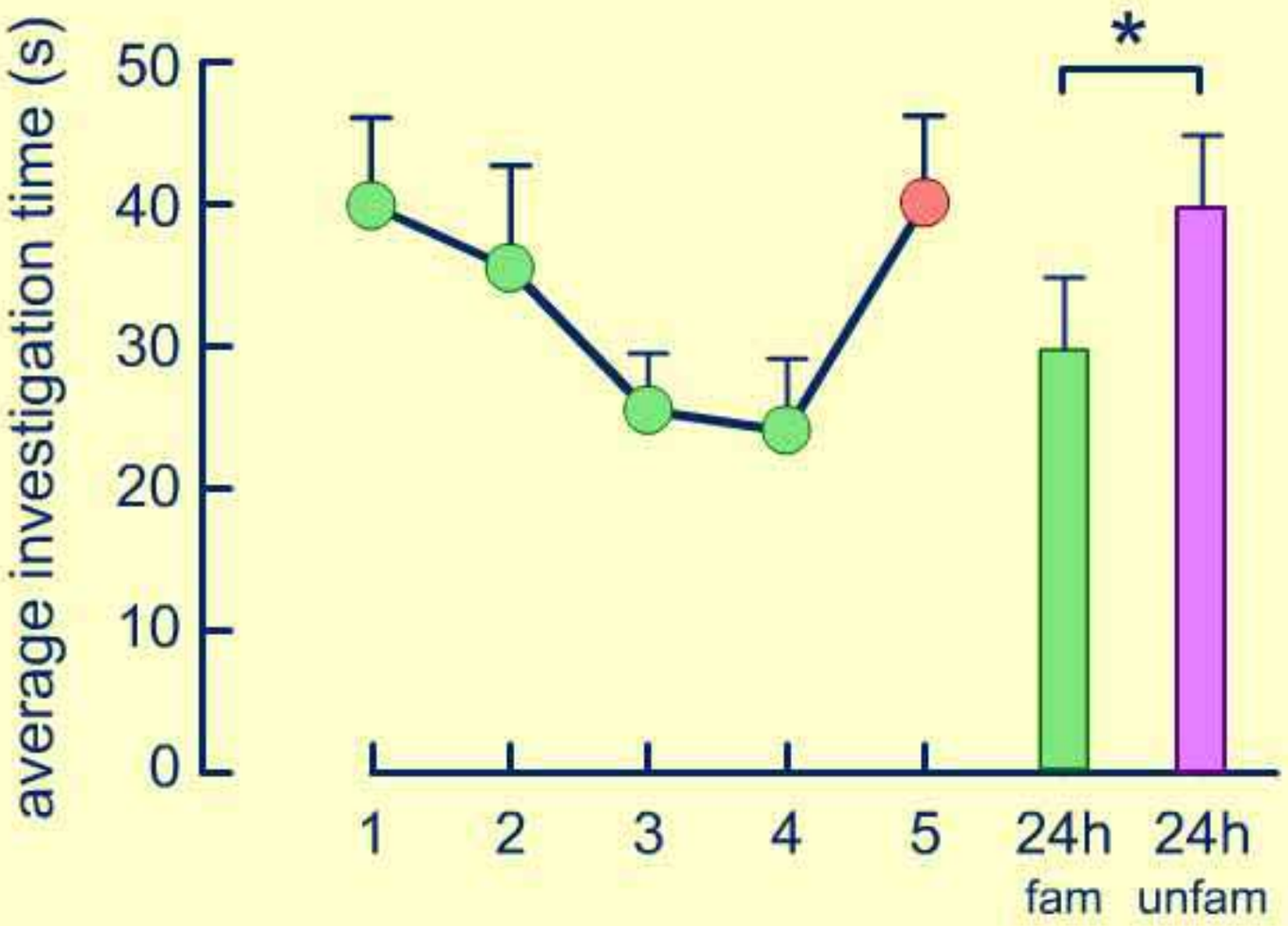
-

Protocol for habituation/dishabituation task

J1 for 1 minute
10 minute wait
J1 for 1 minute
10 minute wait
J1 for 1 minute
10 minute wait
J1 for 1 minute
10 minute wait
J2 for 1 minute
24 hour wait

J1 and J3
for 2 minutes
discrimination





Individual recognition by smell

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- Mice can actually remember the smell of each individual for 5 - 7 days after a 2 minute meeting

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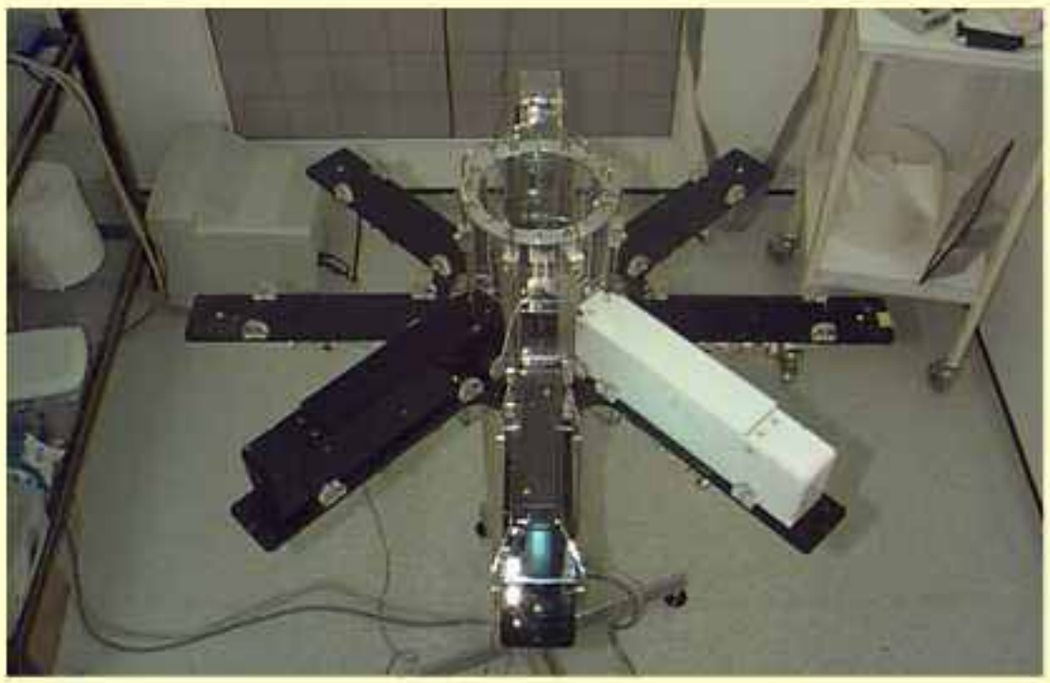
- How many individual mice can be remembered ?



Individual recognition by smell

- Sheep and pigs and glandular secretions

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Individual recognition by smell

- Sheep and pigs and glandular secretions

- Dogs and identical twins

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Individual recognition by smell

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- Dogs and identical twins

- The smell of a baby

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Individual recognition by smell

- Sheep and pigs and glandular secretions
- Dogs and identical twins
- The smell of a baby
- If you don't smell right mum gets aggressive

Ewe/lamb recognition

- Each lamb is recognised separately

-

-

Ewe/lamb recognition

- Each lamb is recognised separately

- The solution to fostering orphans

-

Ewe/lamb recognition

- Each lamb is recognised separately

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Ewe/lamb recognition

- Each lamb is recognised separately

- The solution to fostering orphans

- Probably can't recognise more than 3 lambs at a time

and also.....

Remembering your sexual partner !

Animals recognising humans by smell

- Smell recognition systems are primarily species-specific

- For most animals humans smell disagreeable

-

Animals recognising humans by smell

- Smell recognition systems are primarily species-specific

- For most animals humans smell disagreeable

- Bloodhounds tracking humans

Does perfume aid recognition ?

- 'The Scent of a Woman'
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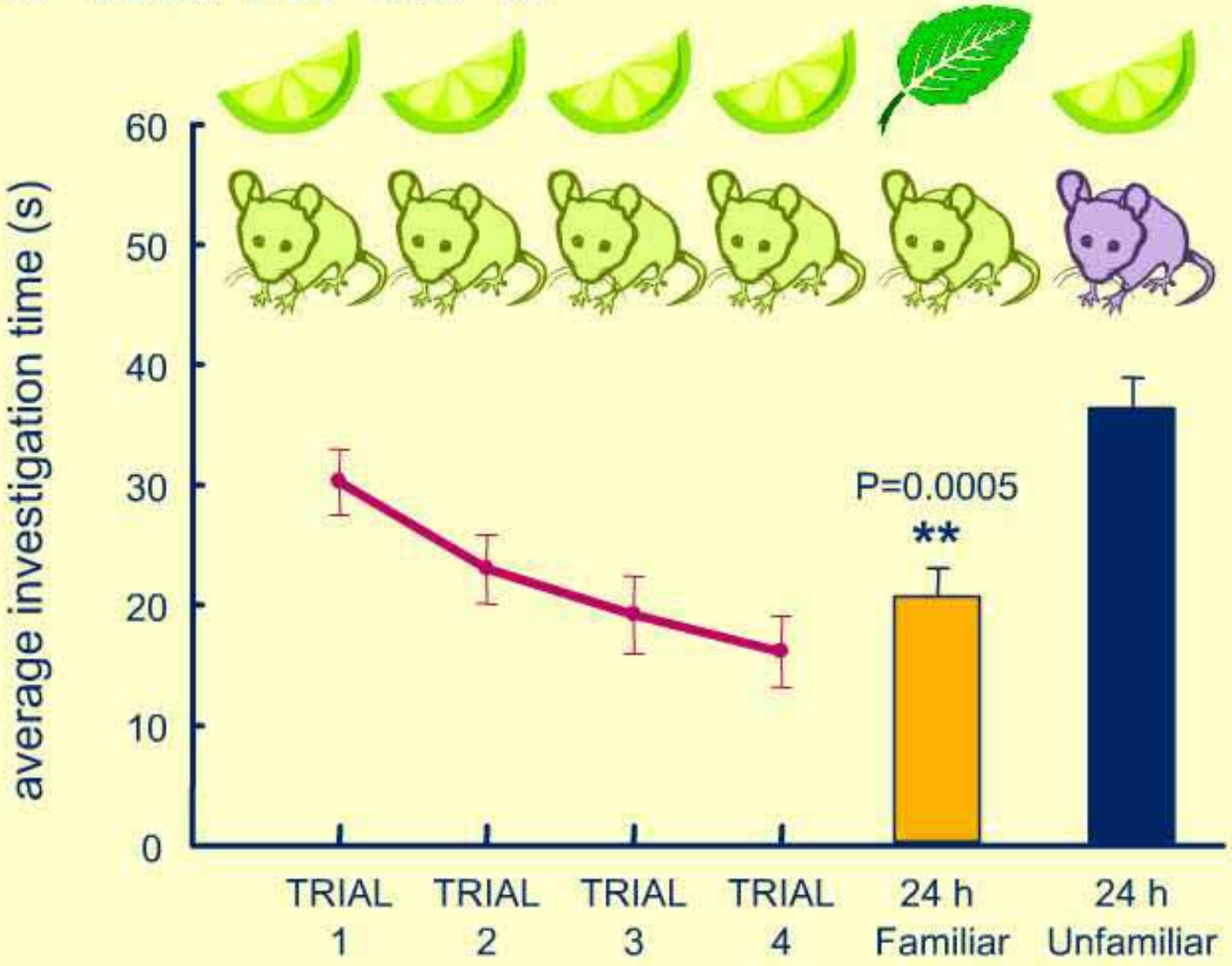

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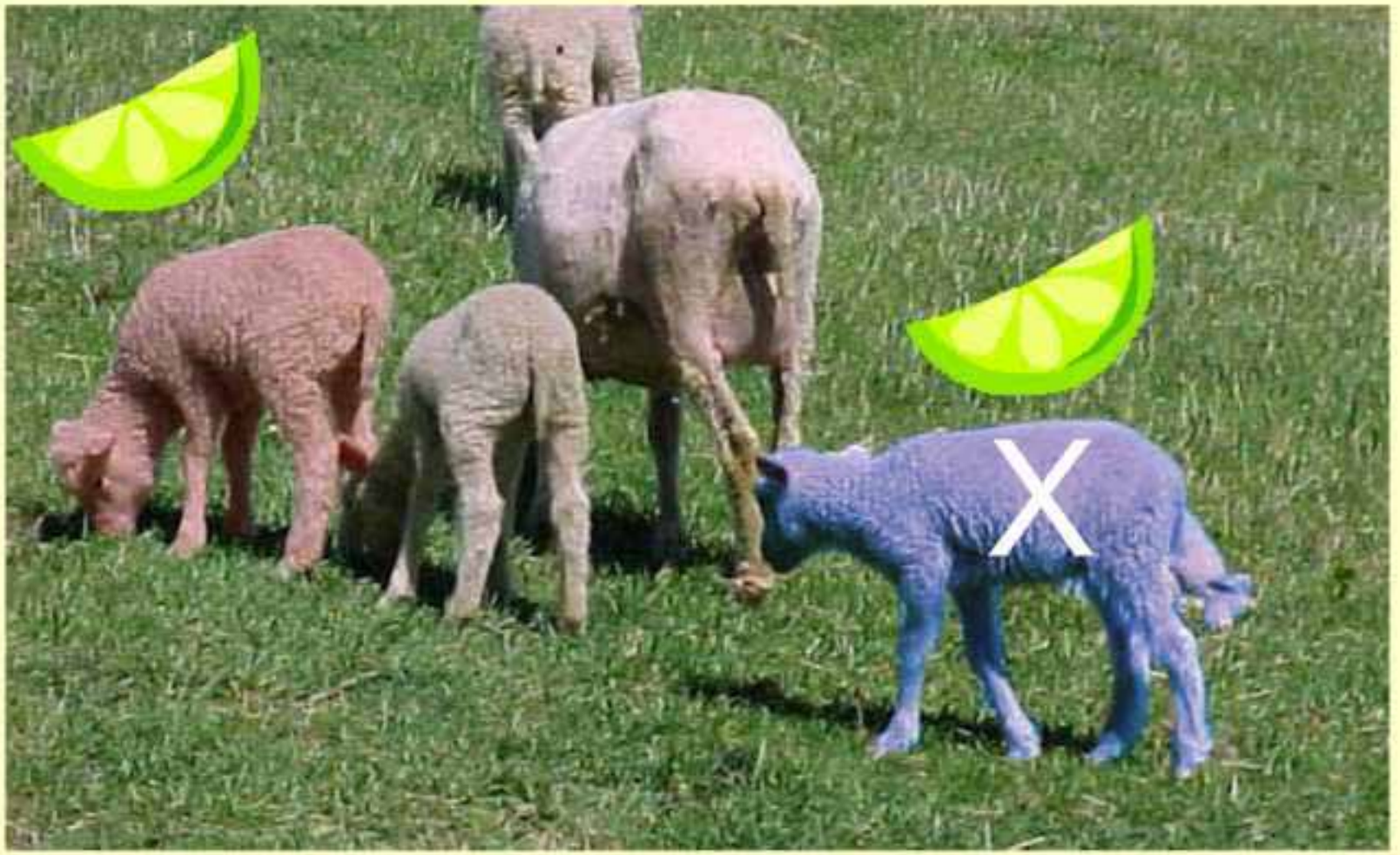

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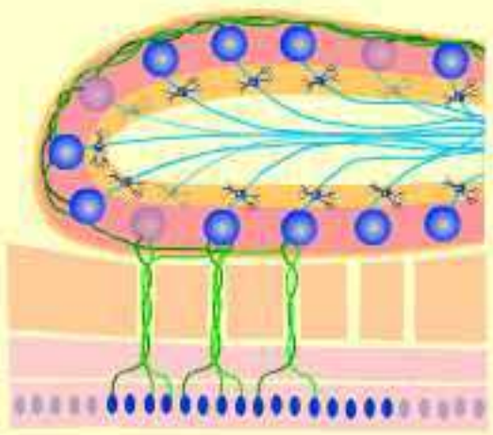

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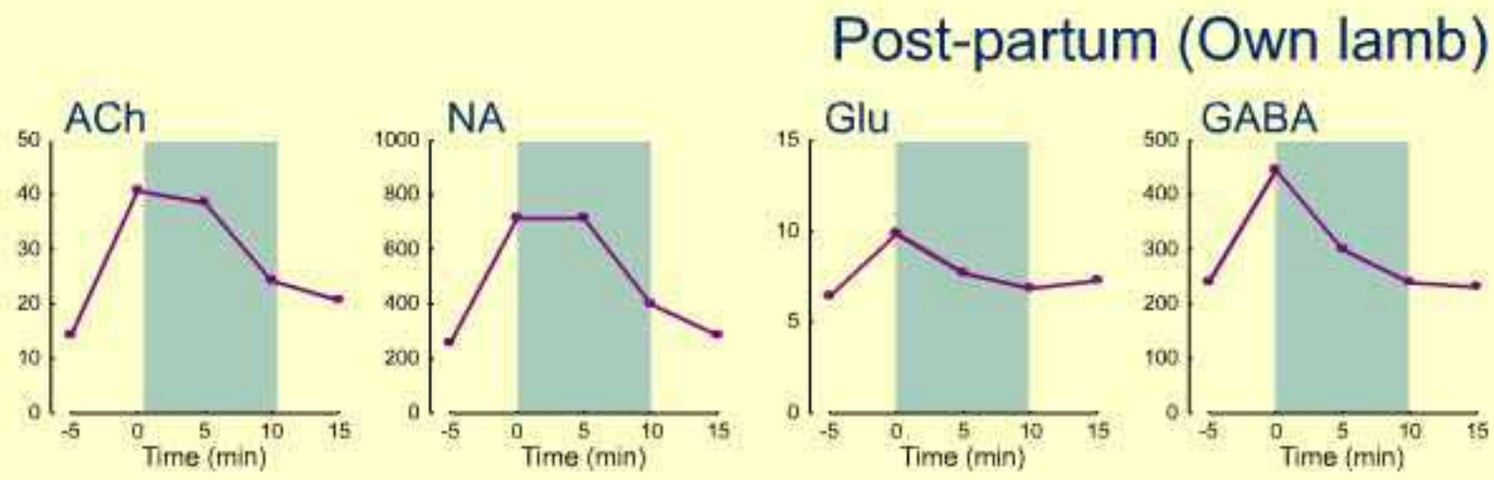

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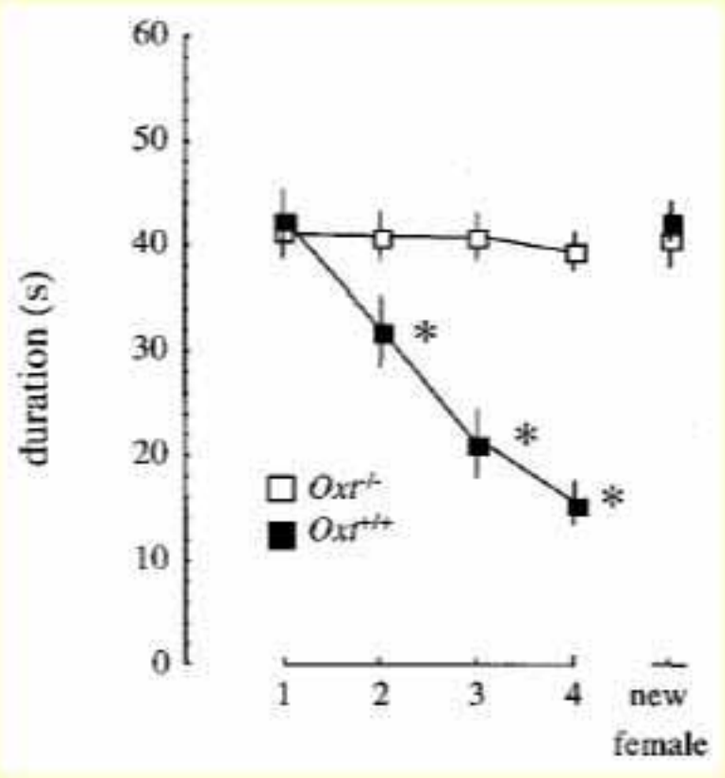

