# Why do you think Rabbits were slow learners and bees quick learners?

**Some Interesting Ideas:**

- Brain size. Smaller brains can learn more quickly (as long as the pattern is simpler)
- Bees have to process things more quickly because of how they fly through the environment
- Bees are social (share the learning)
- Bees are social (task specialists)
- The task is simpler for bees
- Speed accuracy trade-off for short-lived animals

# Why do you think Rabbits were slow learners and bees quick learners?

- Bees have innate attractions to some colours
- Bees have sensori-motor programs that are used to 'centre' symmetrical patterns
- This puts flowers at the same part of the visual system
- This helps rapid learning

**<u>Species specific predispositions</u>** and **<u>associative learning</u>** explain the impressive cognitive performance of the bees

# Unexpected Cleverness

Paul Graham
p.r.graham@sussex.ac.uk
Andy Philippides
andrewop@sussex.ac.uk

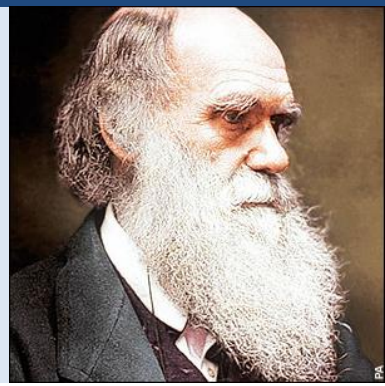
# Learning Outcomes

- **Historical accounts of animal behaviour demonstrate a tension between anthropomorphic and sceptical descriptions.**
- **This dichotomy can also be referred to as romantic vs killjoy.**
- **For animals that show "unexpected cleverness" we can understand killjoy accounts in terms of:**
  - **Specialised morphological adaptations *(embodiment)***
  - **Specialised behavioural adaptations**
  - **Adaptation to ecological niche enabling them to cope with predictable situations *(situatedness)***

# Animal minds after Darwin

***Charles Darwin The Descent of Man (1871)***

*"…the difference in mind between man and the higher animals, great as it is, certainly is one of degree and not of kind"*

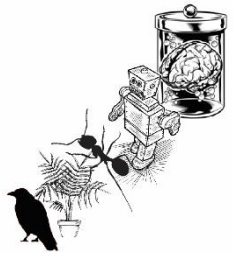


- The idea of evolution promoted a concept of intellectual continuity across animal species.
- Consequently Darwin didn't see a problem using anthropomorphic language to describe animal behaviour.
- This led to people like George Romanes collecting and "verifying" anecdotes about the behaviour of animals. e.g. … …

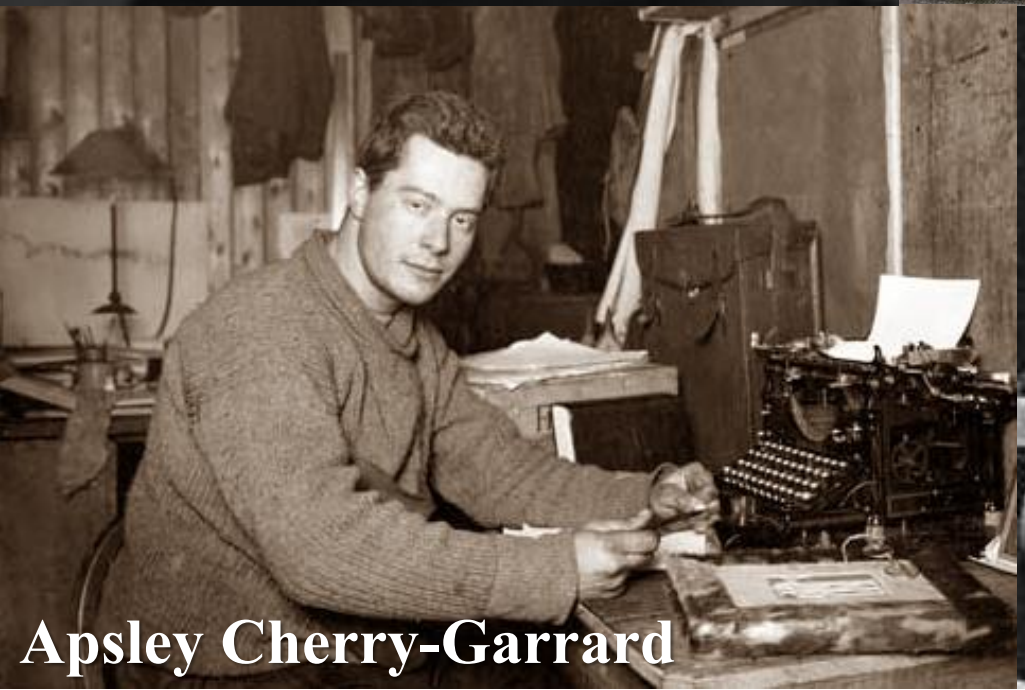
## … … proving fellow- feeling and sympathy, so far as we can trace any analogy between the emotions of the higher animals and those of insects.

