

# In the news

"If birds built their nests according to a genetic template, you would expect all birds to build their nests the same way each time. However this was not the case," added Dr Walsh. "Southern Masked Weaver birds displayed strong variations in their approach, revealing a clear role for experience. "Even for birds, practise makes perfect."

The lack of repeatability of most nest-building behaviours and the changes in those behaviours as males build more nests seems most readily explained by increasing dexterity. Further work is required to confirm any role for cognition in these experience-dependent changes.



The image is a screenshot of a BBC News Scotland webpage. At the top, the BBC logo is on the left, and navigation links for News, Sport, Weather, and Travel are on the right. Below this, the 'NEWS SCOTLAND' logo is prominently displayed. A horizontal menu contains links for Home, UK, Africa, Asia-Pac, Europe, Latin America, Mid-East, South Asia, US & Canada, Business, and Health. A secondary menu lists regional and topical links: England, Northern Ireland, Scotland (highlighted), Wales, UK Politics, and Education. The date '25 September 2011' and time 'Last updated at 23:01 GMT' are shown. Social media sharing icons for Facebook, Twitter, and Email are present, along with a '138' share count. The main headline reads 'New study says birds learn how to build nests'. A sub-headline states: 'A new study has found birds learn the art of nest-building, rather than it being just an instinctive skill.' The text continues: 'Researchers from Edinburgh, Glasgow and St Andrews Universities studied film of southern masked weavers recorded by scientists in Botswana.' It then notes: 'This colourful species was chosen because individual birds build many complex nests in a season.' A quote from Dr Patrick Walsh of Edinburgh University is included: 'Dr Patrick Walsh of Edinburgh University said the study revealed "a clear role for experience".' The article mentions: 'The research has been published in the Behavioural Processes Journal.' A final paragraph states: 'Individual birds varied their technique from one nest to the next and there were instances of birds building nests from left to right as well as from right to left.' To the right of the text is a photograph of a yellow and black Southern Masked Weaver bird perched on its cup-shaped mud nest. The photo is credited to 'RACHEL WALSH'.

# In the news

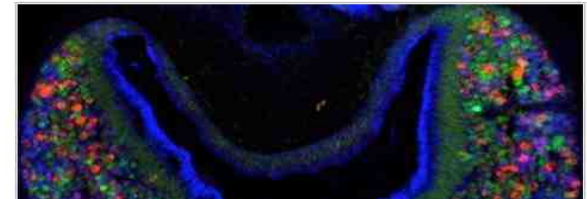
Animals rely on these chemicals secreted by others to identify both individuals of their own species (in this case, they are often called pheromones) and those of other species. Dulac said that to the researchers' surprise, most of the receptors they found were cued to respond to scents from other species, especially those from potential predators

"The vomeronasal organ has always been advertised as the organ that determines mating behaviors," Dulac said.

"If the animal needs to recognize every possible predator ... then you probably need a lot of receptors just to be safe," Dulac said. "Some are specialized in detecting predators; some, even the type of predator — reptilian, mammalian, ferret or fox."



The screenshot shows the top of a web browser with navigation links for Home, US, World, Politics, Business, Sports, Entertainment, and Health. Below the navigation bar is the MSNBC logo and the word "Science". The main headline reads "Fight or flight: How the nose knows what to do" with a sub-headline "Scientists identify receptors in animals' noses that react to specific scents". There is a yellow comment box showing "15 total comments" and social media sharing buttons for Facebook (Recommend 108), Twitter (17), LinkedIn, and YouTube (Share 130). Below the article content, there are links for "Discuss" and "Related".



# In the news

The researchers inserted an electrode into 16 subjects' noses and then showered the volunteers with six different scents.