Ferguson *et al* 2000
Nature Genetics

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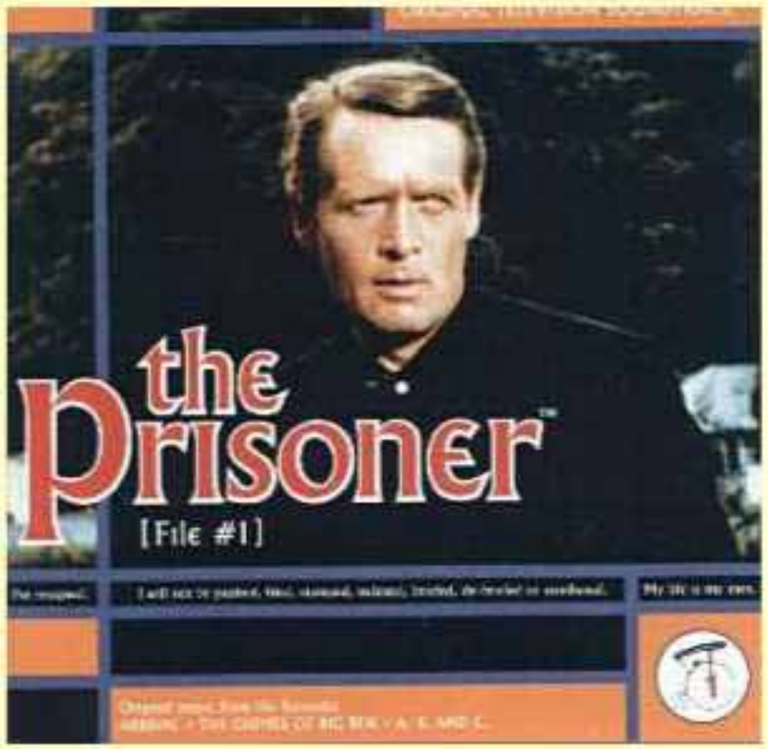
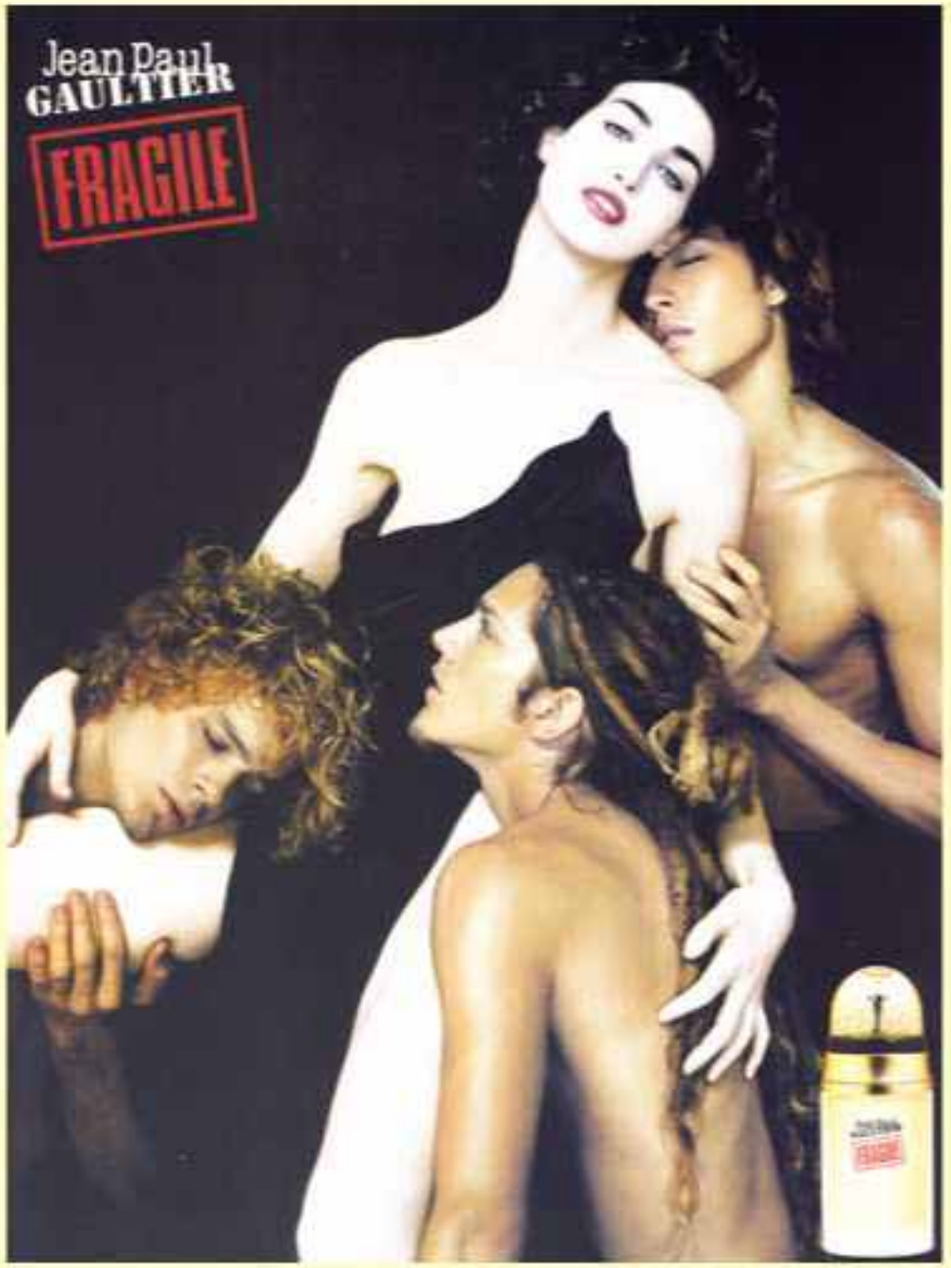
- Diet, hormones, health status, arousal and stress all change your smell but not your individuality



Does perfume aid recognition ?

What about humans ?



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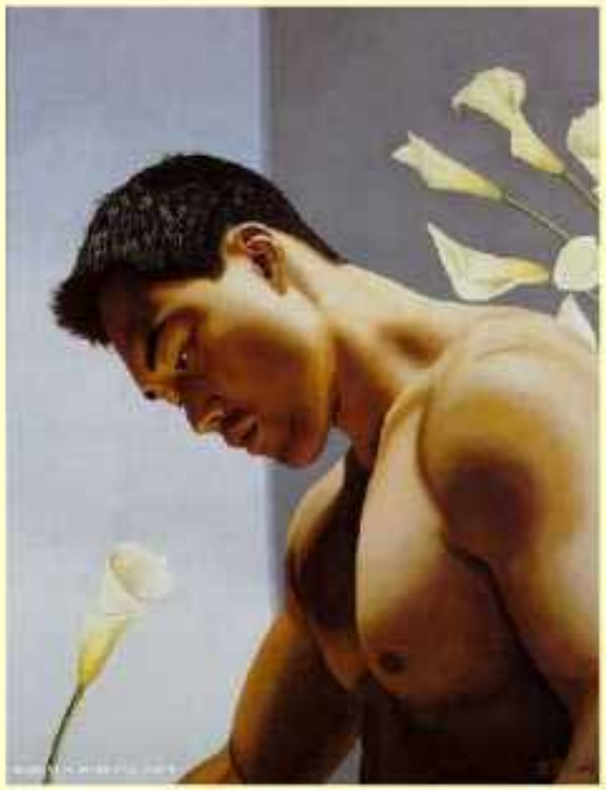

What are the limitations of recognising individuals by smell ?

- Very proximal and sensitive to wind direction

- Best designed for recognising small numbers with specific emotional salience

- Not much good at parties and football matches !

Individual recognition by voice

- Generally best in social species that use complex vocal communication

- Most exceptional in species that communicate over great distances and live in fission/fusion societies

The call of the elephant

- Detect each others calls over 100 km^2 using infrasound (15-24Hz)

- The calls of each animal are distinct

- Play-back experiments reveal female elephants may be able to recognise 100 or more different individuals

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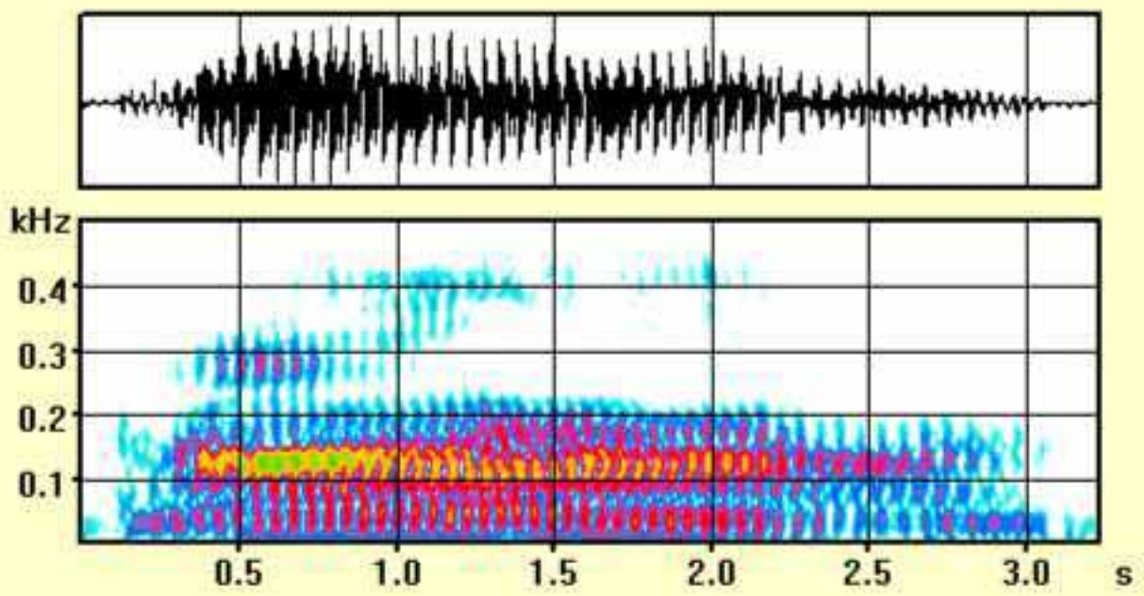

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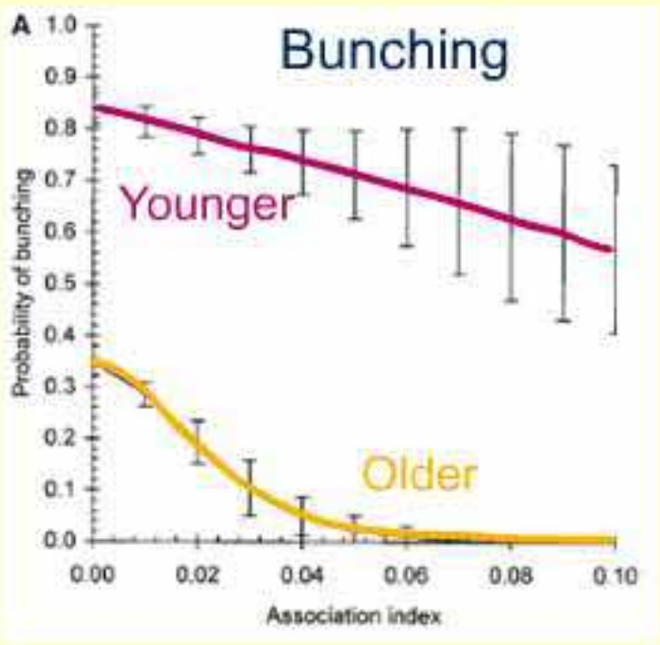

McCoomb *et al*
Science 2001

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- Poaching is killing off main respositories of social knowledge

Dolphins and 'signature whistles'

- The bottlenose dolphin call sign
    - "Hi, I'm Robert" "Hi, I'm Keith"
- Signature imitation and the beginnings of language
    - "Hi Keith, this is Robert"
- At least 10 - 20 individuals can be recognised, probably many more

Head turning monkeys

- Female monkeys can discriminate the 'coo' calls of their kin

- Individual recognition skills appear to be good and would be helpful in the trees

- Vervet monkeys even recognise third-party relationships using vocal recognition

- Adult right ear advantage for recognising familiar voices

The case of the laughing hyena

- Hyenas recognise the 'whoop' call of each different cub

- Don't show evidence for recognising third-party relationships

Other species

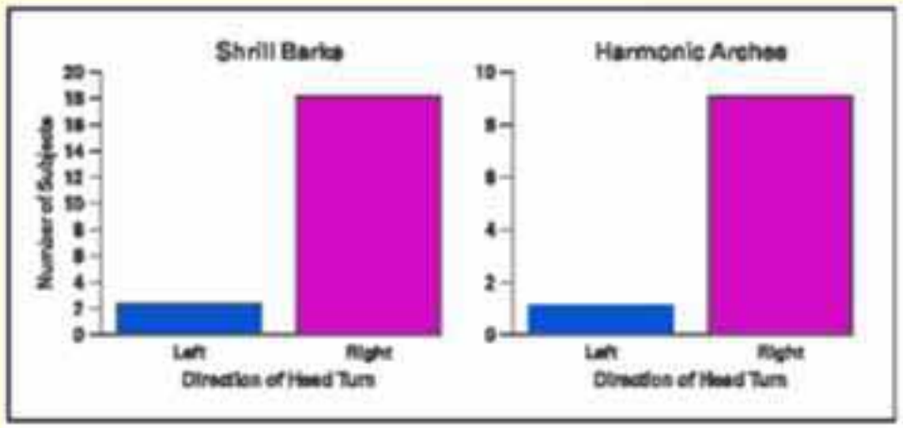
Vocal recognition is common in mothers and infants

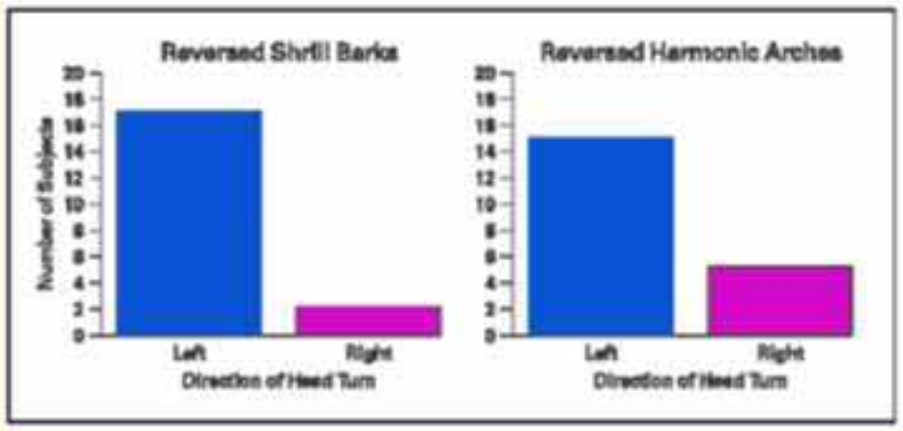
What are the main cues for individual vocal recognition and how does the brain make the necessary distinctions ?

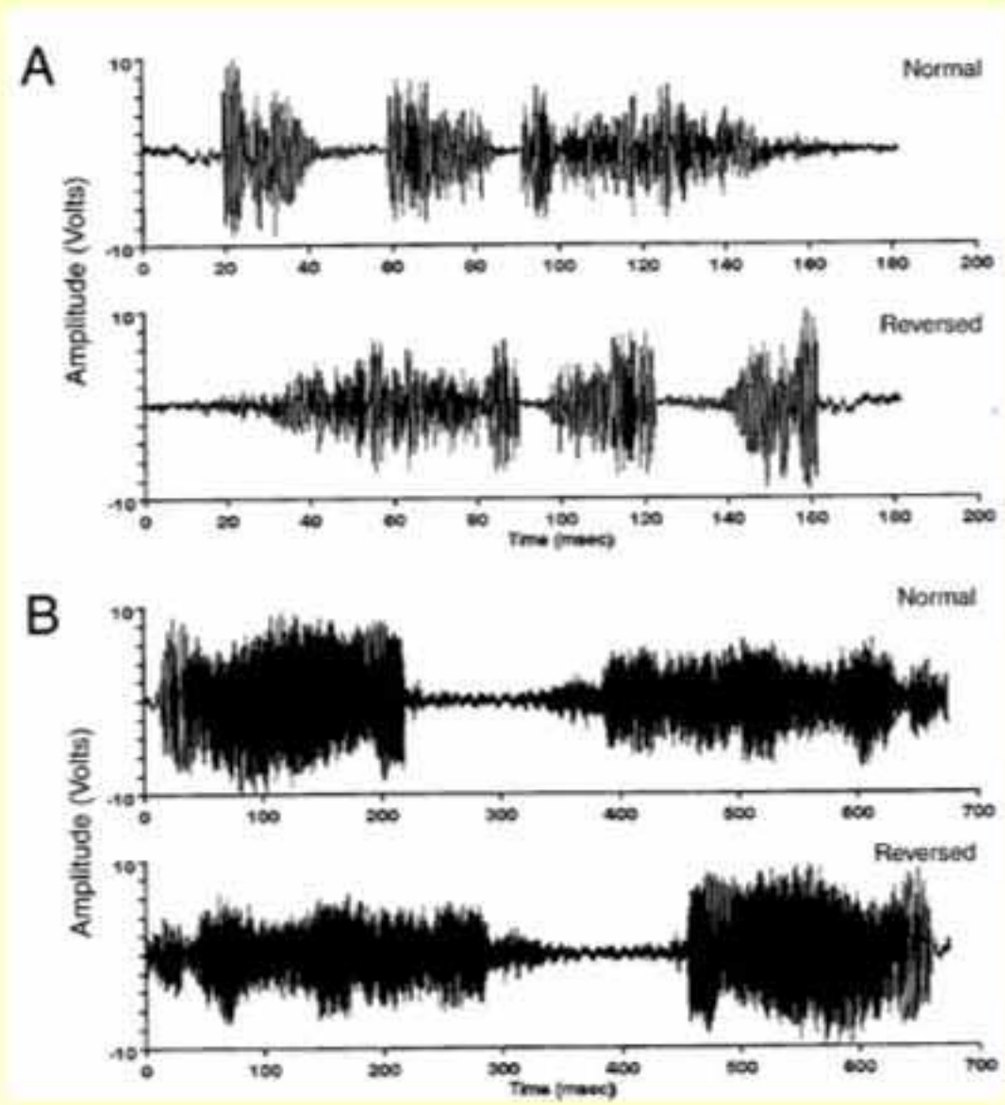
- Fundamental frequencies

- Temporal spectral patterning

-







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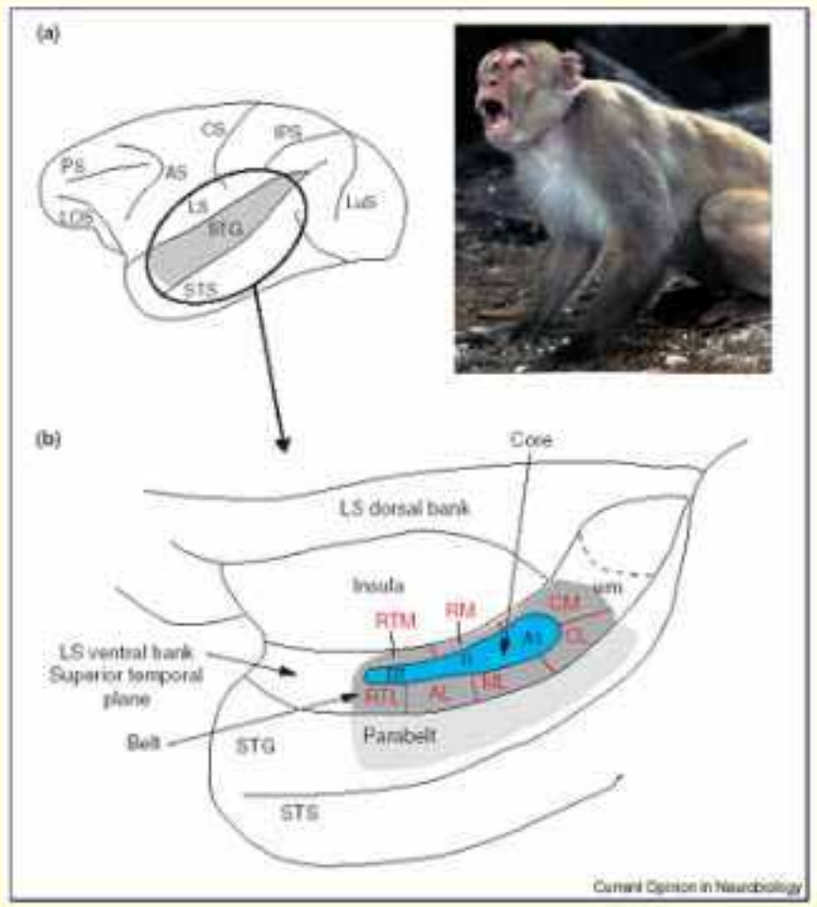

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- Some neural specialisation but not at the level of specific individuals or call sounds

What are the limitations of recognising individuals by their voices ?