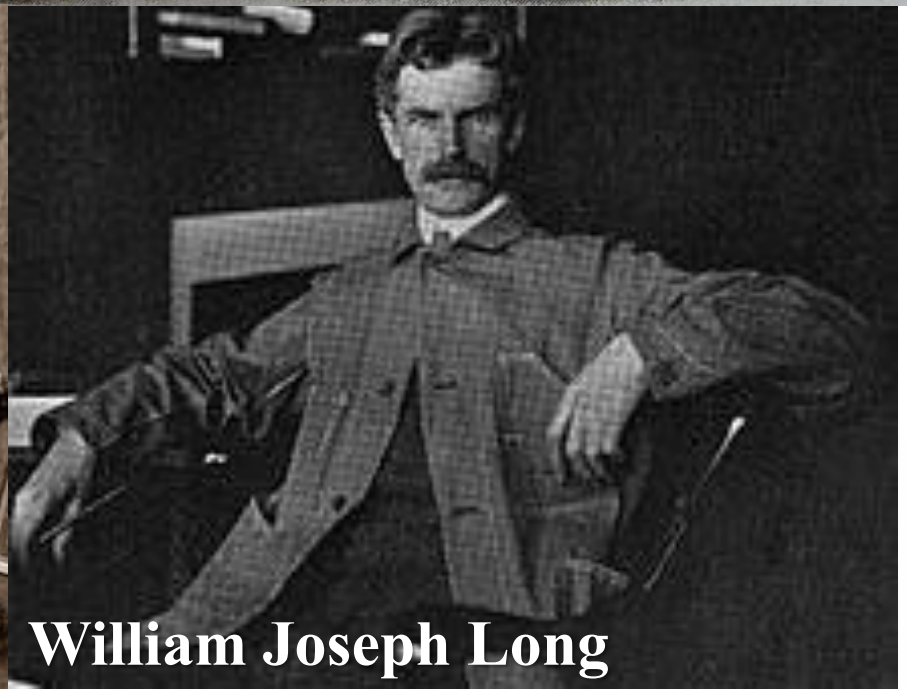
One day, watching a small column of these ants (*Eciton hamata*), I placed a little stone on one of them to secure it. The next that approached, as soon as it discovered its situation, ran backwards in an agitated manner, and soon communicated the intelligence to the others. They rushed to the rescue; some bit at the stone and tried to move it, others seized the prisoner by the legs and rugged with such force that I thought the legs would be pulled off, but they persevered until they got the captive free. … … Another time I found a very few of them passing along at intervals. I confined one of these under a piece of clay at a little distance from the line, with his head projecting. Several ants passed it, but at least one discovered it and tried to pull it out, but could not. It immediately set off at a great rate, and I thought it had deserted its comrade, but it had only gone for assistance, for in a short time about a dozen ants come hurrying up, evidently fully informed of the circumstances of the case, for they made directly for their imprisoned comrade and soon set him free. **I do not see how this action could be instinctive. It was sympathetic help, such as man only among the higher mammalia shows. The excitement and ardour with which they carried on their unflagging exertions for the rescue of their comrade could not have been greater if they had been human beings.**

George Romanes *Animal Intelligence* (1888)