The screenshot shows the Science News website interface. At the top, the logo 'ScienceNews' is displayed in blue, with the tagline 'MAGAZINE OF THE SOCIETY FOR SCIENCE & THE PUBLIC' below it. To the right of the logo are several category links: 'ATOM & COSMOS', 'GENES & CELLS', 'BODY & BRAIN', 'HUMANS', 'EARTH', 'LIFE', 'ENVIRONMENT', and 'MATTER & ENERGY'. Below the logo is a navigation menu with links for 'HOME', 'NEWS', 'FEATURES', 'BLOGS', 'COLUMNS', 'DEPARTMENTS', 'RSS FEEDS', and 'E-MAIL ALERTS'. A 'SUBSCRIBE' button is also visible. The main content area features the article title 'Nose divides sweet from foul' and a sub-headline 'Segregation of scent detectors suggests innate preference'. The author is listed as 'By Nick Bascom' and the publication time is 'Web edition : 12:10 am'. A small image of the magazine cover with the headline 'Life on the Moon' is shown. The article text begins with 'Even the inside of the nose can be a little cliquish. Like feather, nasal molecules that respond to pleasant smells together, keeping their distance from sensor molecules unpleasant smells.' and continues with 'Sensor molecules, or receptors, appear to be organized to the pleasantness (or unpleasantness) of the odors in a new study finds. For example, locations in the nose that respond strongly to one fragrant aroma will respond strongly to detectable smells. Patches of nasal surfaces that once'.

“Not only are the receptors organized in patches, but the axis that best describes their organization is pleasantness.”

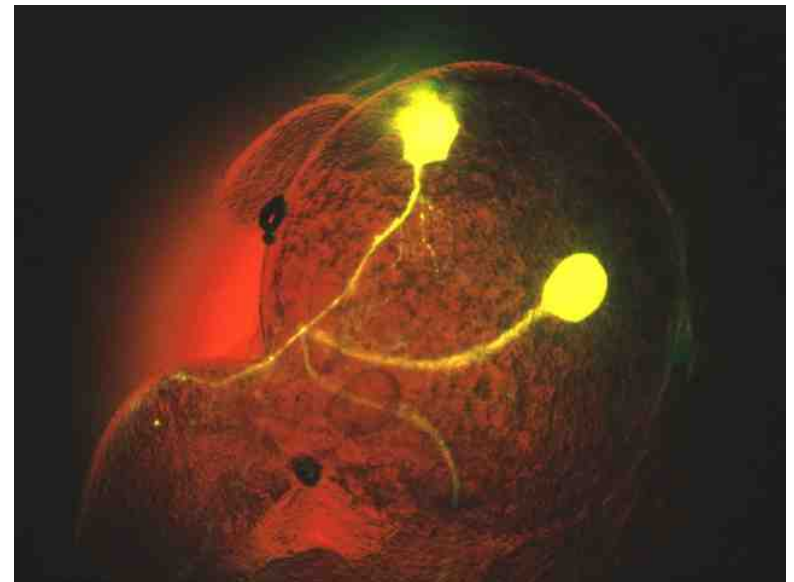
An innate attraction to sugary smells and repulsion to acrid odors may confer an evolutionary advantage by helping newborn babies seek out the food sources they need to survive.

# Ethology: topics

- 1) Roots of ethology: from Darwin to behaviourism
- 2) Classical ethology: perception, elementary reactions, pre-wired learning
- 3) Behavioural ecology approach: optimisation, game theory
- 4) Neural and genetic control of behaviour (biological rhythms, CPG, simpler networks)
- 5) Genetics and evolution of behaviour, evolution of communication
- 6) Choosing the habitat and food
- 7) Learning theories, cognition
- 8) Parental investment
- 9) Systems of reproduction
- 10) Evolution of social behaviour, cooperation and conflict

# Central Pattern Generators (CPG)

Rhythmic movements: endogene rhythm or feedback?  
TRITONIA (giant neuron)