- Usually brief and controlled by signaller not receiver !

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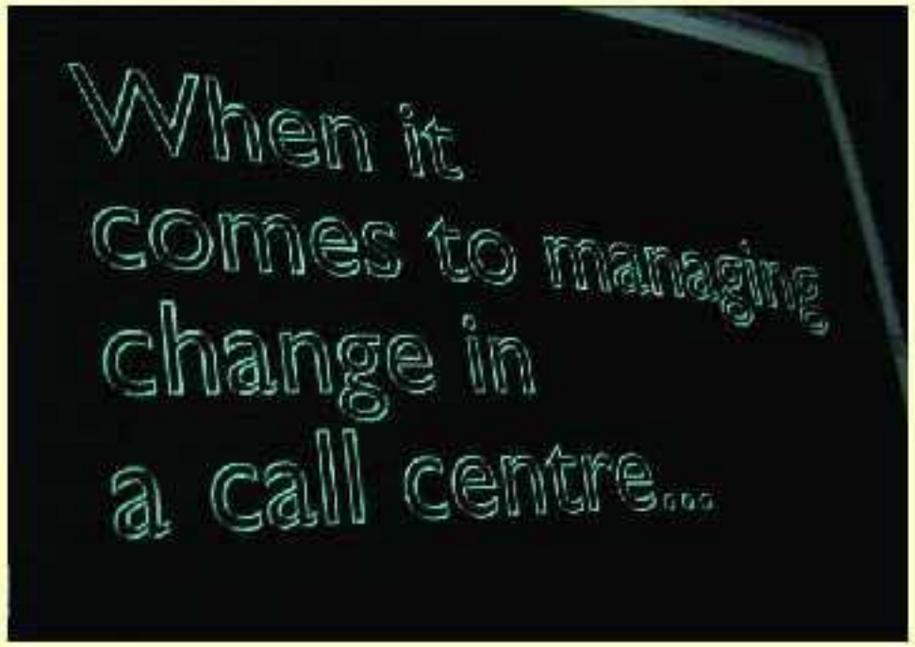
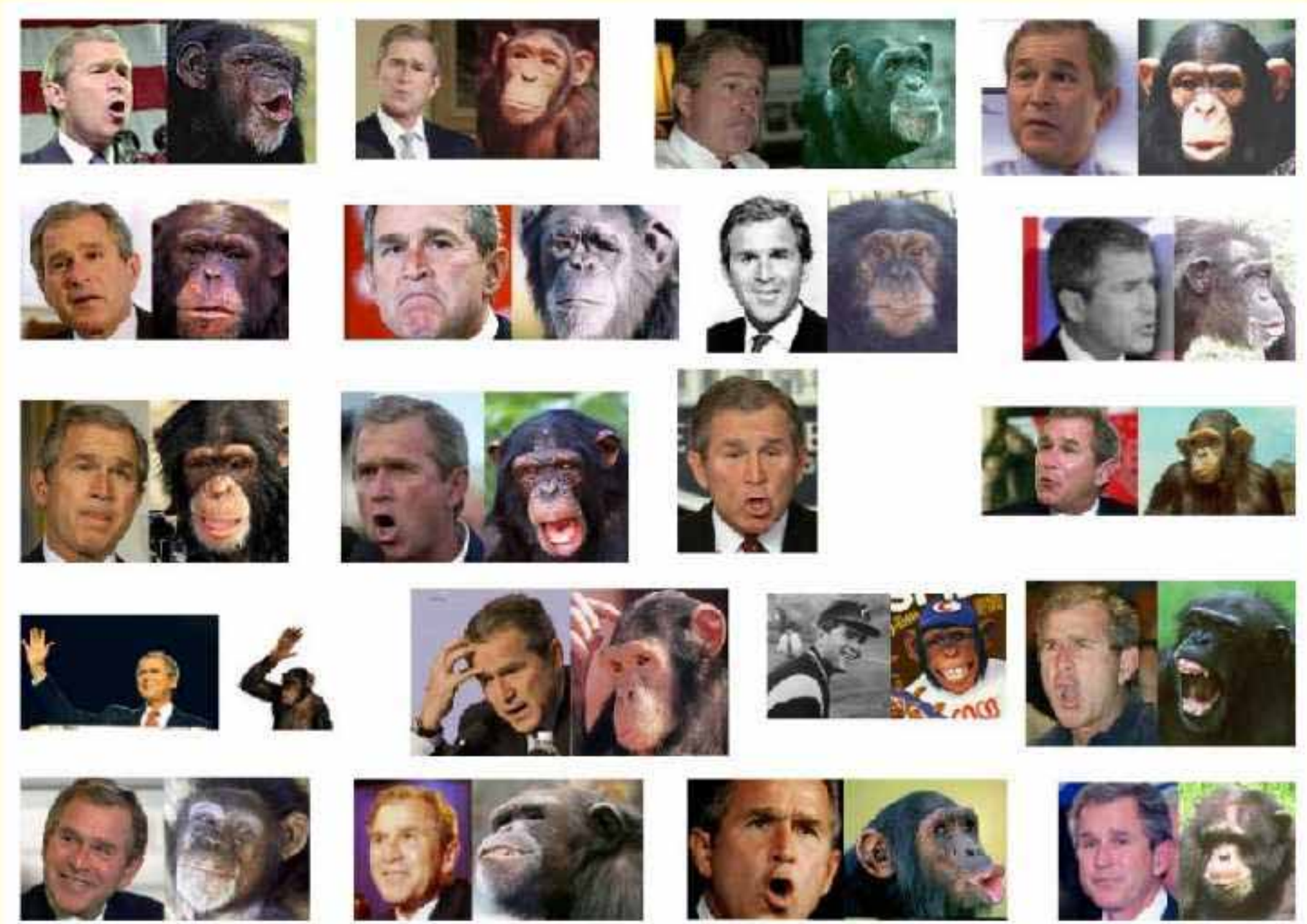
- Not good for recognising the strong silent types !

- Not really that good for recognising many new individuals quickly



Individual recognition by sight

If you have good visual acuity how do you recognise each other ?



What is special about face recognition in humans ?

- We recognise and remember hundreds of faces

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What is special about face recognition in humans ?

- We recognise and remember hundreds of faces

- New faces can be distinguished and remembered in seconds

- They are a major source of individual attraction

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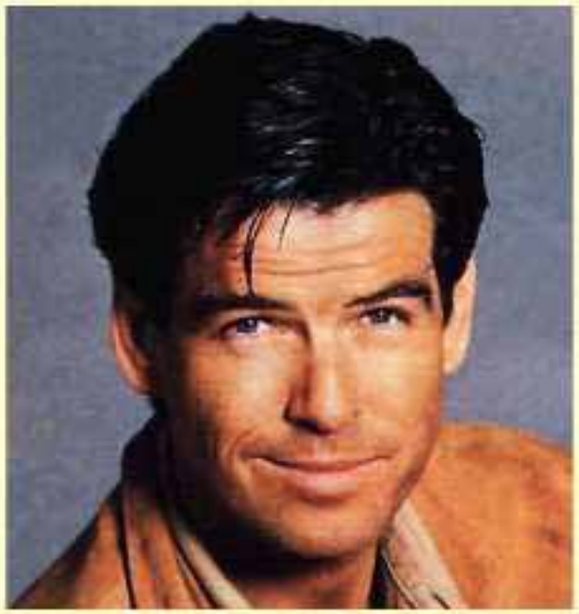

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- When we think of people we often imagine their faces

What is special about face recognition in humans ?

- We are sensitive to subtle configural changes in features

- We have trouble recognising inverted or negative face images

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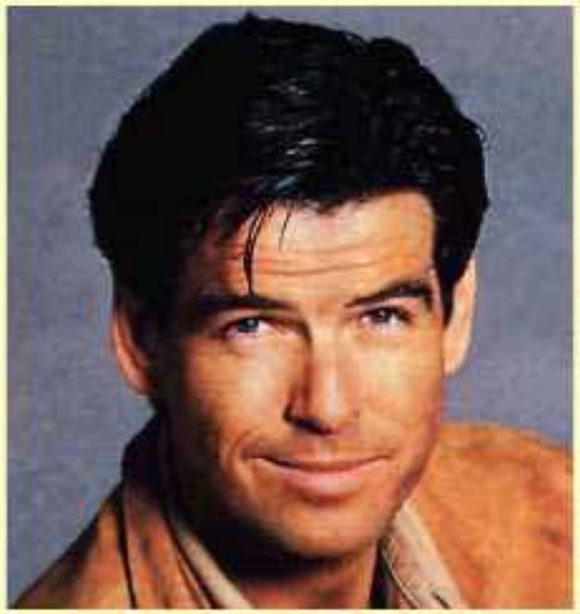

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- Special parts of the brain deal with faces
  - mainly right hemisphere

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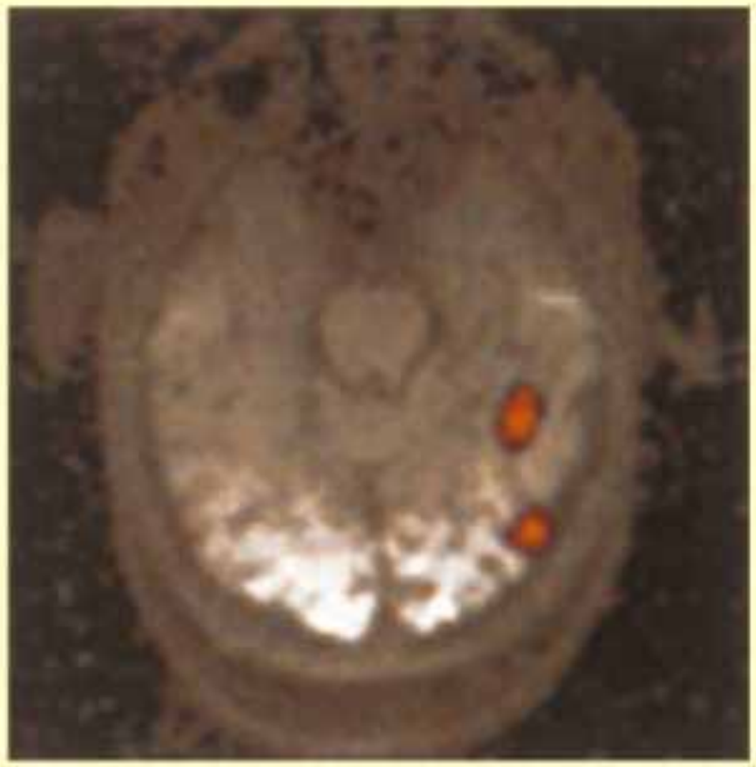
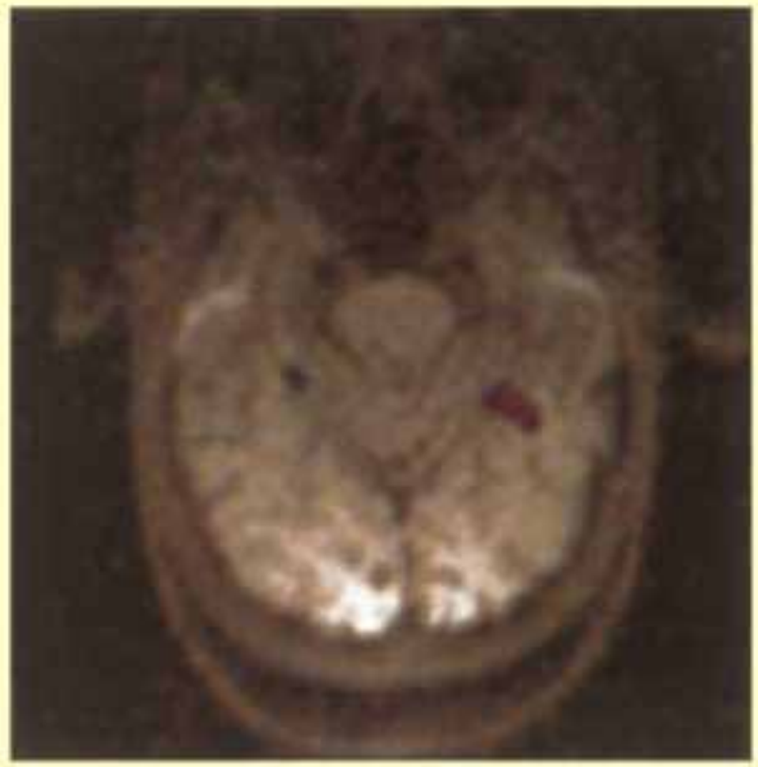


Human fMRI



Looking at a face

Imagining a face

What is special about face recognition in humans ?

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- Our brains are quick to compute what faces should look like

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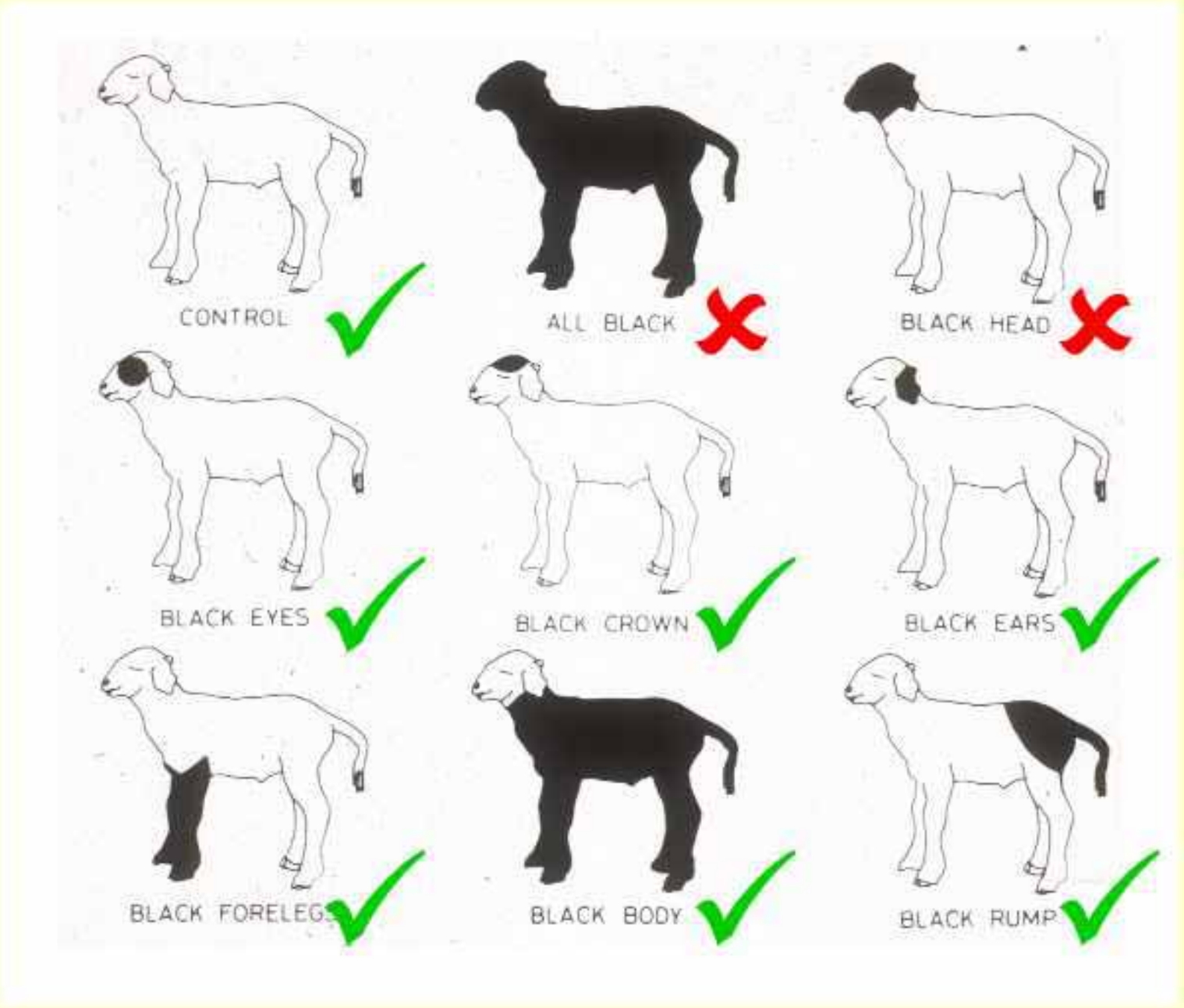
What is special about face recognition in humans ?

'To prepare a face to meet the faces that you meet.'
T. S. Eliot

'A man finds room in the few square inches of the face for the traits of all his ancestors, for the expression of all his history , and all his wants.'
Ralph Waldo Emerson

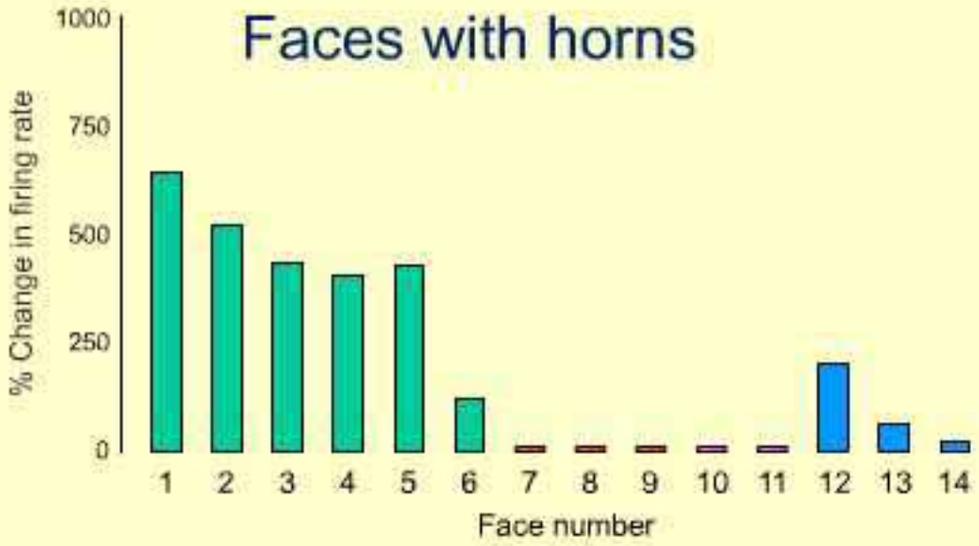
What about other animals ?