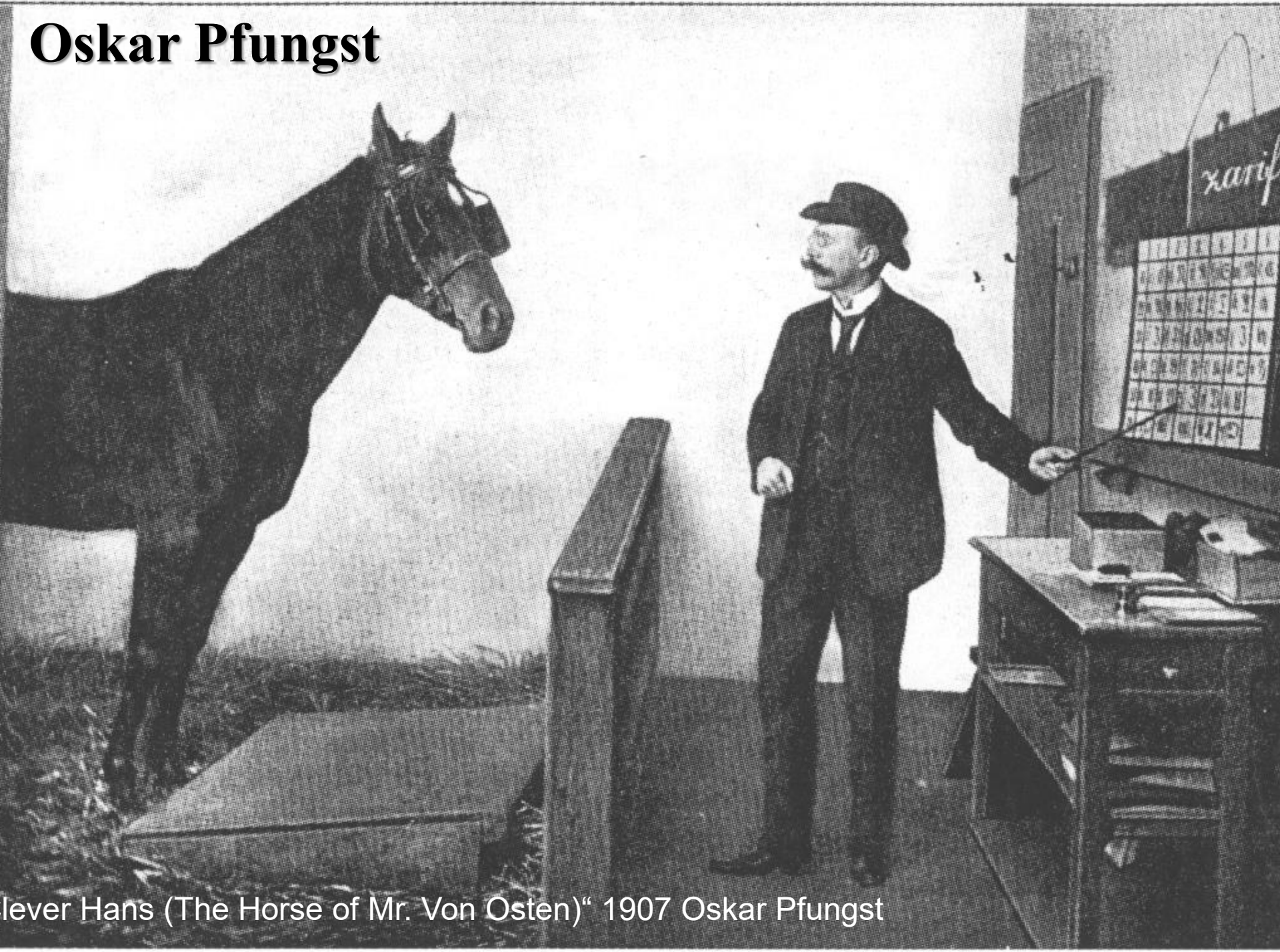


Clever Hans

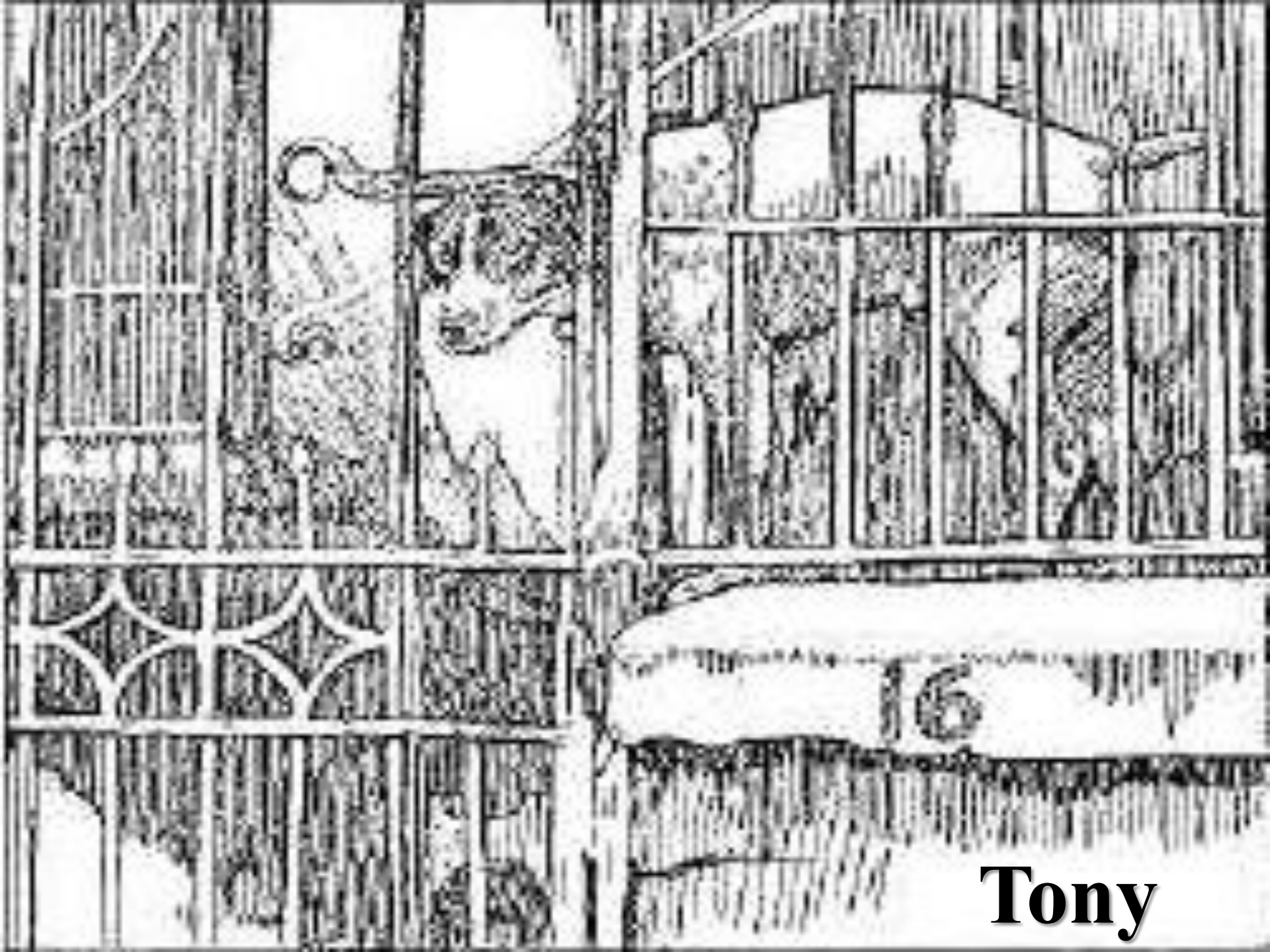

Apsley Cherry-Garrard


William Joseph Long

# Oskar Pfungst



lever Hans (The Horse of Mr. Von Osten)“ 1907 Oskar Pfungst


Tony

# C Lloyd Morgan

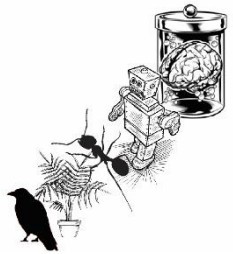
***"…In no case may we interpret an action as the outcome of the exercise of a higher mental faculty, if it can be interpreted as the exercise of one which stands lower in the psychological scale"***

Morgan CL (1903). "Chapter 3 Other minds than ours".
In *An Introduction to Comparative Psychology* (2nd ed.). W. Scott. p. 59

# Lessons Learned

- Words matter and anthropomorphic descriptions don't help us understand how smart animal behaviour comes about.
- We need to be sceptical and rigorous and detailed observation or experimentation is needed.
- This leads to the "accusation" of being a **killjoy**

This historical story is told nicely in Gould's 'Animal Cognition'
Marked as Essential on the Reading List



# Killjoy Explanations

Killjoy explanations account for behaviours that seem to require human-like thought in terms of simple processes such as associative learning and species-typical predispositions.