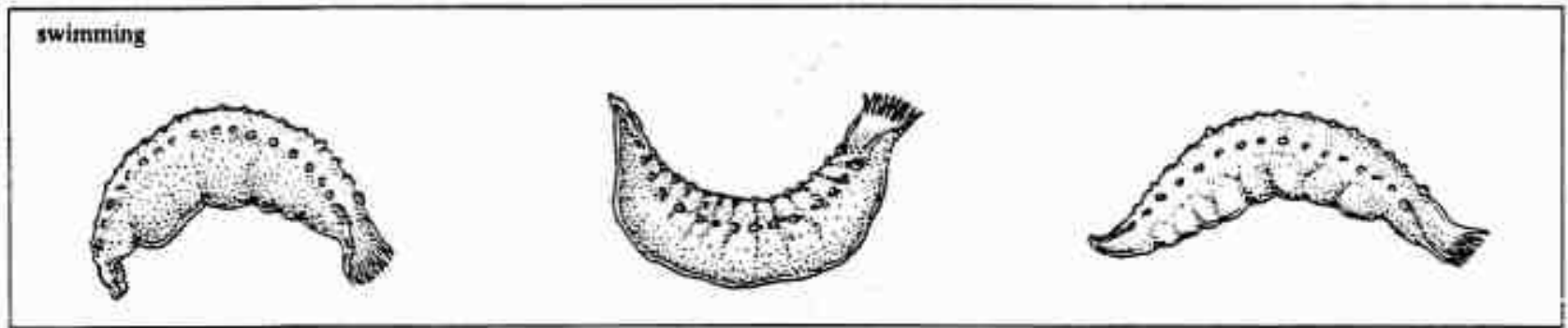
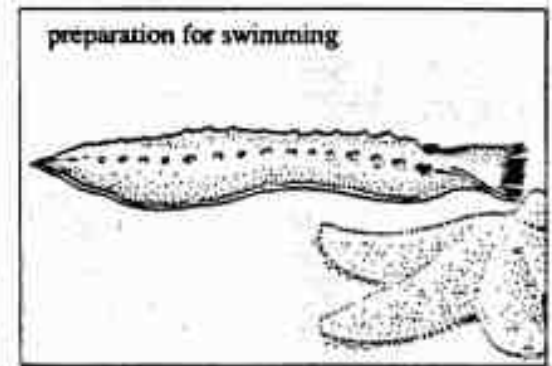
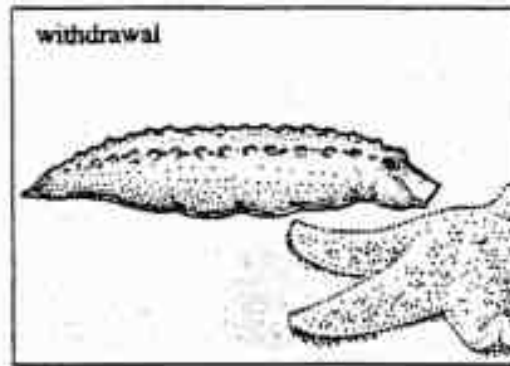
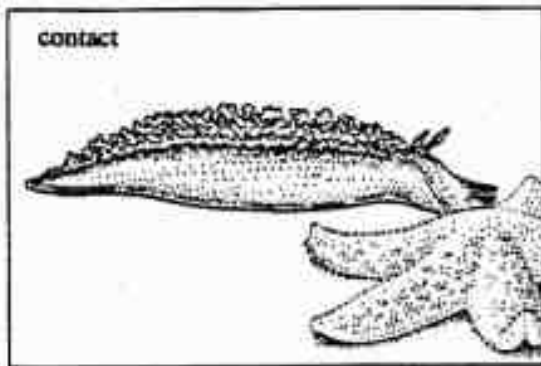
Escape: rhythmic swimming