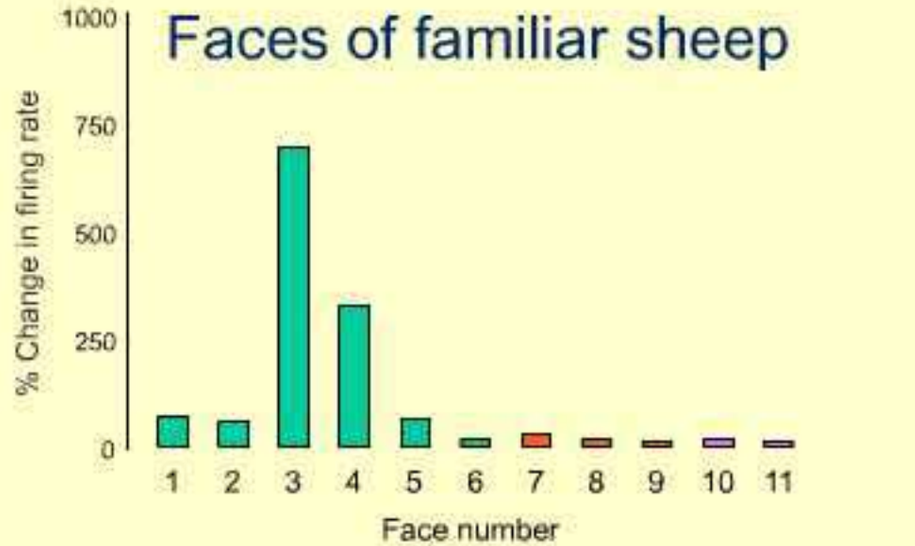
The story of sheep face recognition - ewes and lambs

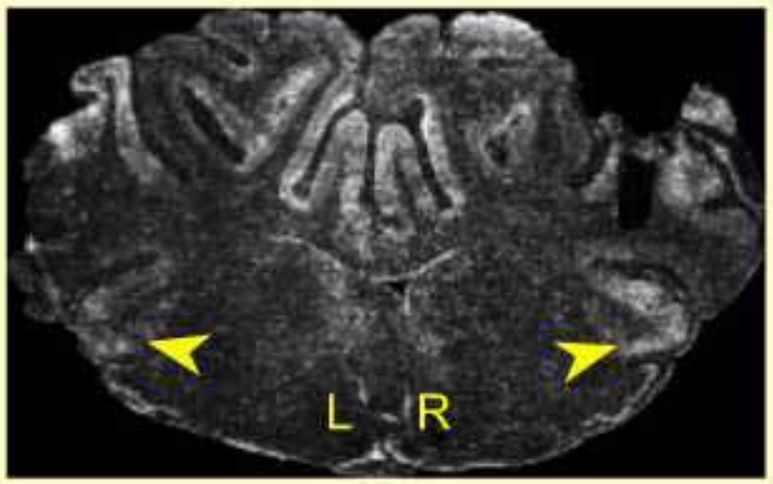


Elizabeth Walser

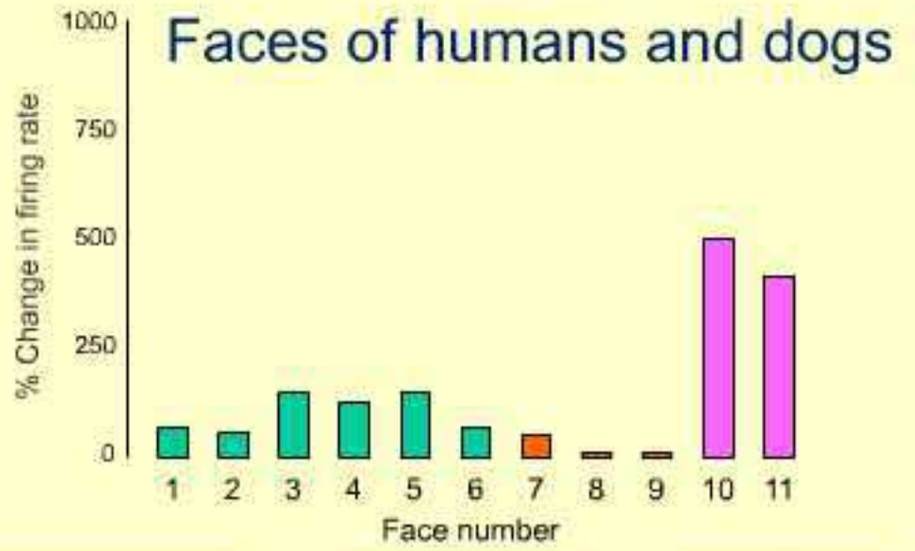
The story of sheep face recognition - electrophysiology







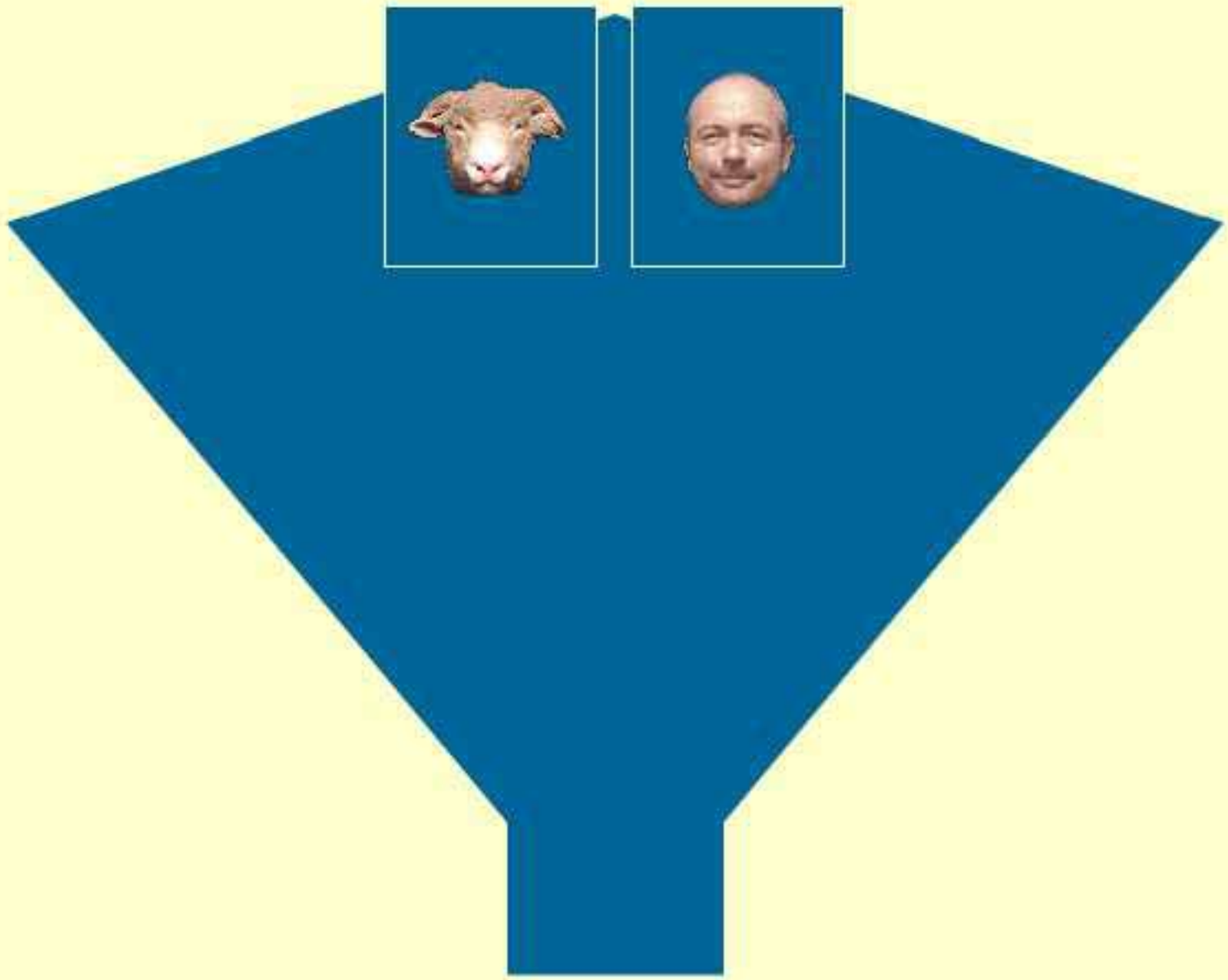
Medial temporal cortex



The story of sheep face recognition - the 'Y' maze

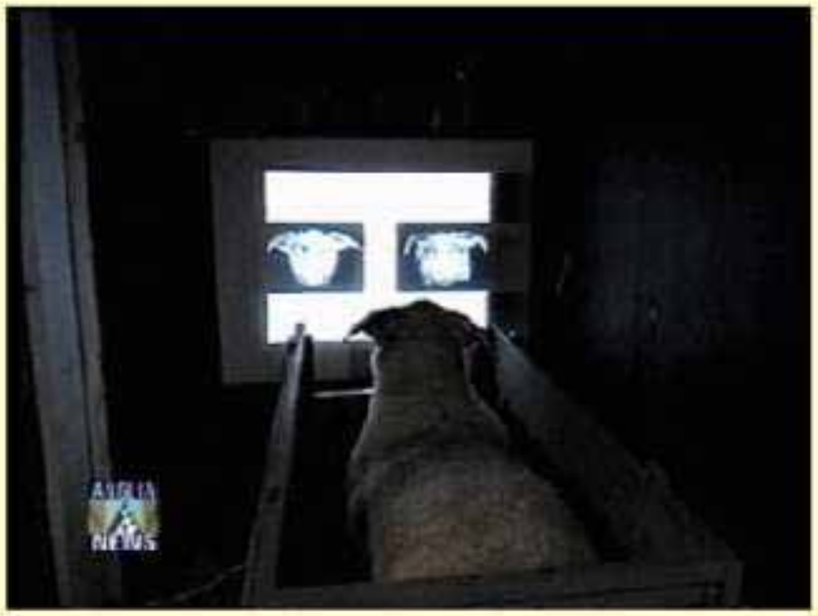
Film courtesy of Anglia News
and Sky News November 2001

I'm entering the start-box...



The story of sheep face recognition - panel pressing

Film courtesy of Anglia News
and Sky News November 2001

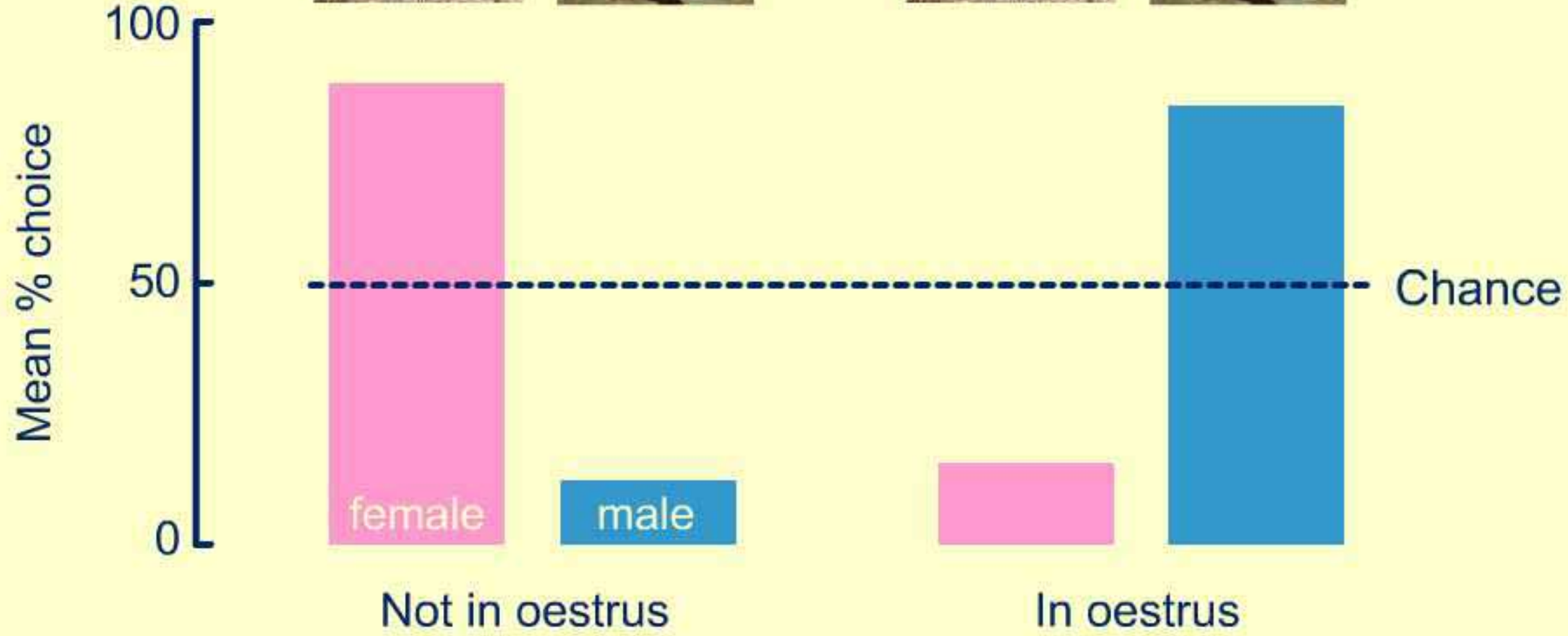


The first pictures.....

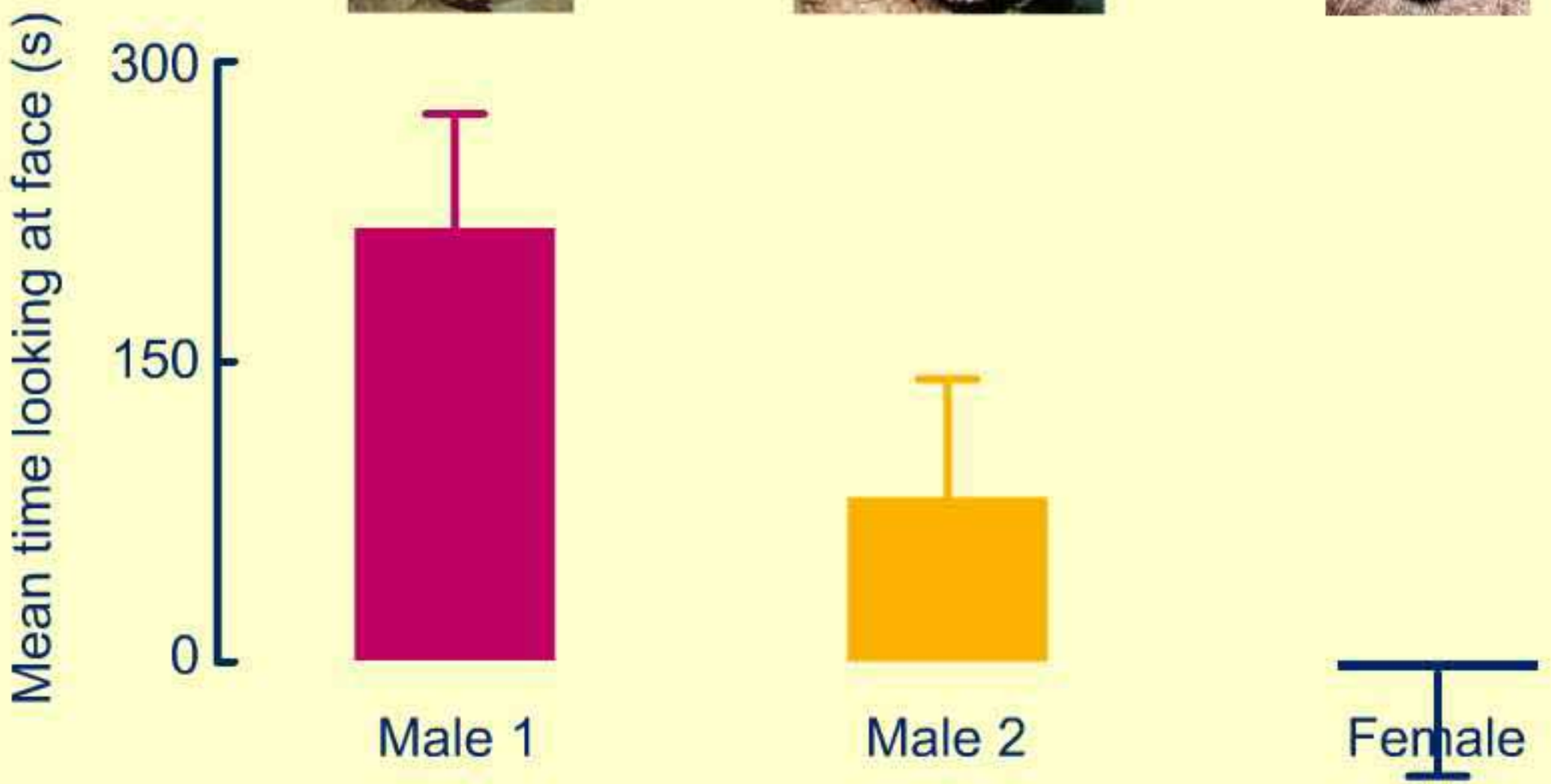
I'm looking at the faces

The story of sheep face recognition - human vs. sheep
What you see is what you get

The story of sheep face recognition - male vs. female
What you see is what you get