**Shettleworth (2010)**

| | Anthropomorphic | Killjoy |
|---|---|---|
| **Clever Hans** | **Advanced numeracy** | **Associative learning of social cues** |
| **Tony the dog** | **Insightful/Spontaneous problem solving** | **Trial and error learning** |

Reading List: Shettleworth (2010) Clever animals and killjoy explanations in comparative psychology. TiCS

# Killjoy breakdown

**Simple (associative) learning**

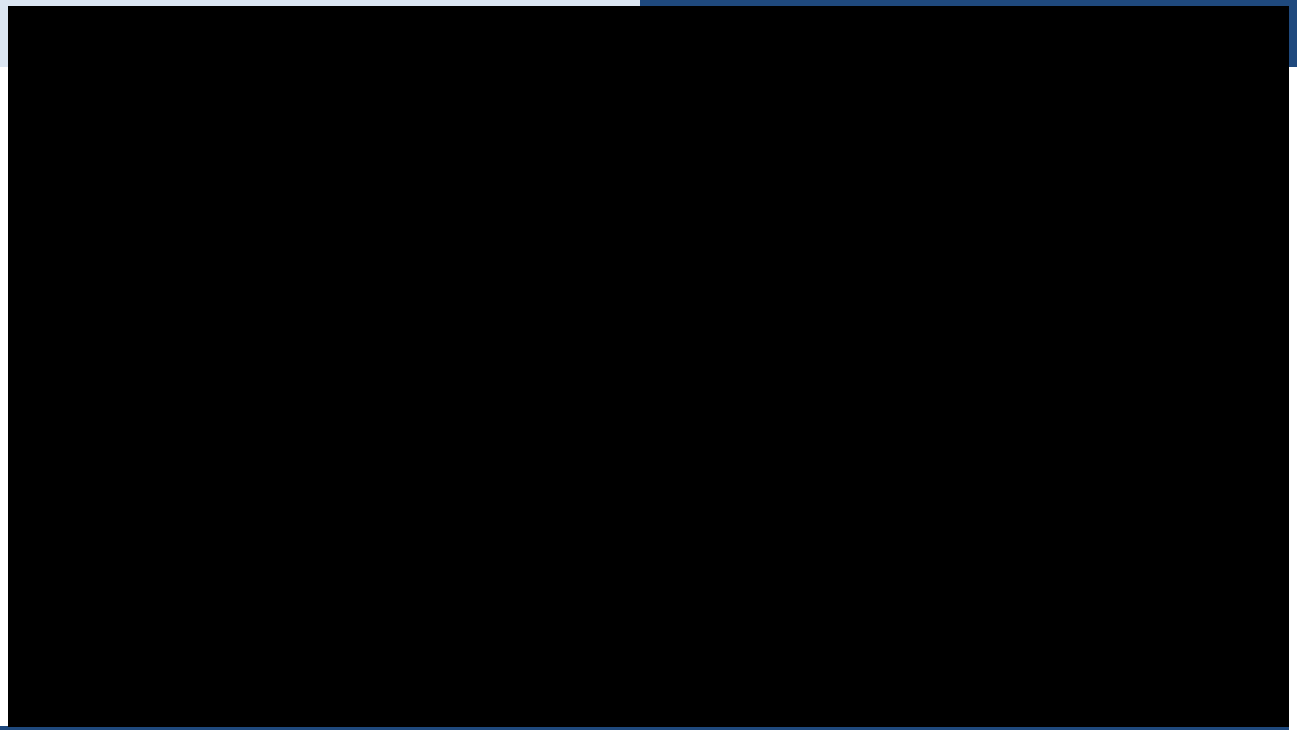
- Habituation
- Sensitisation
- Classical conditioning
- Operant conditioning
- Trial and error learning

**Species specific predispositions**

- Morphological adaptations (embodiment)
- Behavioural adaptations
- Adaptation to narrow ecological niche (situatedness)

# Let’s try to be killjoy

| **Anthropomorphic** | **Killjoy Explanations** |
| --- | --- |
| Novel unnatural behaviour | ? |
| Proto tool-use | ? |
| Culture | ? |



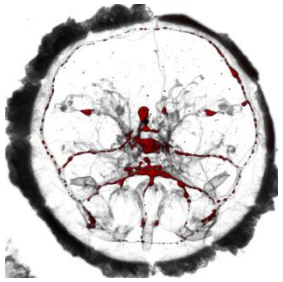
Alem et al (2016) String-pulling bees. *PLoS biology*, *14*(10), e1002564
https://www.youtube.com/watch?v=gSCr5OxXN1A

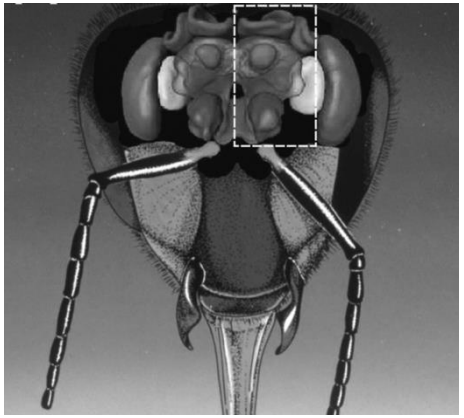
# Mini-break

# Unexpected cleverness in small brains

Let’s get killjoy

# What is a small brain?





**Zooplanckton larvae** **Higher invertebrates** **Humans**

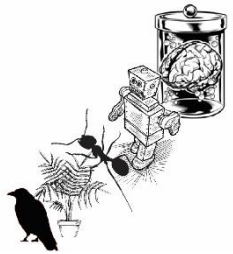
**0-10 neurons** **$10^6$ neurons** **$10^{11}$ neurons**