# Escape behavior by a sea slug



# Central Pattern Generators

## TRITONIA



Escape from sea star: Fixed Action Pattern

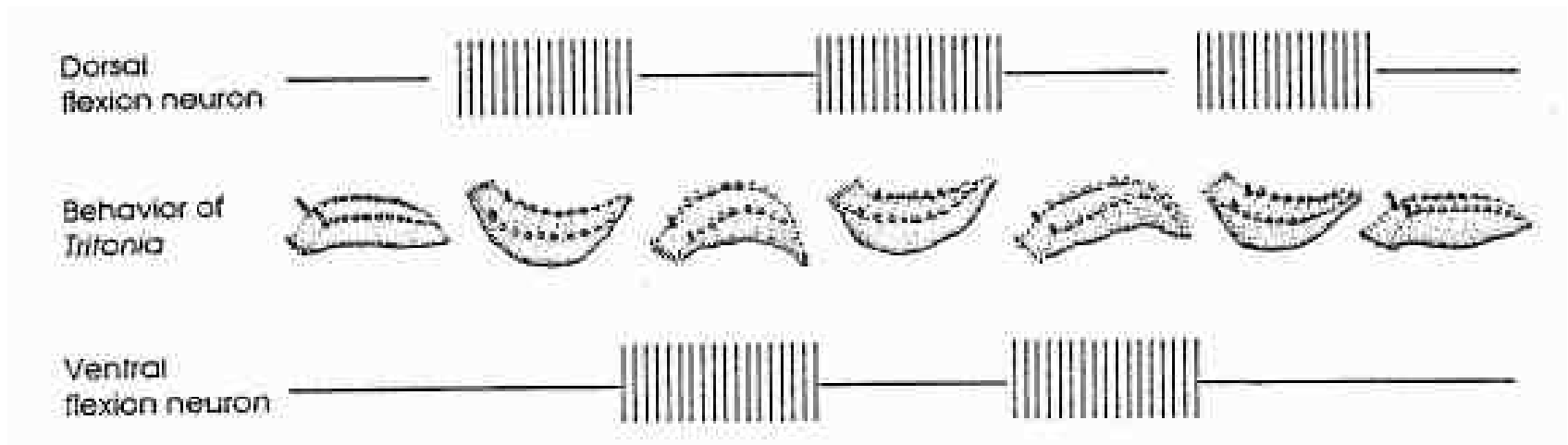
# Central Pattern Generators

## TRITONIA

Swimming:

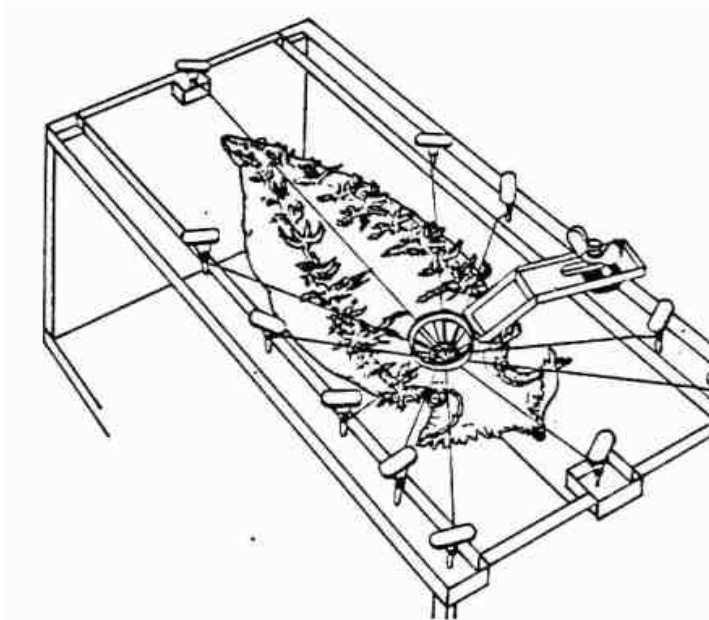
Dorsal and ventral muscle alternative activation