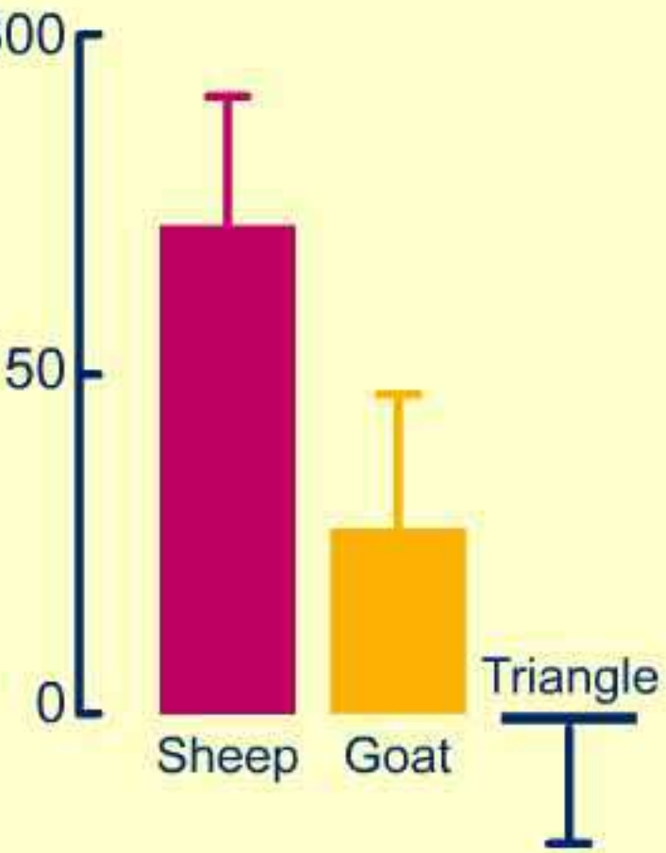


The story of sheep face recognition - male vs. male
Individual facial attraction

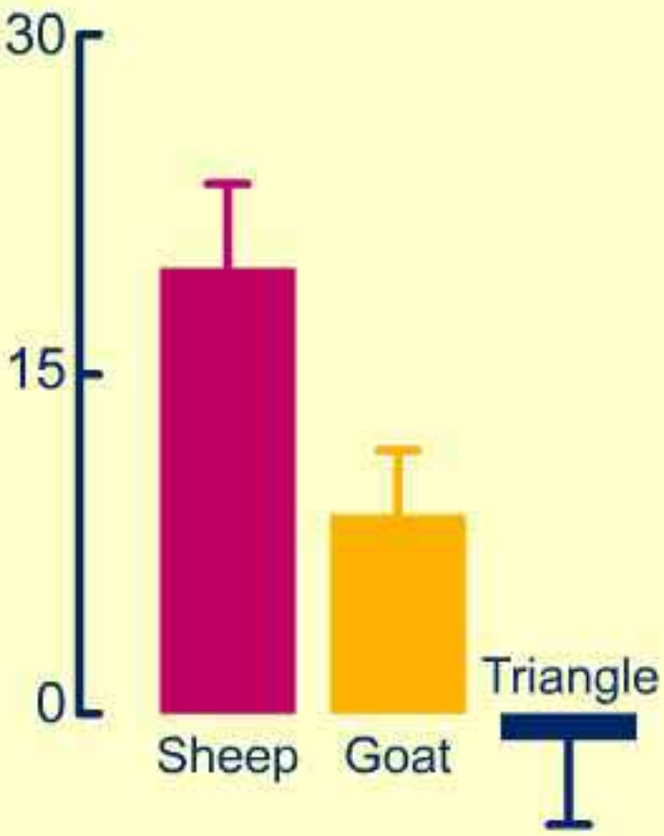


A familiar face reduces stress

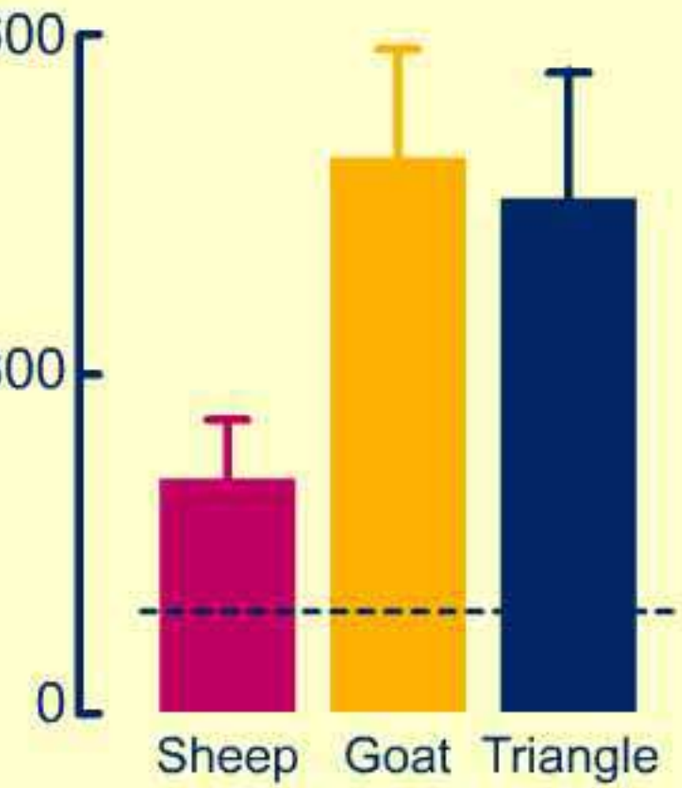
Time looking at face (s)



Reduction in high pitched bleats



% change in cortisol level

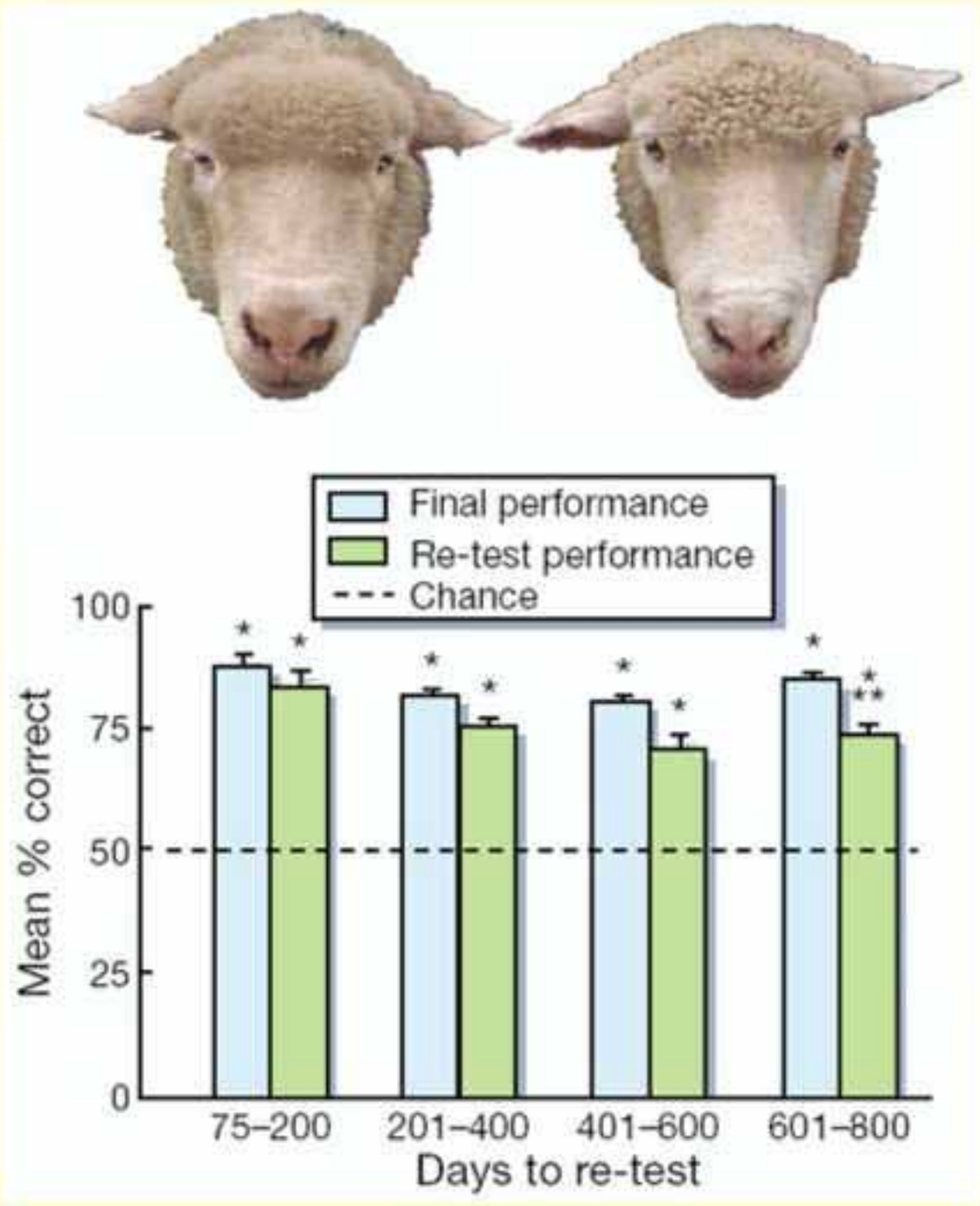


Stimuli

Hypothalamus (PVN)

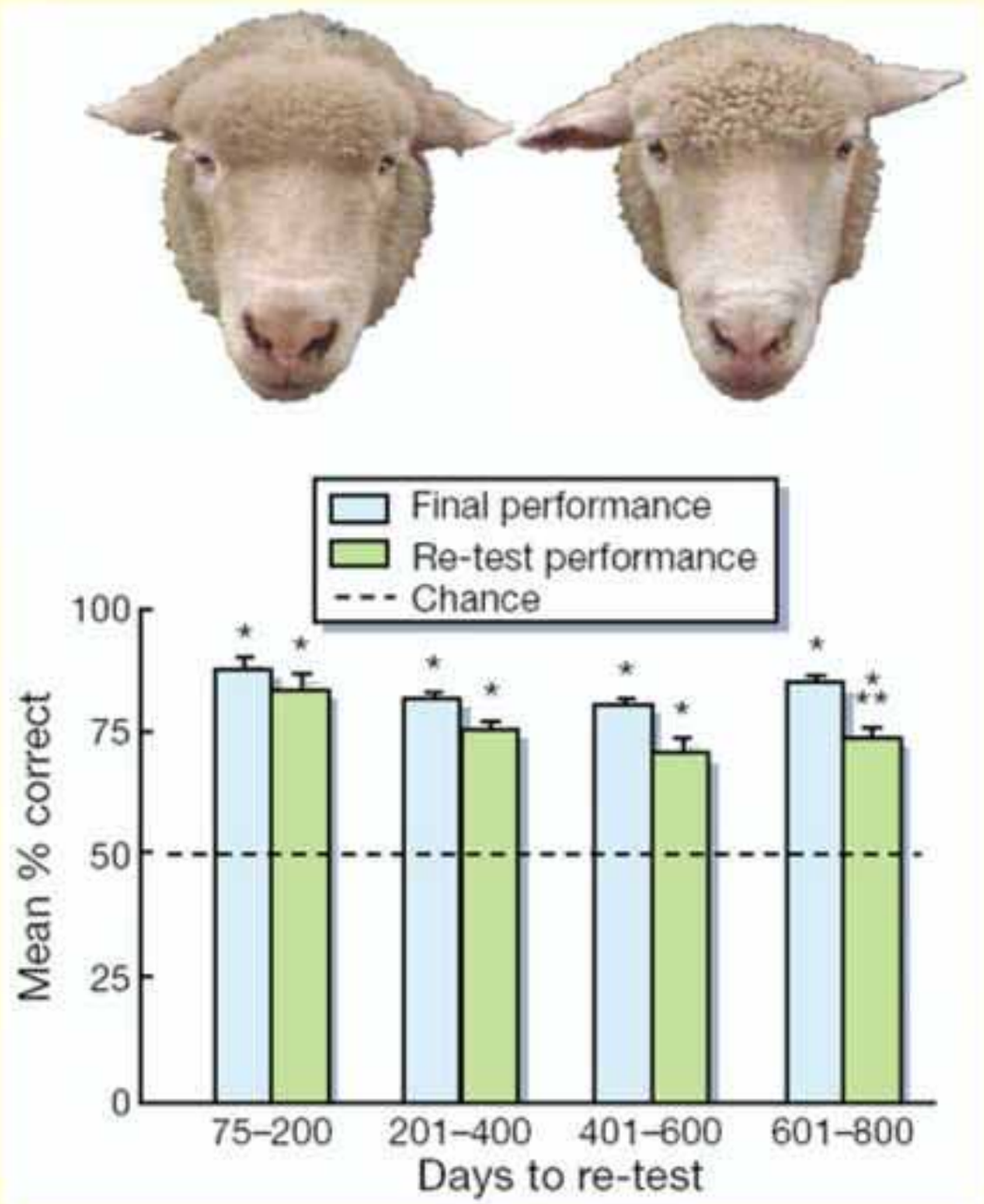
Individual recognition

Memory for faces



Kendrick *et al* Nature 2001

Memory for faces



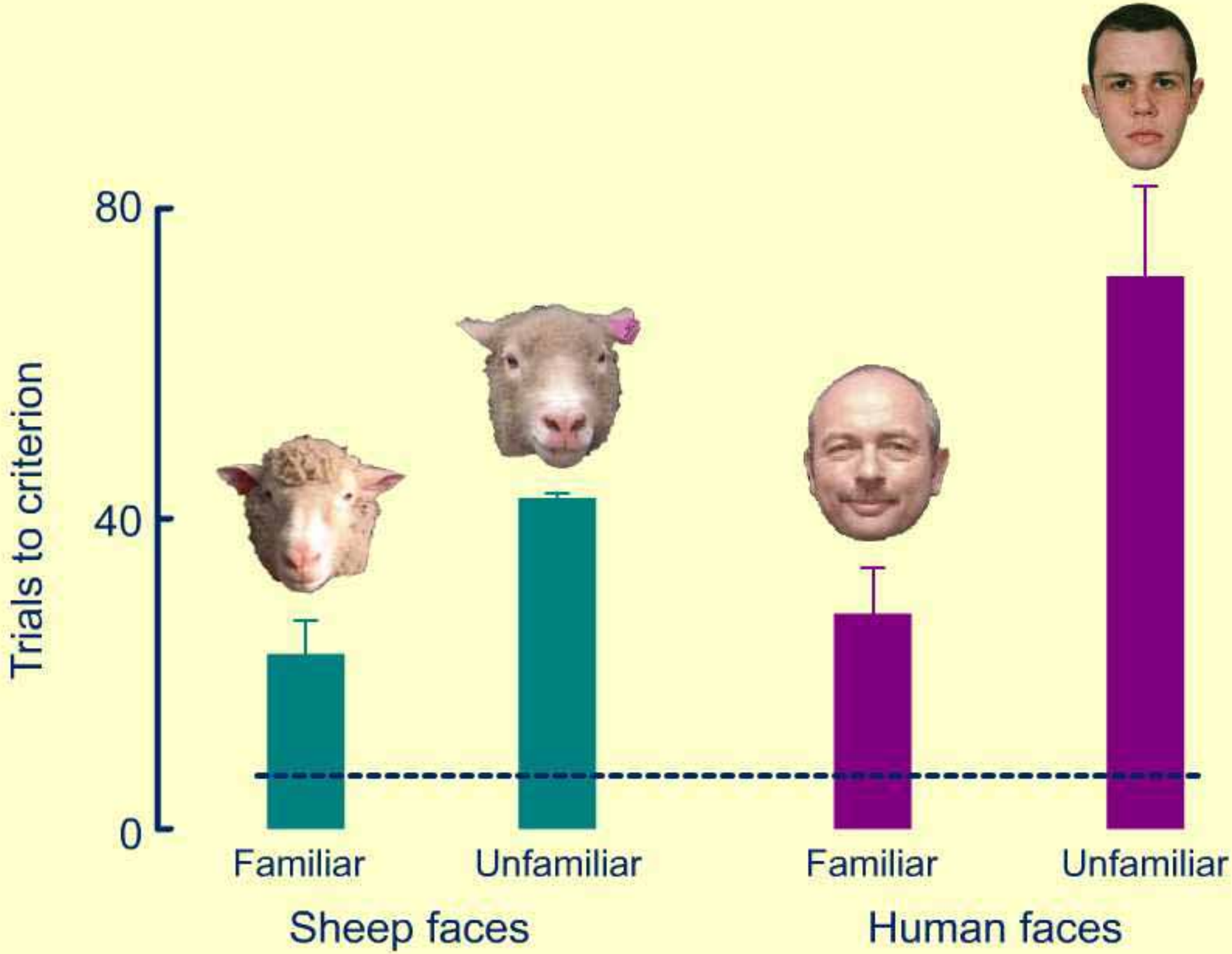
Kendrick *et al* Nature 2001

The Sun November 2001


'I'm sure you're wrong. Stephen Byers's nose is much shorter than that.'