**X 100,000** **X 100,000**

# Hunting in *Portia*, a primitive jumping spider

***Portia*** **hunts a variety of spiders by stalking, detouring. It has a repertoire of behavioural strategies, each matched to a specific prey.**

https://www.youtube.com/watch?v=UDtlvZGmHYk

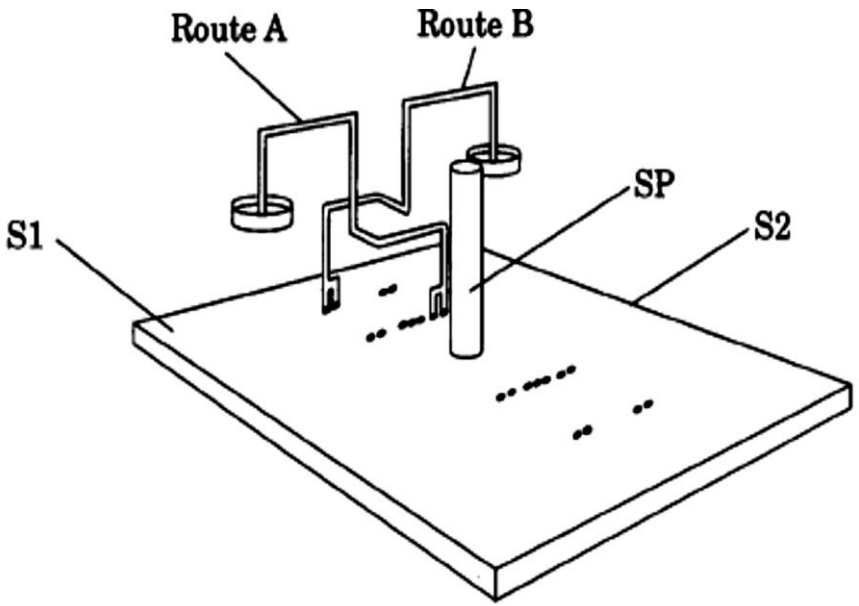
# Natural detours

1. **A spider was in an orb web on a tree trunk with a limb 10 cm above the orb.**
2. **A *Portia* walking on the trunk scanned and frequently fixated the spider in the web.**
3. **After c. 20 min, *Portía* walked around the trunk to be out of view of the web and then up the trunk.**
4. **After 15 min it returned to the same side as the web but was now 10 cm above it with the web hidden by the limb.**
5. ***Portia* continued along the limb and the web came into view 5 min later.**
6. **From this point, *Portia* scanned, and often fixated the web and the prey.**
7. **20 min later *Portia* dropped on a dragline until just above the victim spider and grabbed it.**

**The sequence took about an hour.**

Jackson and Wilcox, J. Zool. 1993

# Lab detours

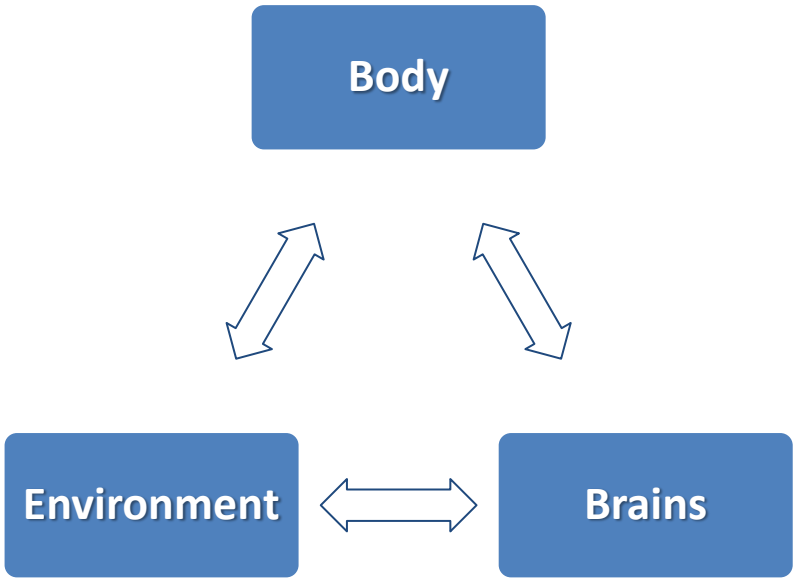



***Portia* select between complex routes. It does so near the top of the starting pole. Once it has climbed down it can no longer see the prey.**