Dorsal and ventral neurons

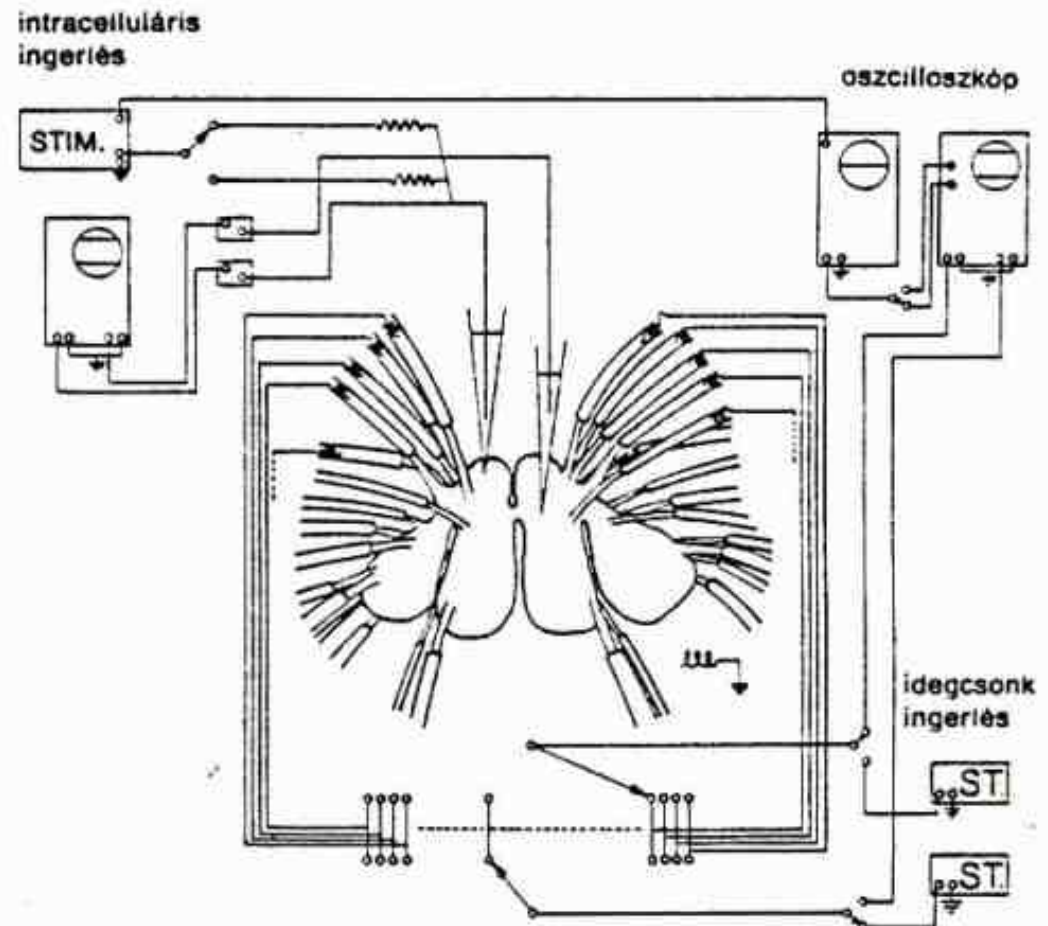


# Central Pattern Generators

TRITONIA



Giant neurons, activation

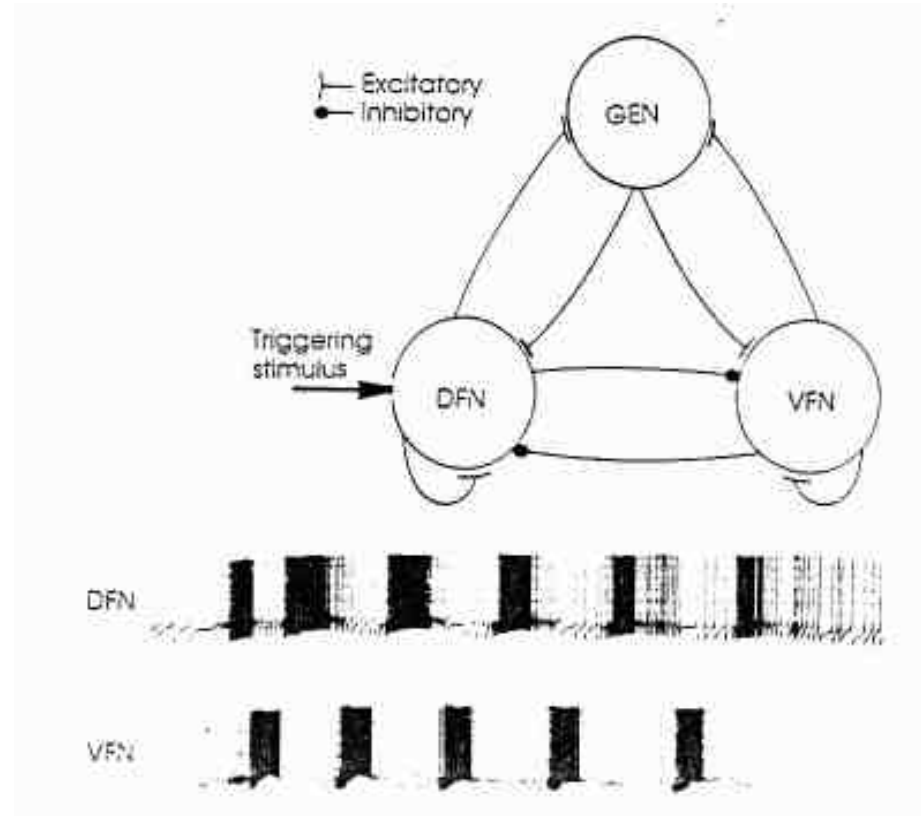