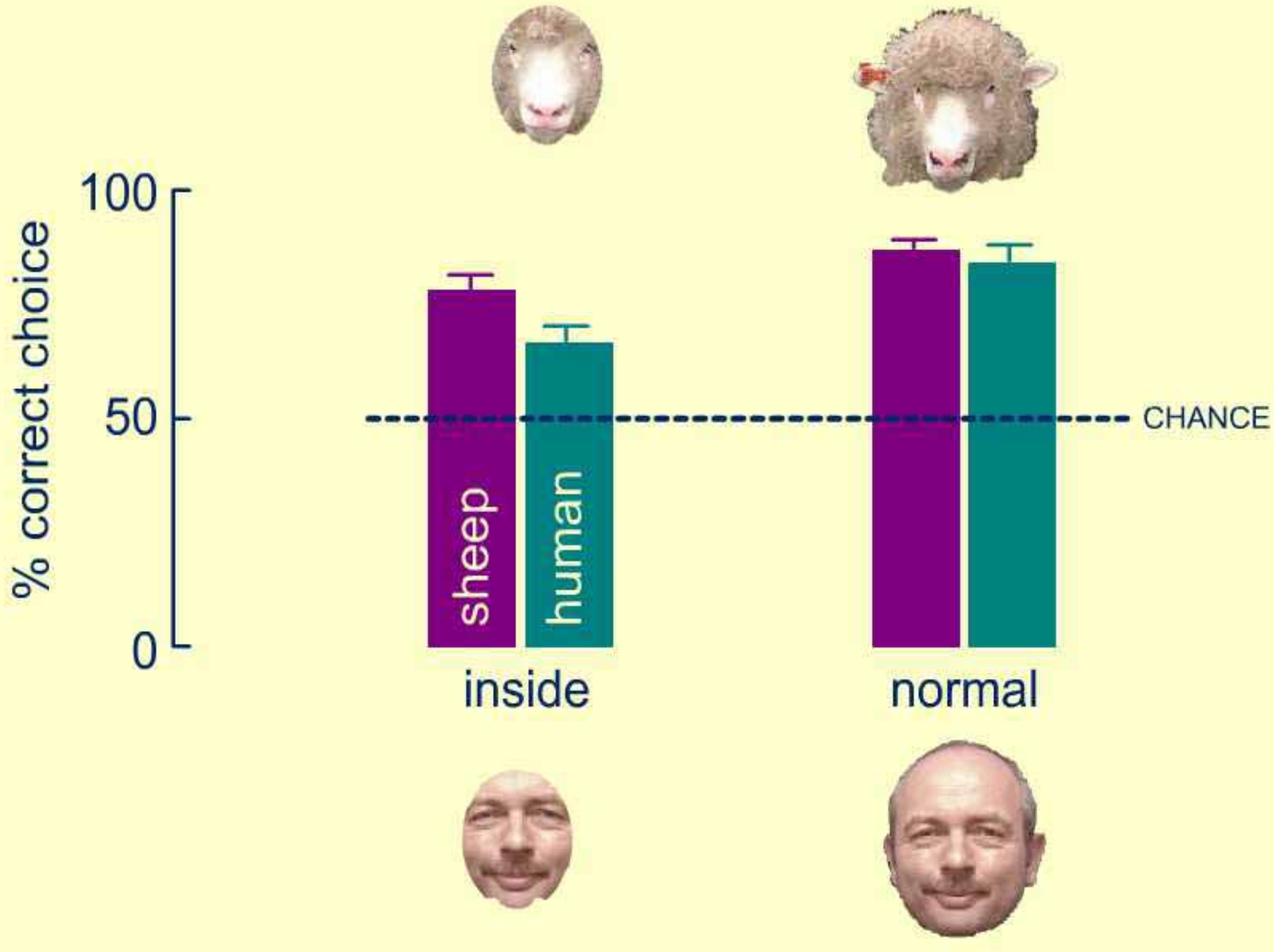
Daily Mail November 2001

Speed of learning

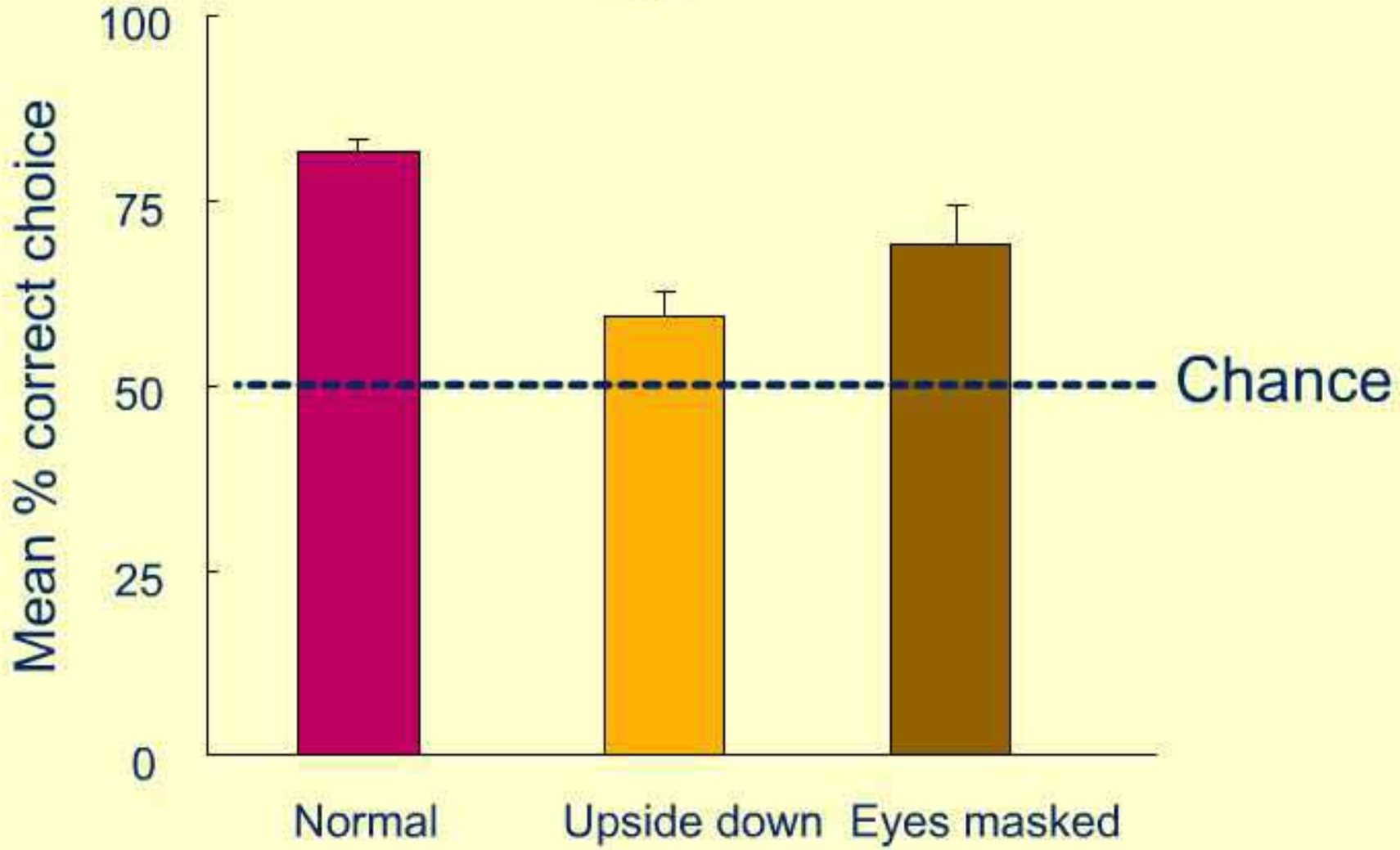


Sensitivity to face orientation and configuration

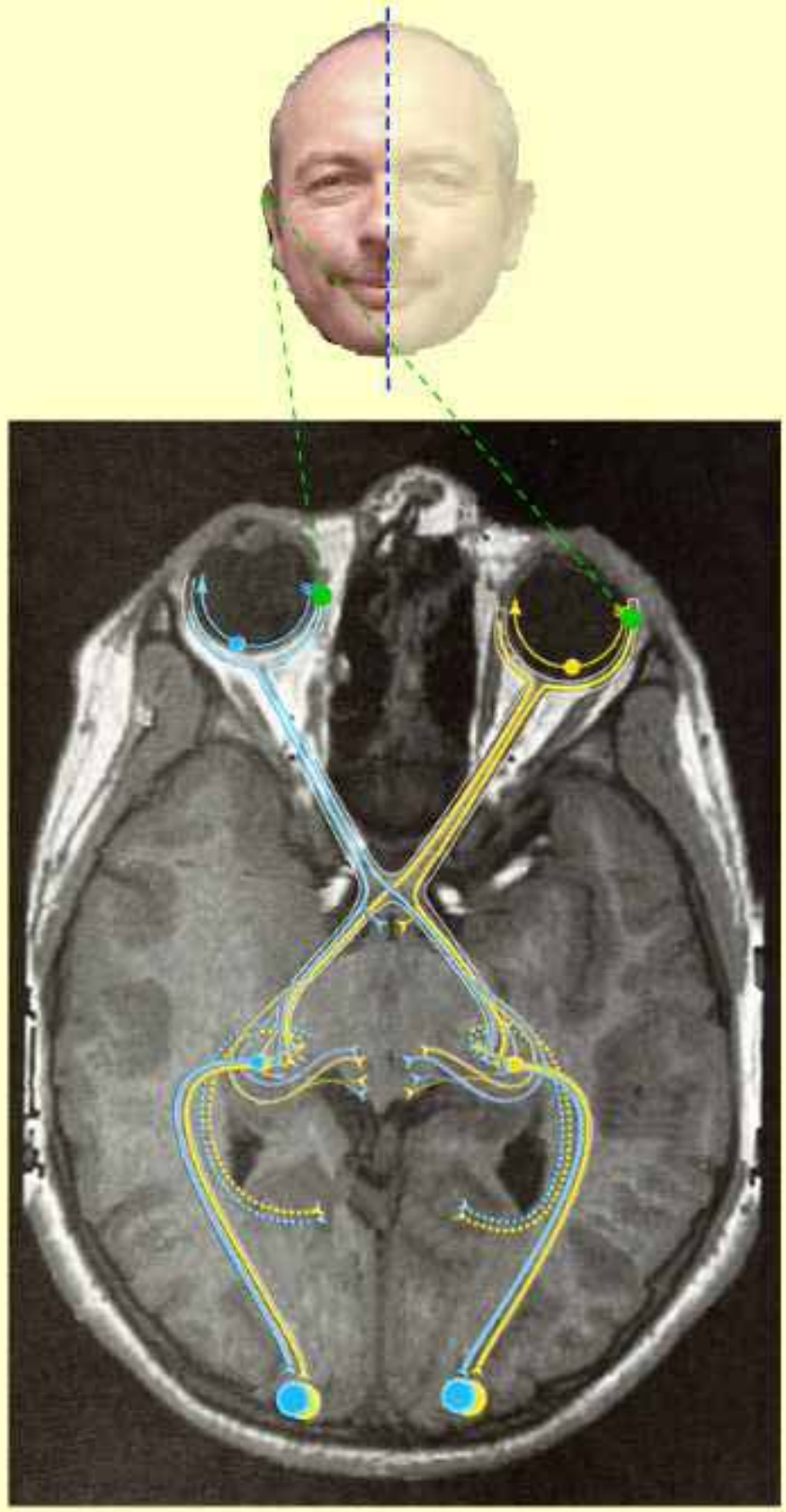
Sensitivity to face orientation and configuration