Tarsitano and Jackson Anim. Behav. 1997

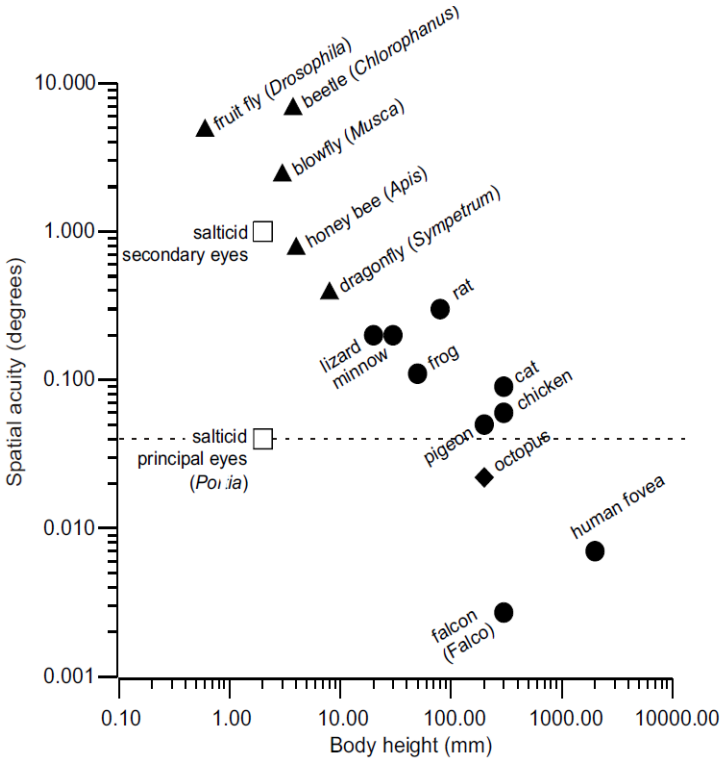
# Sensory adaptations

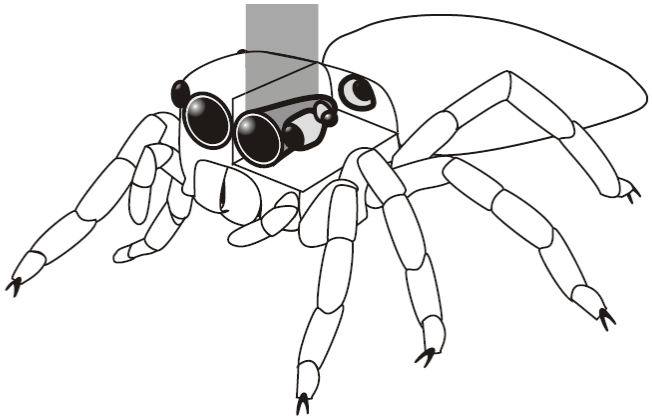
**A spider's frontal eyes have very narrow fields of view. To use these eyes, spiders turn and scan its surroundings.**




# Jumping Spider Vision

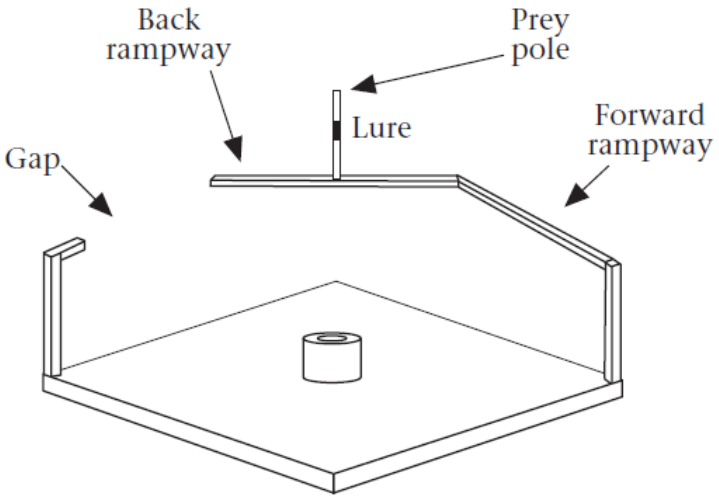
- Jumping spiders have large principal eyes.
  - Very high resolution
  - Very small field of view

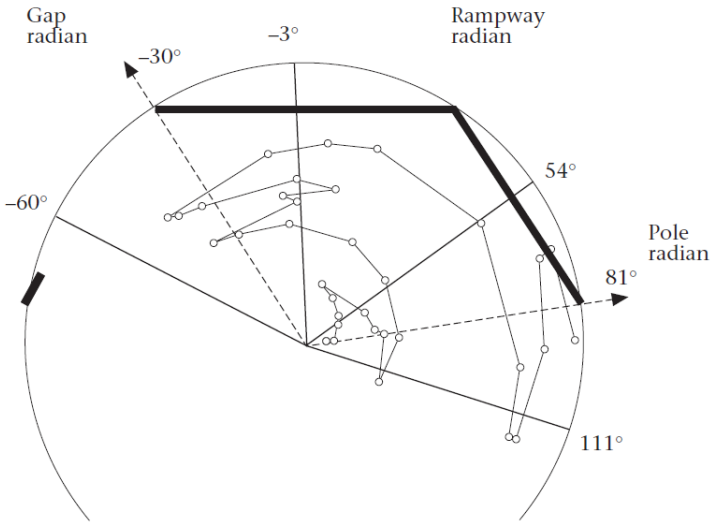


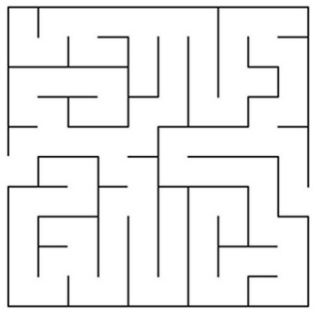
# *Portia* and detours in the lab

**Spider fixates the lure the reorients its body in 20º steps. Initially looks across gap. As scanning progresses, focuses on route. Does scanning pick out a continuous route?**




**Route planning for a spider is thus a form of vicarious trial and error, in which scanning substitutes for locomotion.**



Tarsitano and Andrew, Animal Behaviour, 1999

# Unexpected cleverness with small brains comes from:

- **Morphological and behavioural adaptations *(embodiment)***
- **Very narrow ecological niches creating predictable situations *(situatedness)***