# Central Pattern Generators

video

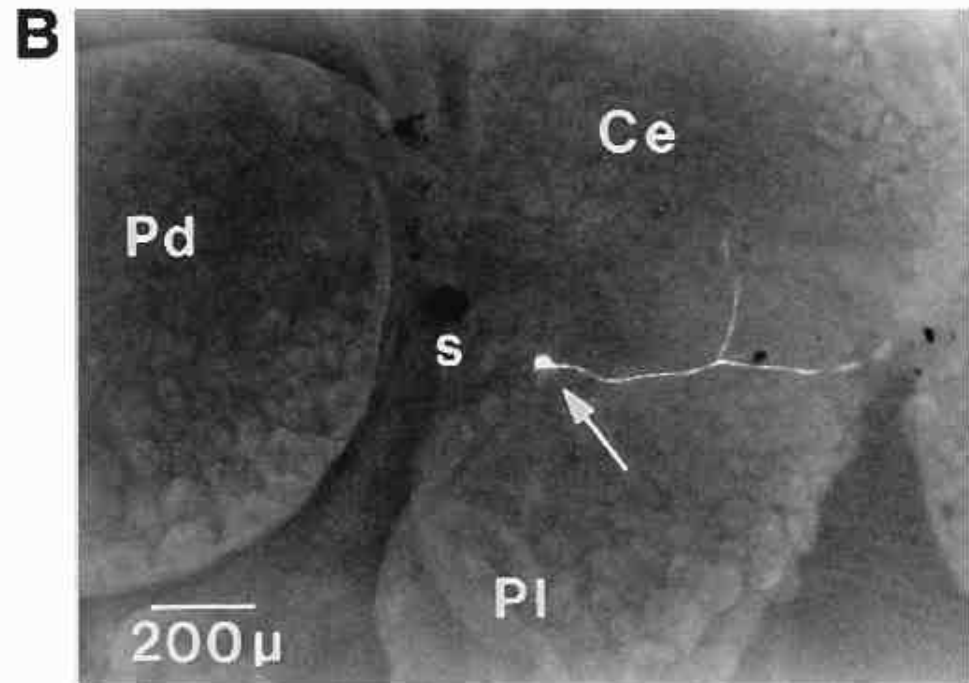
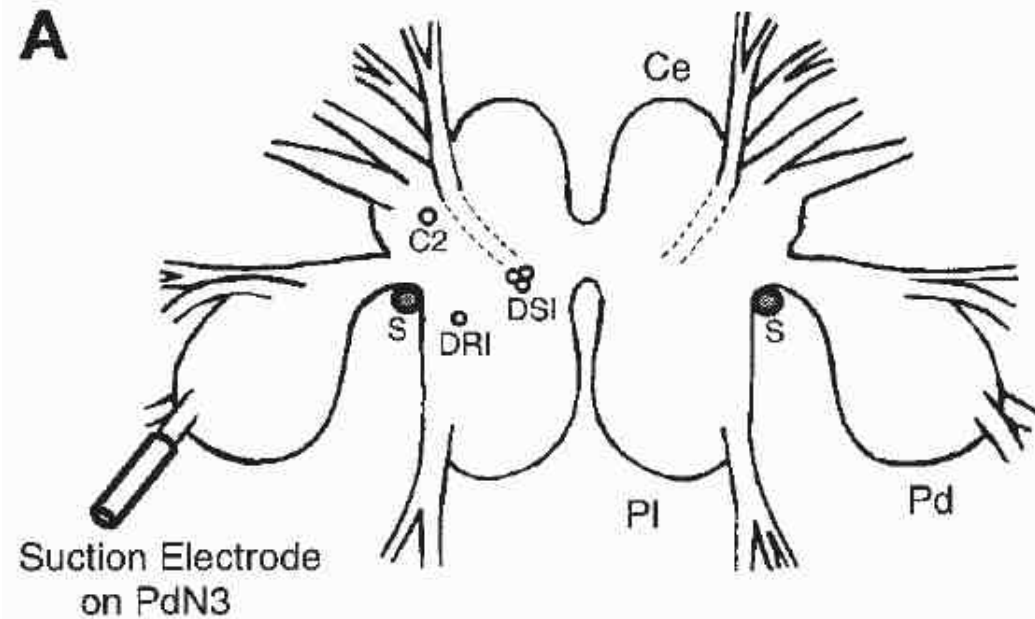
# Central Pattern Generators