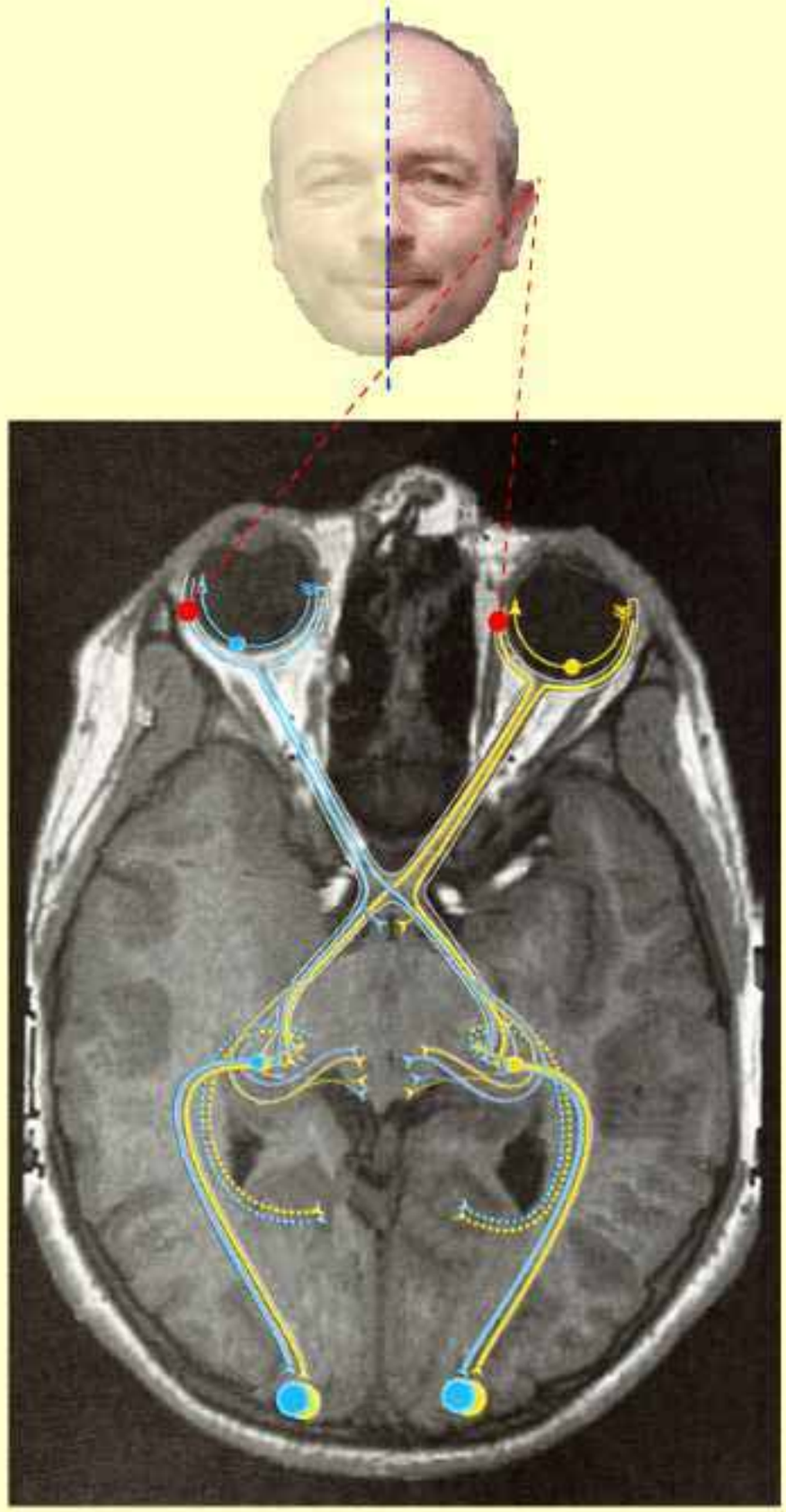
The eyes have it



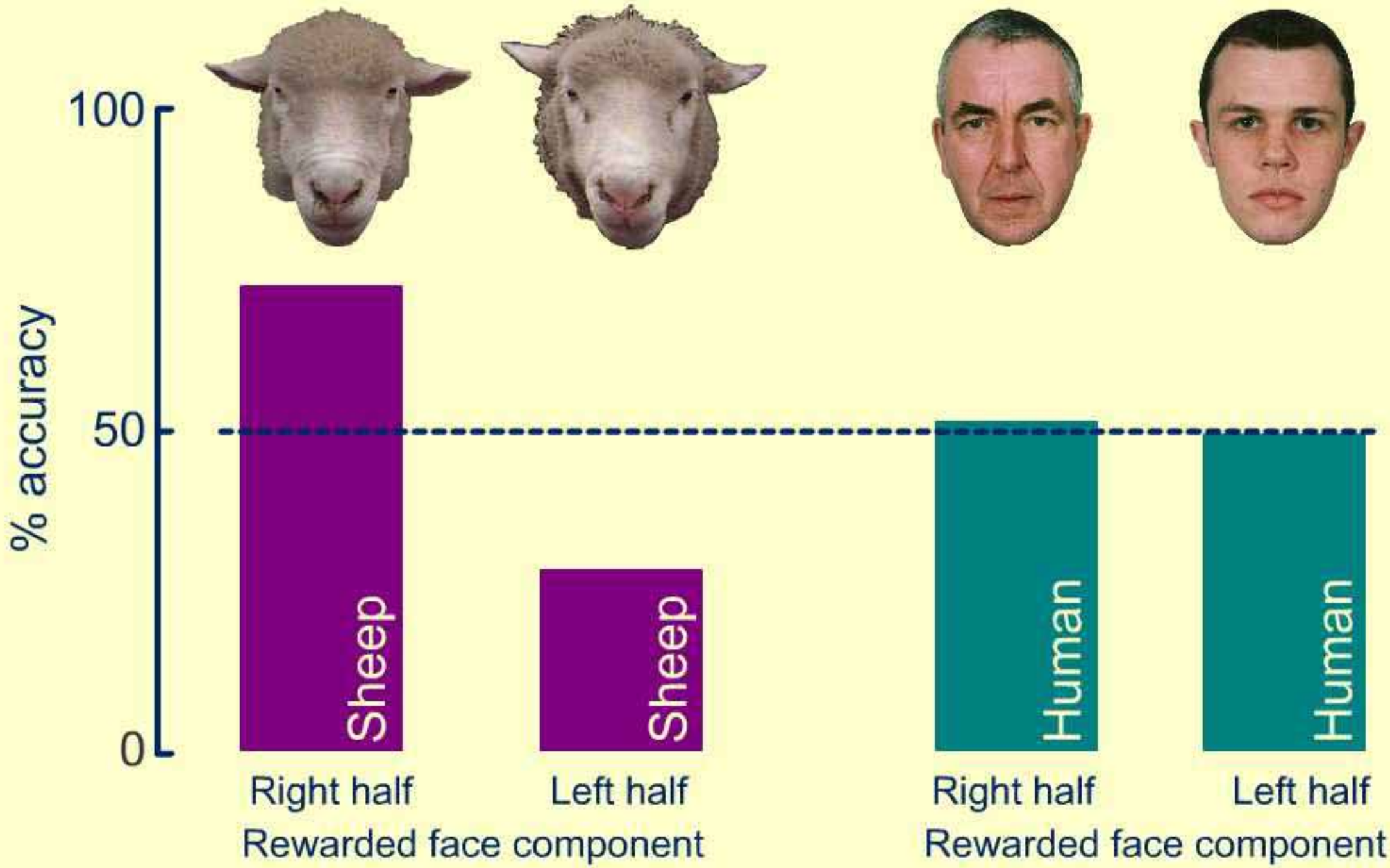
Faces out of the left field



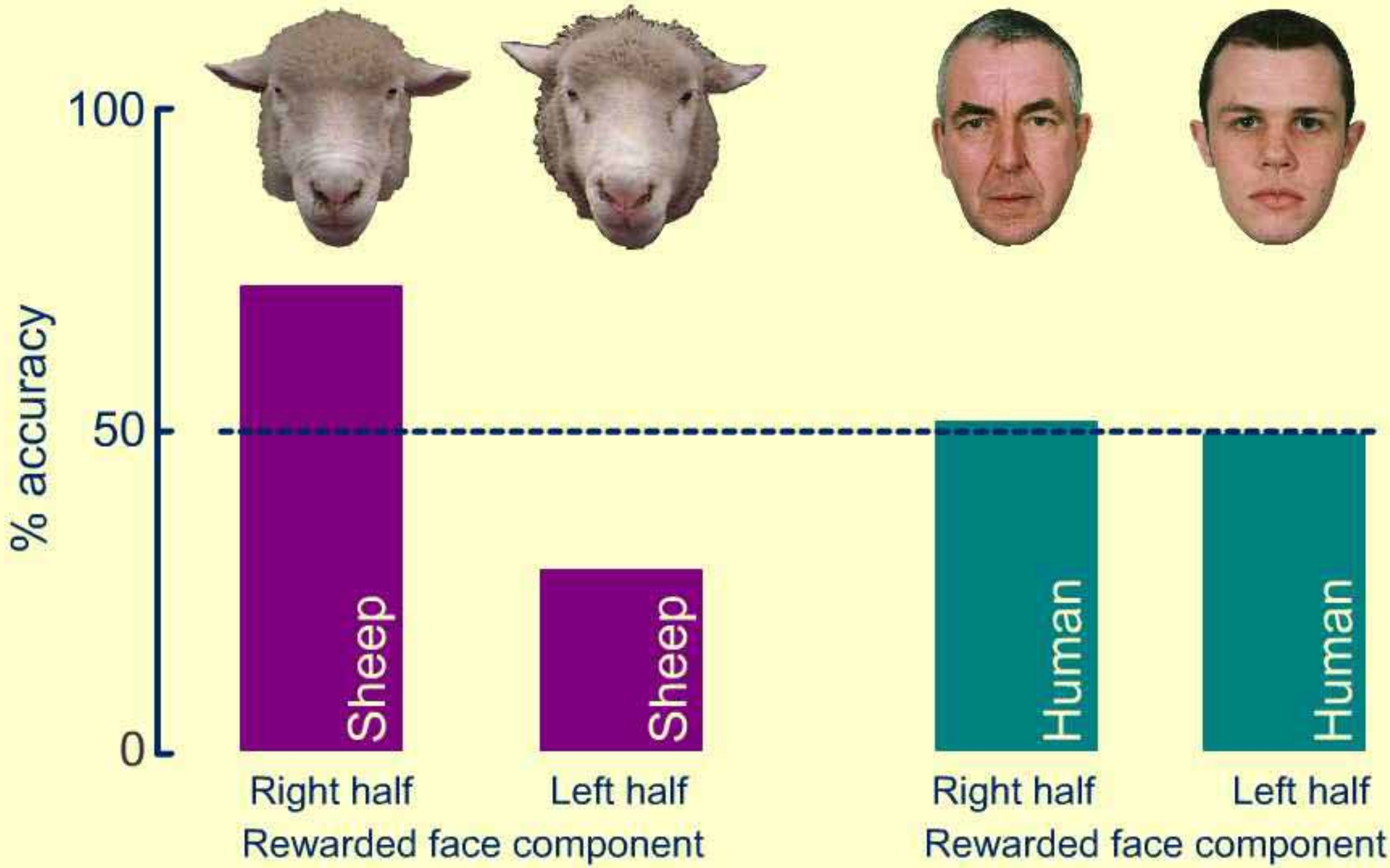
Faces out of the left field



Faces out of the left field



Faces out of the left field

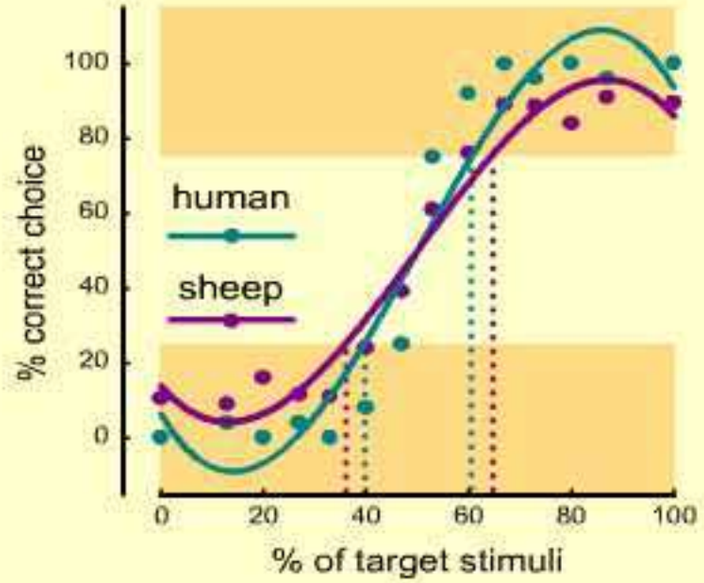


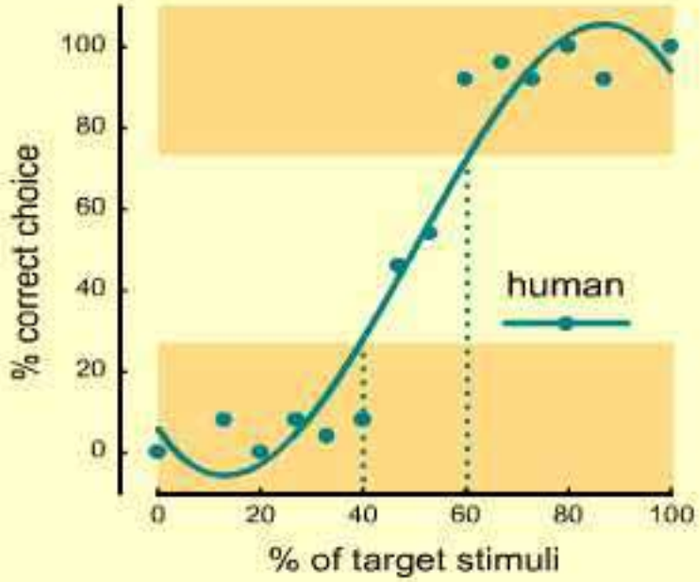
Discrimination acuity

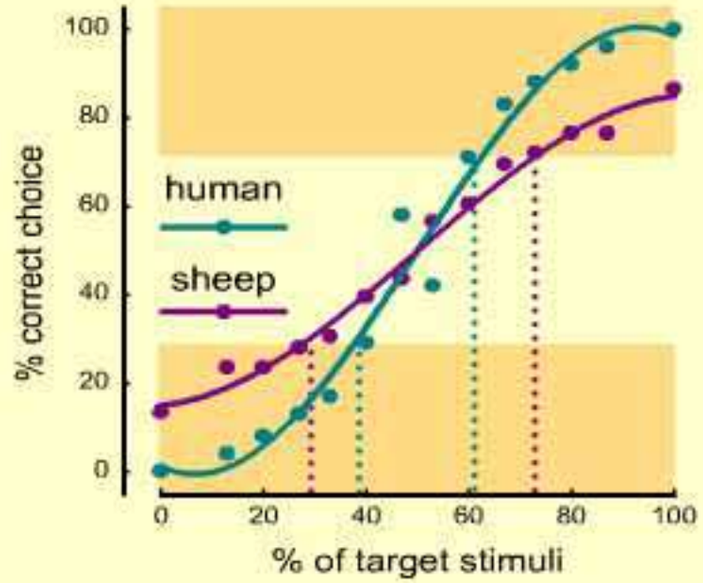
Human vs. sheep

Human vs. human

Sheep vs. sheep





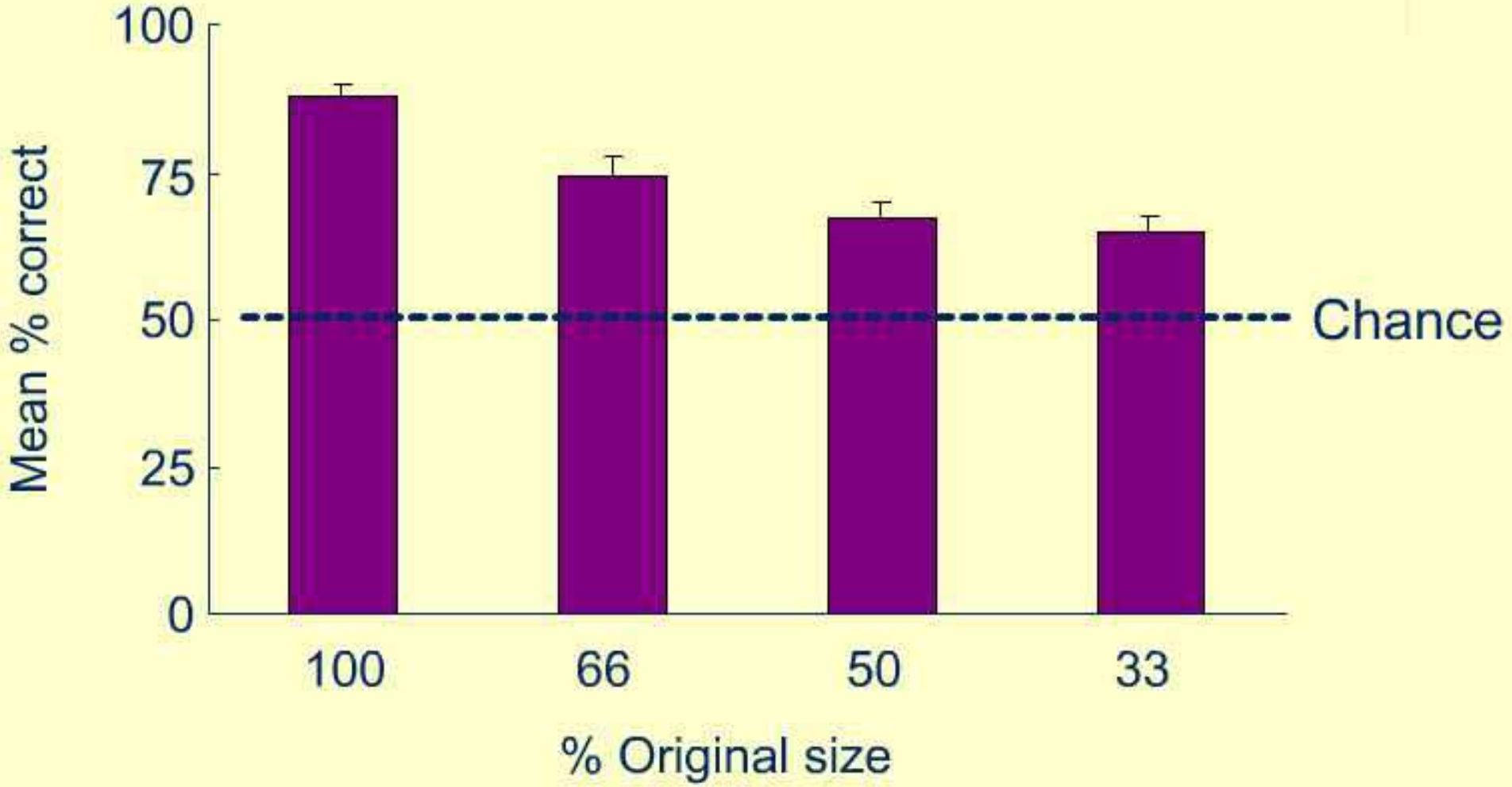


Detection limits:

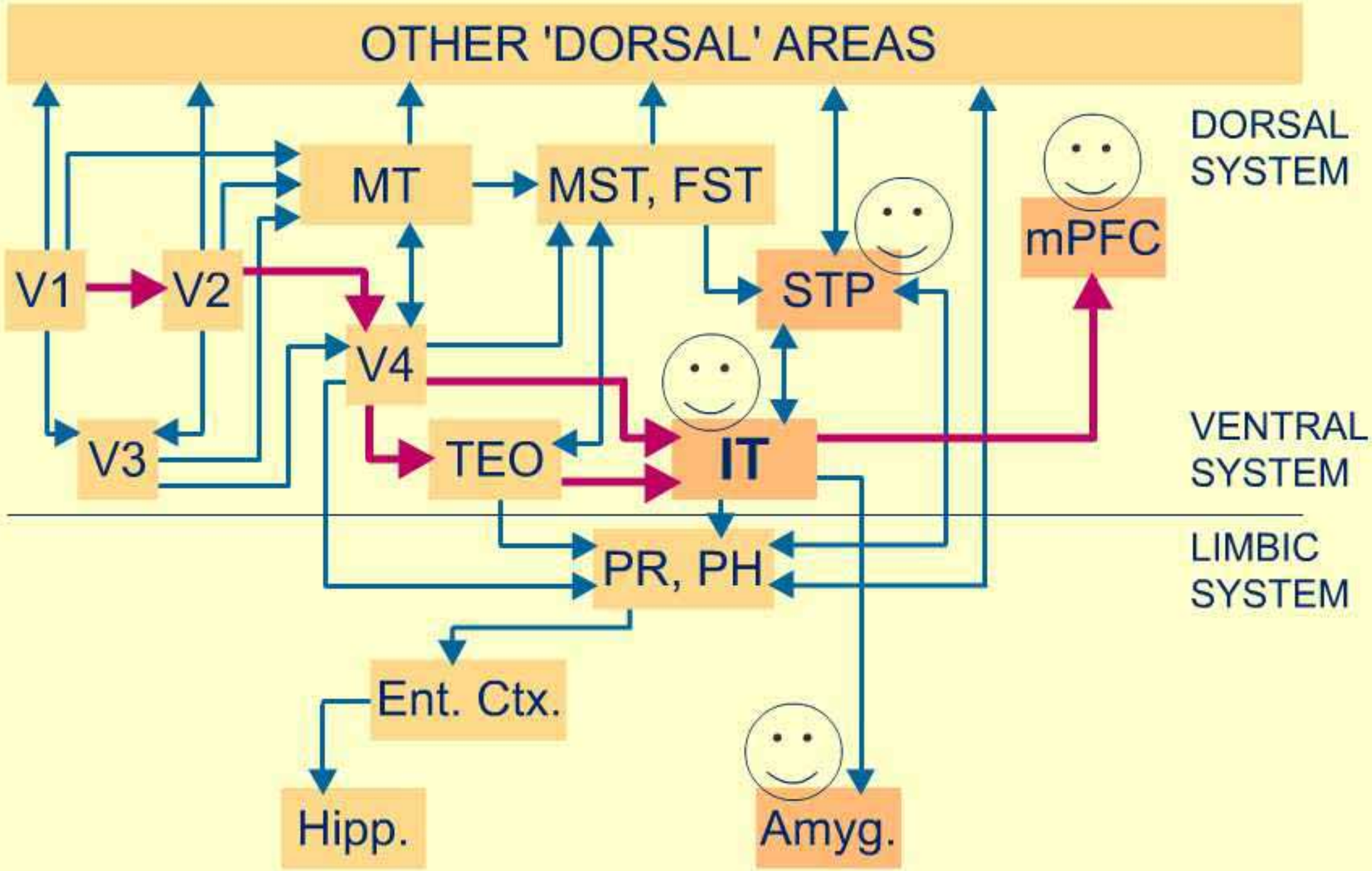
Humans:10 - 15% difference

Sheep: 15 - 20% difference

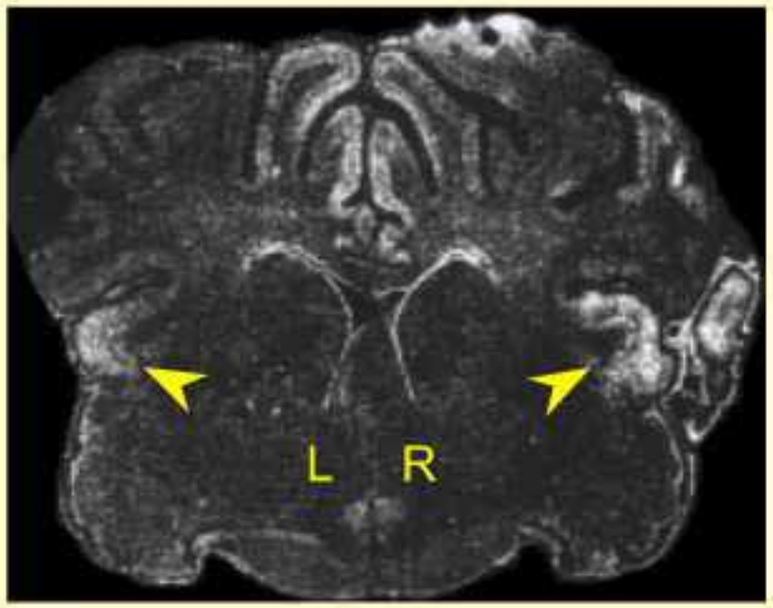
Small faces



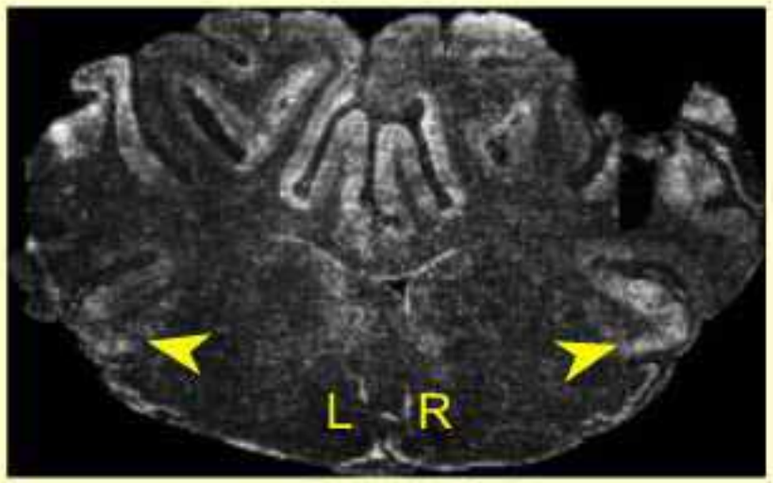
Does the sheep brain recognise faces the same way that the human brain does ?