**Anthropomorphic Descriptions**

Visualising

Planning

Mental simulation

Strategy

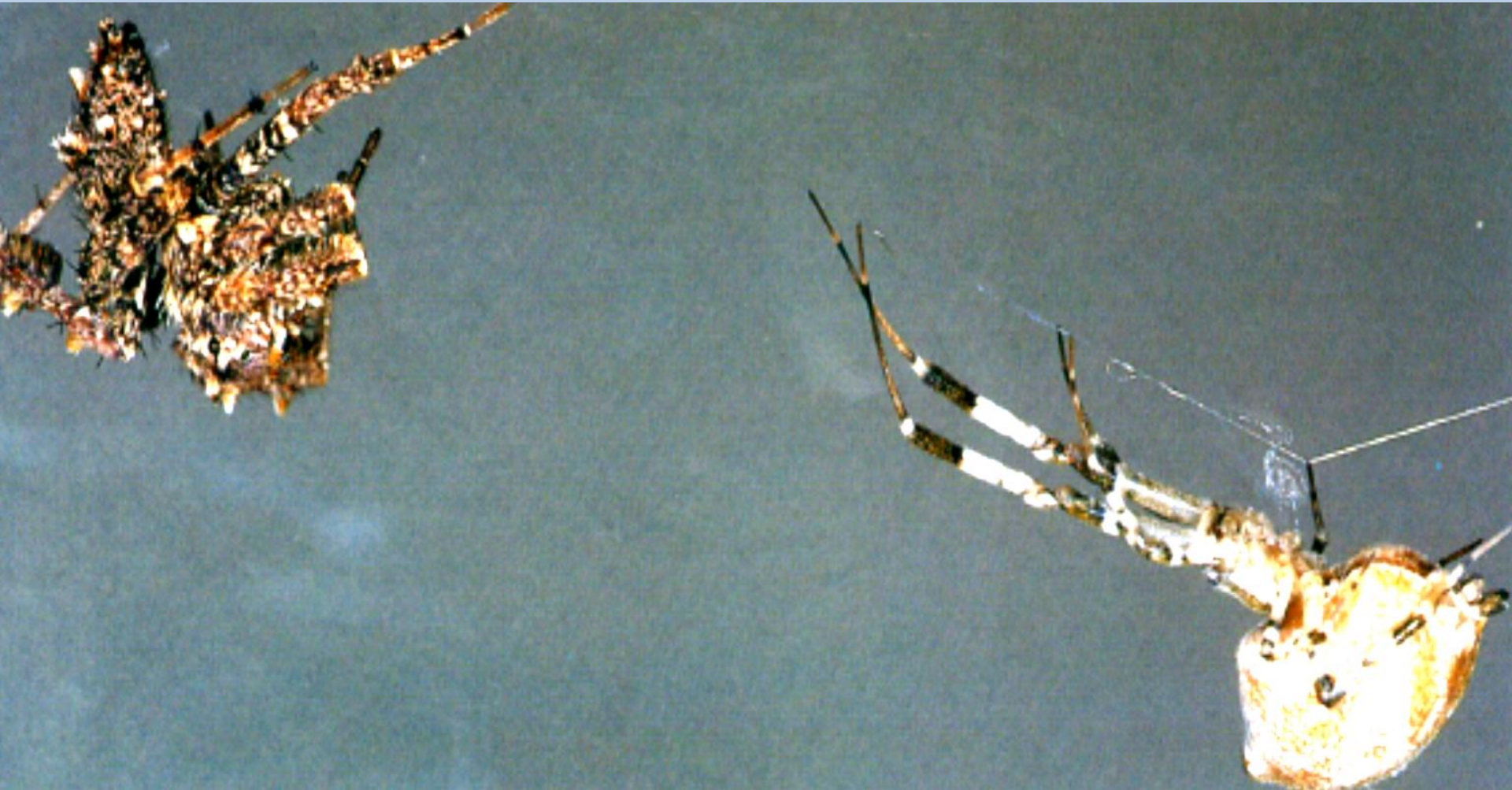
**Killjoy Explanations**

Species specific vision and visual behaviour

Optimised for a world of branches, twigs, stems …

# ‘Lure’ strategy in action

**Juvenile *Portia* flexes her legs to generate a vibration on the web to catch the attention of a larger orb-weaving spider.**