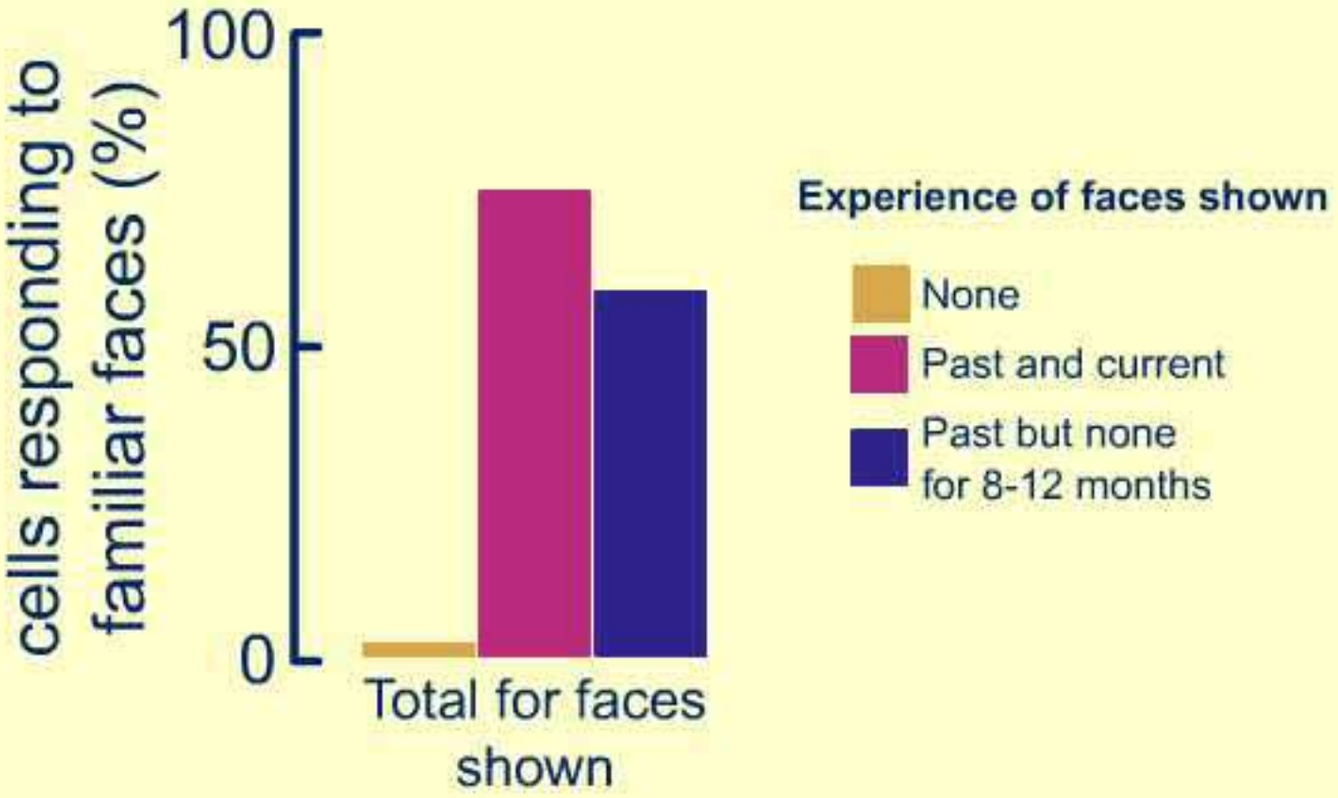
Right brain hemisphere bias and memory



Posterior temporal cortex



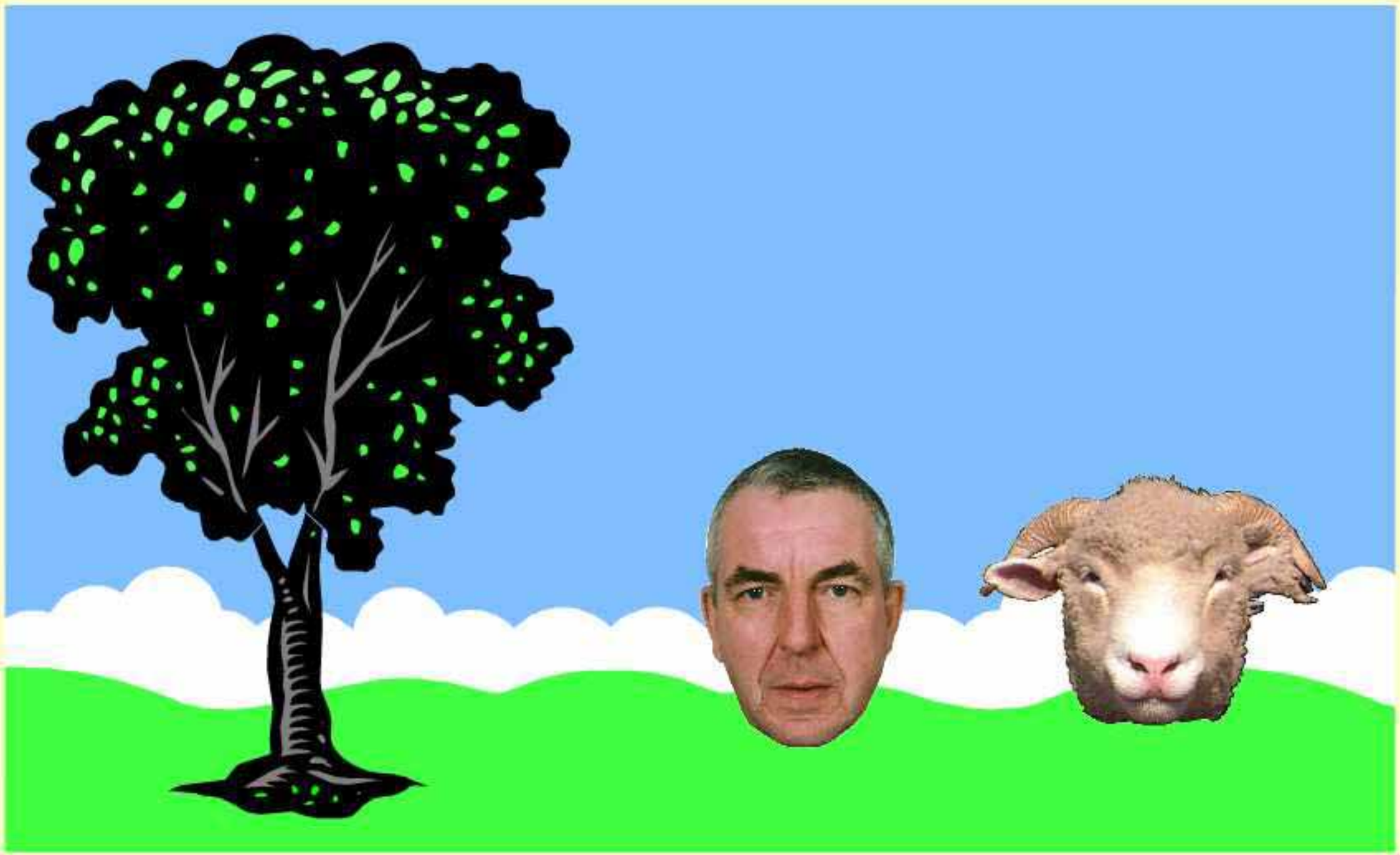
Medial temporal cortex



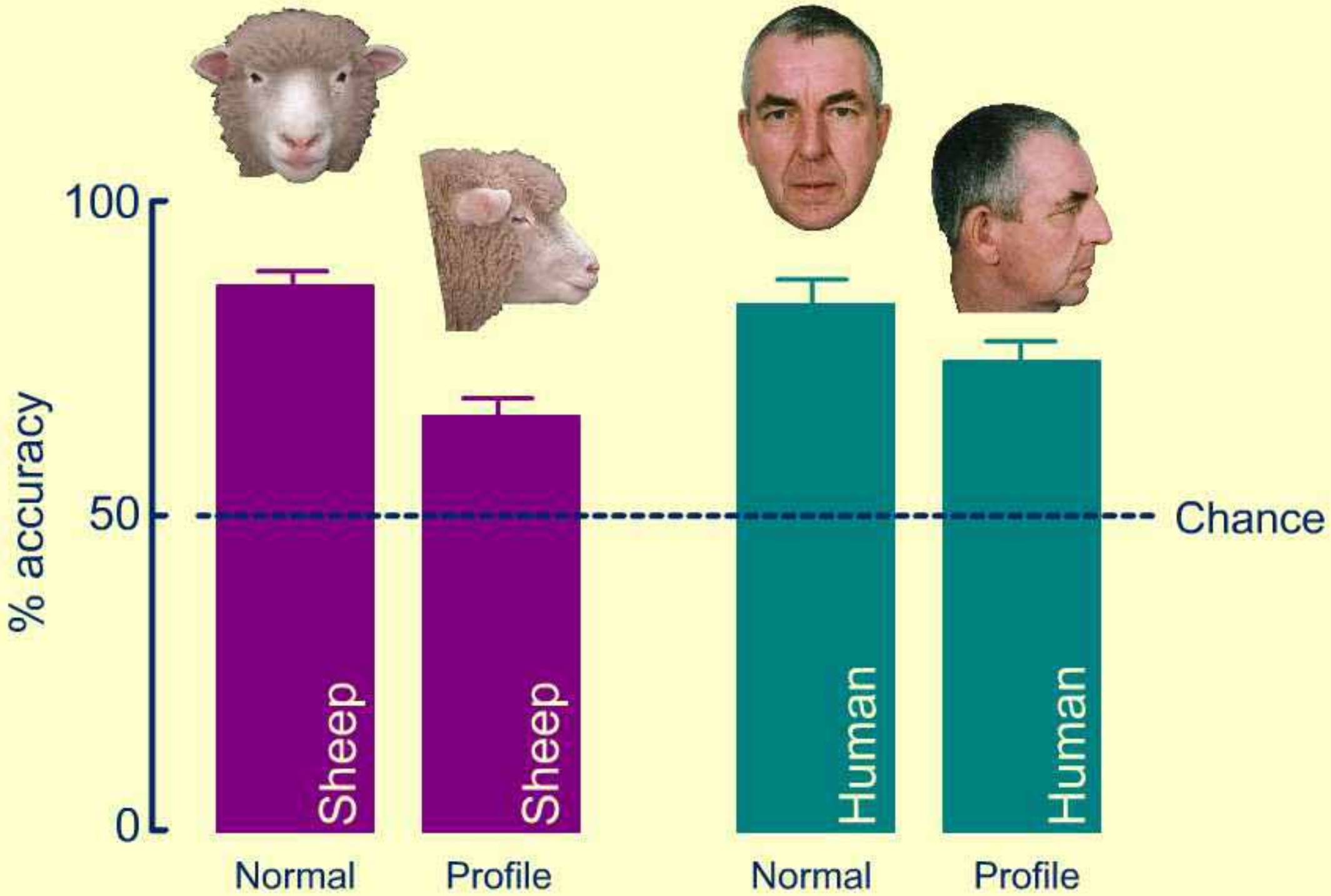
Can sheep also imagine faces ?

- Being able to hold mental images of faces

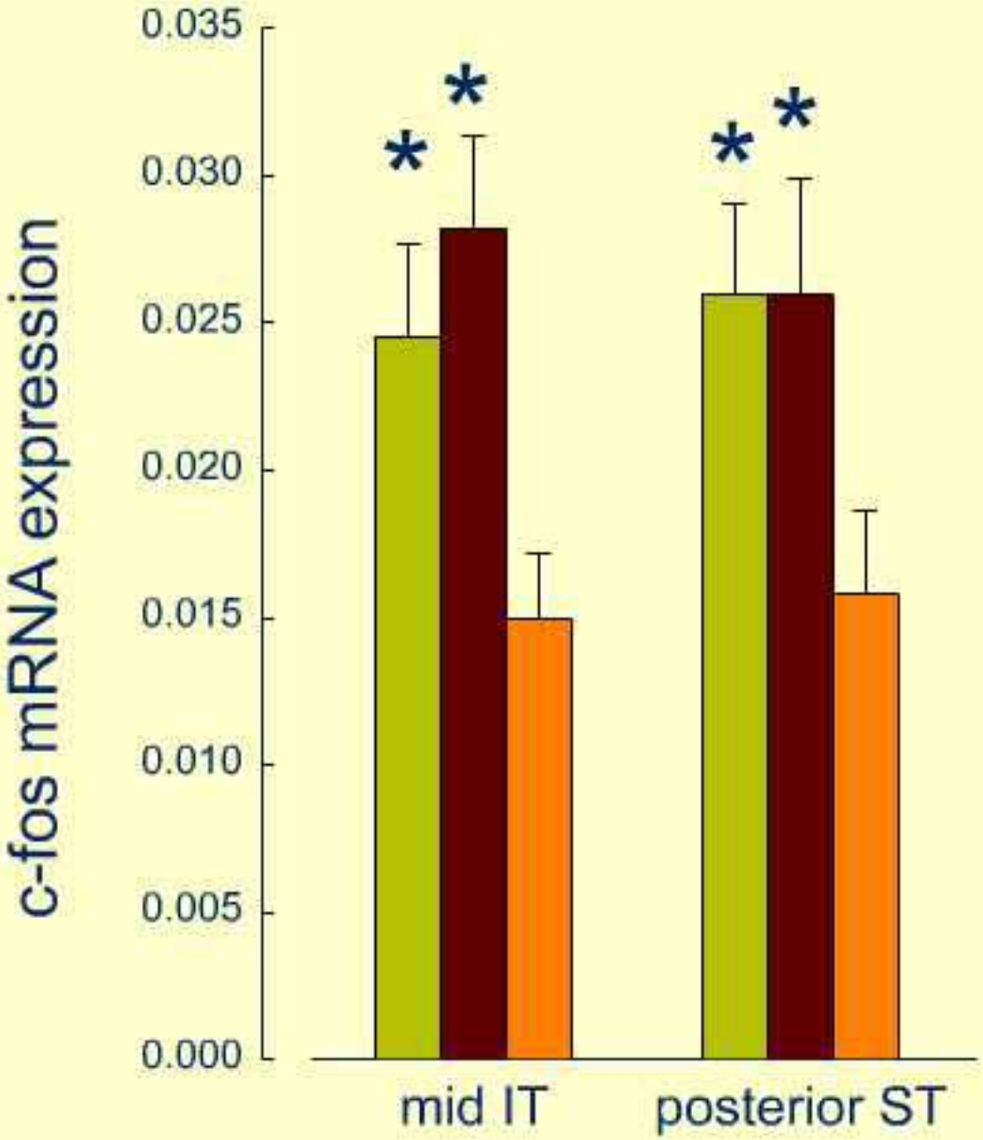
-



Can sheep also imagine faces ? - mental rotation

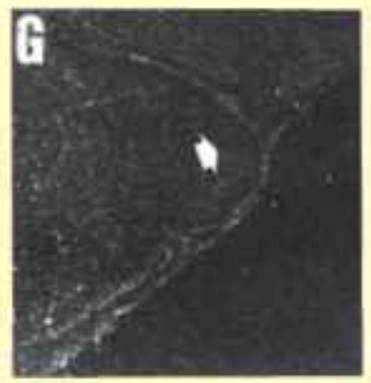


Can sheep also imagine faces ? - evidence from the brain



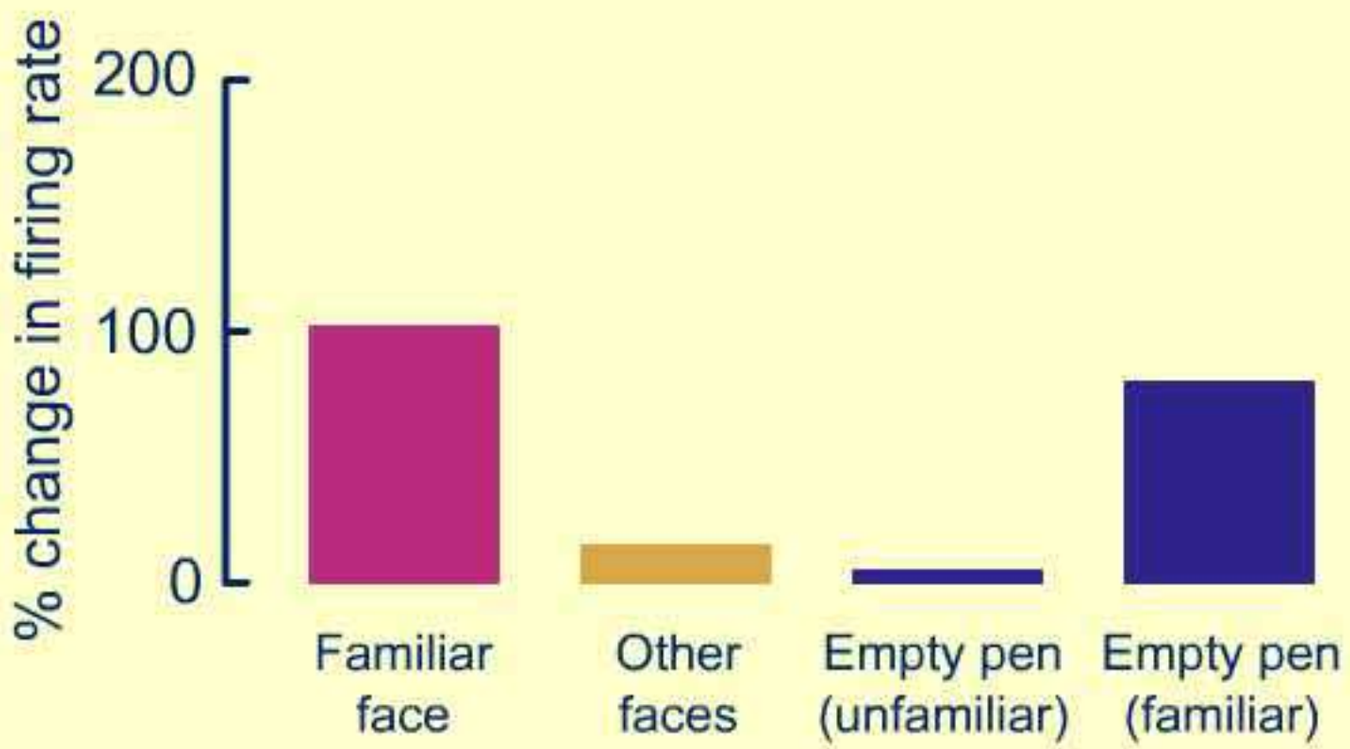
Face of lamb

Bleat of own lamb



Mixed bleat of own lamb

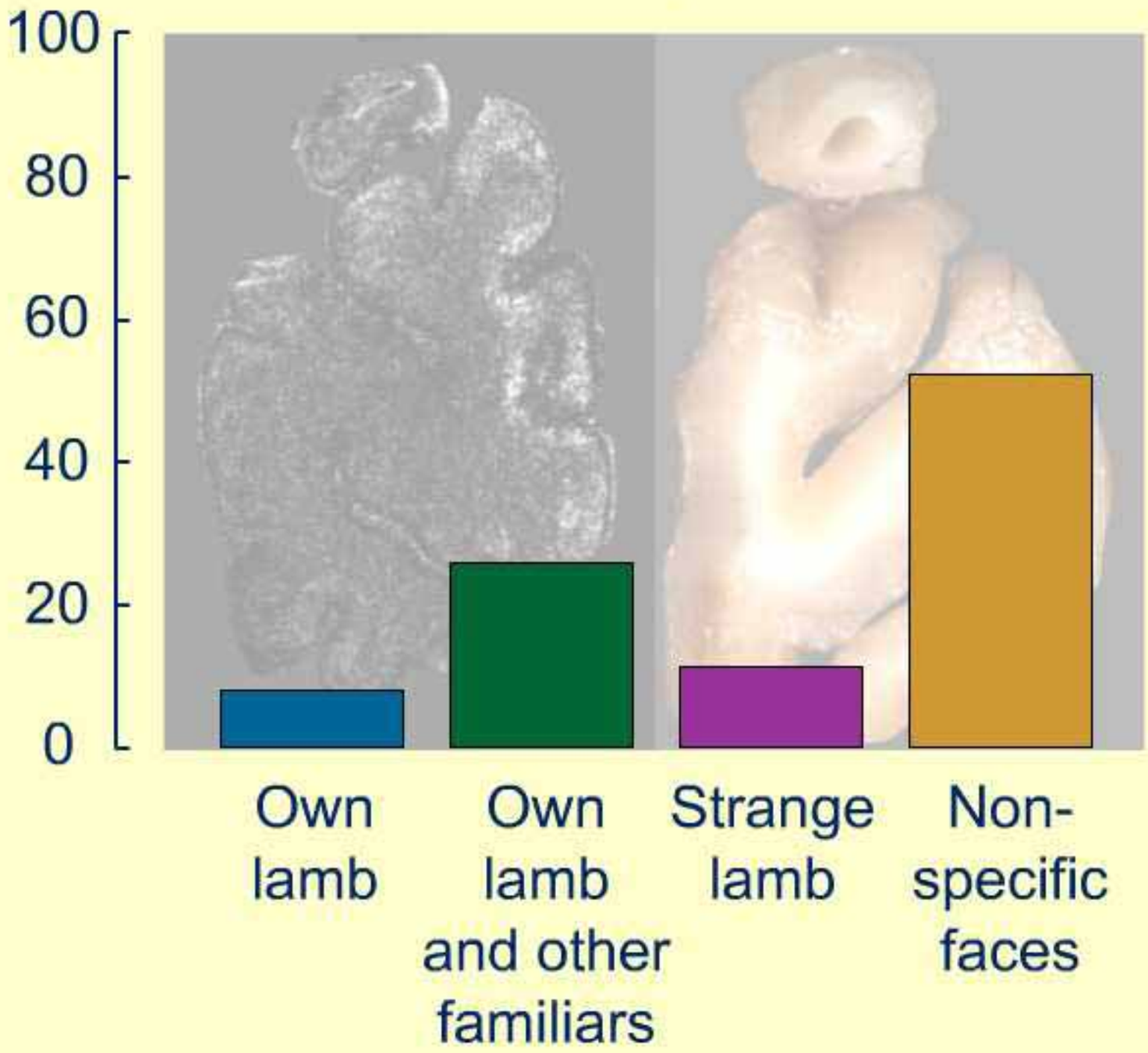
Can sheep also imagine faces ? - evidence from the brain



Can sheep also imagine faces ?

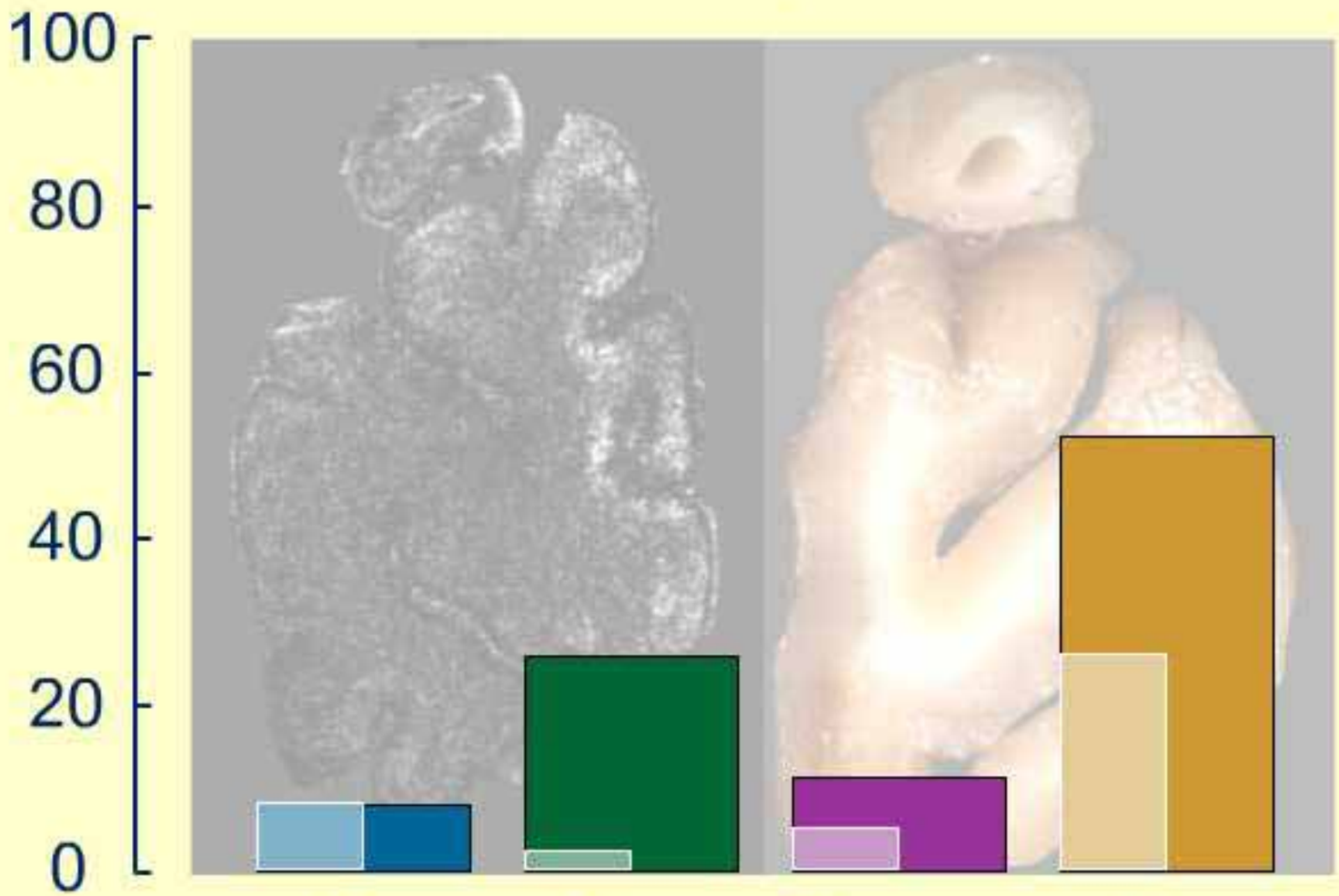
Face recognition may be present in other mammals

Can sensory information be combined to effect more accurate recognition ?



Can sensory information be combined to effect more accurate recognition ?

Proportion of cells in the medial pre-frontal cortex responding to faces



Total cells
45/308

Multimodal cells
15/45

Some general final conclusions

- Animals can recognise individuals by their smell, voices or faces

- In general they are better at recognising their own species

- The brain is specialised to detect relevant patterns of information

- Remembering lots of different individuals needs brain power !

- Perfume is not an aid to identity or a means of deception !

- Elephants and dolphins don't forget a good voice

Some general final conclusions

- Looking back over your right shoulder means you recognise a voice

- While smells and voices can be good for recognition, faces are even better

- Remember it's all down to the right side of your face

- Other species may imagine the faces of their friends or enemies

Some general final conclusions

- So you thought sheep all looked alike, and lacked a brain ?

- Face up to it, you need to think again !