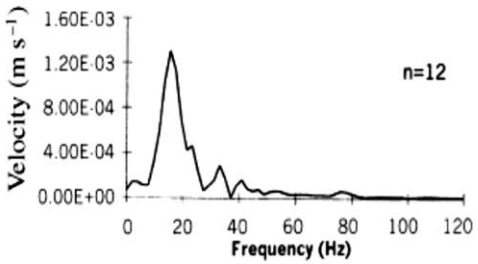
# *Portia* flexibly ‘strums’ the web

Disturbance

Prey

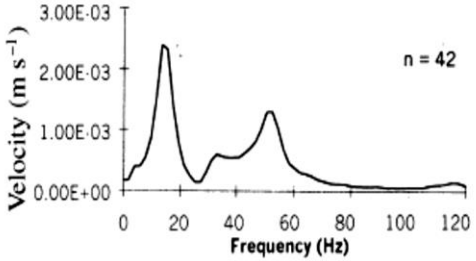
Natural


Web disturbance; *Zygellia*



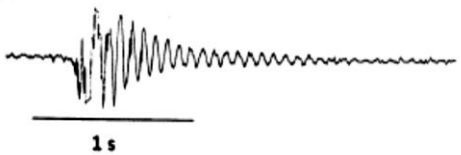


*Musca* in *Zygellia* web

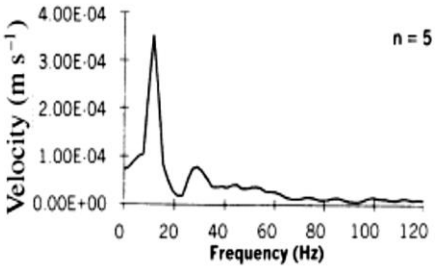


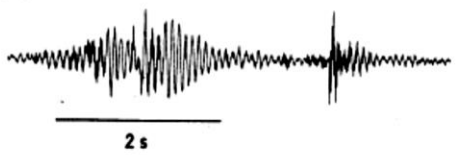

Sneak

*Portia* produced

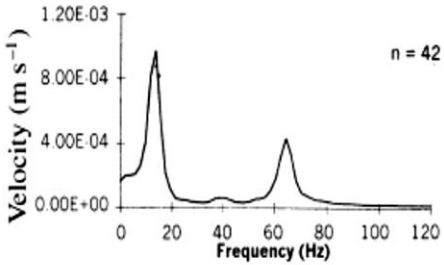



*Portia* "sneak" vibrations




*Portia* in *Zygellia* web




Lure

Tarsitano et al. Ethology 2000

# *Portia* web behaviours

## Go to the Padlet and fill in your thoughts

**Anthropomorphic Descriptions**

- They understand that flies cause disturbance and how this can mask their movements
- They understand the difference between wind and flies
- They are sneaky

**Killjoy Explanations**

?

?

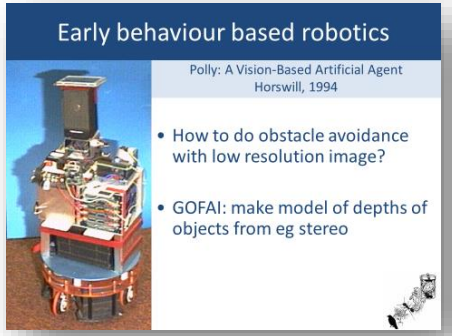
?

?

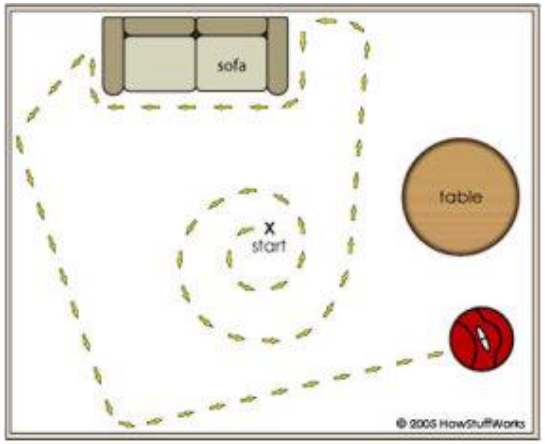
https://uofsussex.padlet.org/prgraham/

# What about machines?

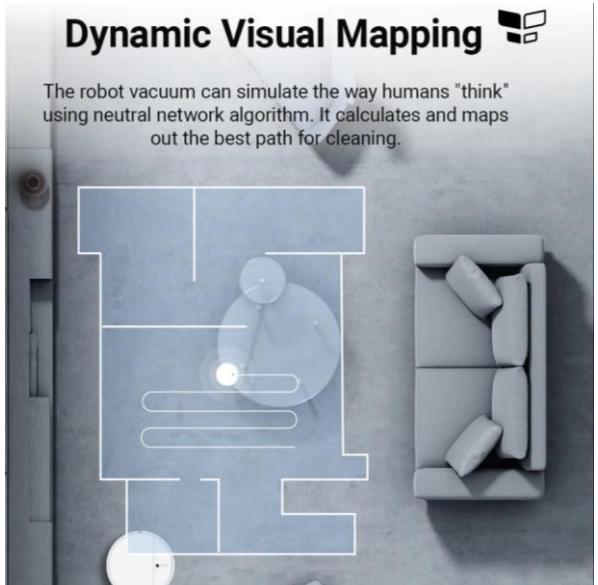
- We can flip the logic of killjoy explanations to think about engineering solutions.
- We can build 'species' specific predispostions that fit the ecological niche of our 'use case'.




## What about robot vacuum cleaners?



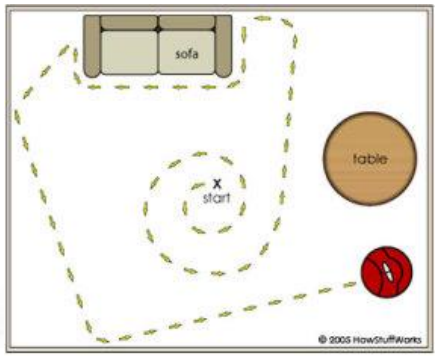

Roomba algorithm




Xiaomi algorithm

# What ecological niche(s) suit basic versus sophisticated robot vacuum cleaners?

## Basic or ‘killjoy’





## Sophisticated


# Learning Outcomes

- **Historical accounts of animal behaviour demonstrate a tension between anthropomorphic and sceptical descriptions.**
- **This dichotomy can also be referred to as romantic vs killjoy.**
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  - **Specialised behavioural adaptations**
  - **Adaptation to ecological niche enabling them to cope with predictable situations *(situatedness)***

# Reading List

- Essential
  - Gould, J. L. (2004). Animal cognition. *Current biology*, *14*(10), R372-R375.
  - Shettleworth, S. J. (2010). Clever animals and killjoy explanations in comparative psychology. *Trends in cognitive sciences*, *14*(11), 477-481.
- Optional
  - Cross, F. R., Carvell, G. E., Jackson, R. R., & Grace, R. C. (2020). Arthropod intelligence? The case for Portia. Frontiers in Psychology, 11, 2573.