TRITONIA: model  
Simple model:  
3 neurons suffice



TRITONIA: model  
Simple model:  
3 neurons

Recent results  
Command neuron:  
dorsal ramp interneuron  
(DRI, white arrow)  
the single interneuron  
between sensory and  
motor systems

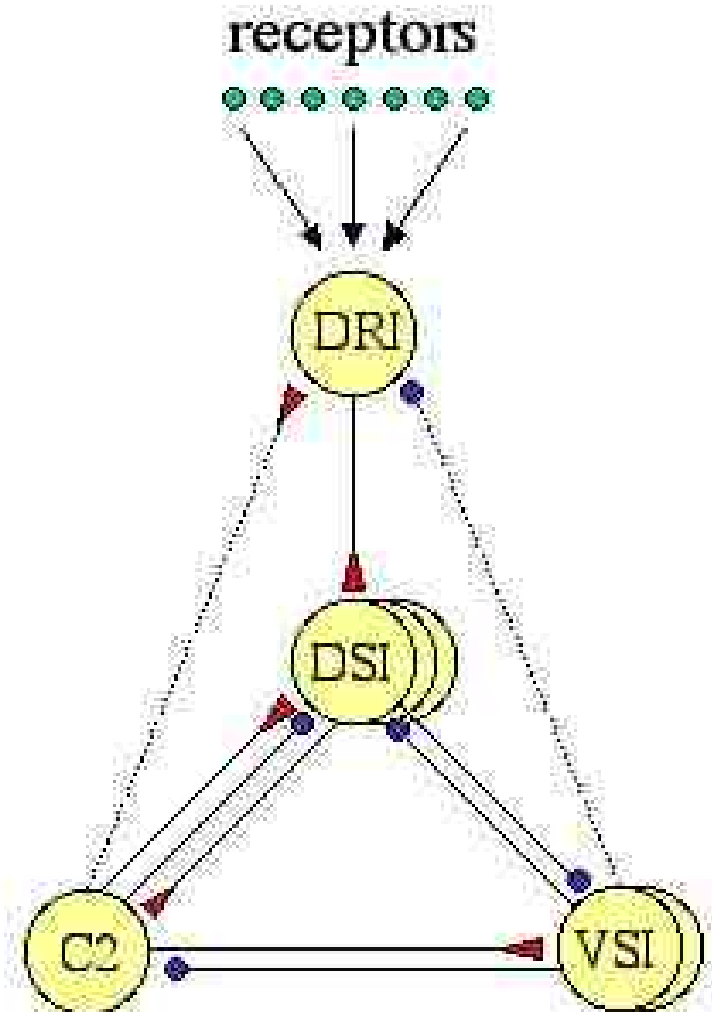


# Central Pattern Generators

TRITONIA: model

Receptors → dorsal ramp  
interneuron (DRI)  
3 dorsal swimming interneurons  
(DSI)  
2 ventral swimming interneurons  
(VSI)  
1 interneuron (C2)

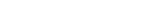
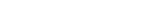
Excitation red, inhibition blue



receptors



DRI



DRI activates the 3 DSI  
DSI excite C2,  
inhibit VSI



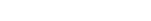
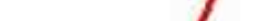
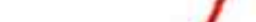
DSI



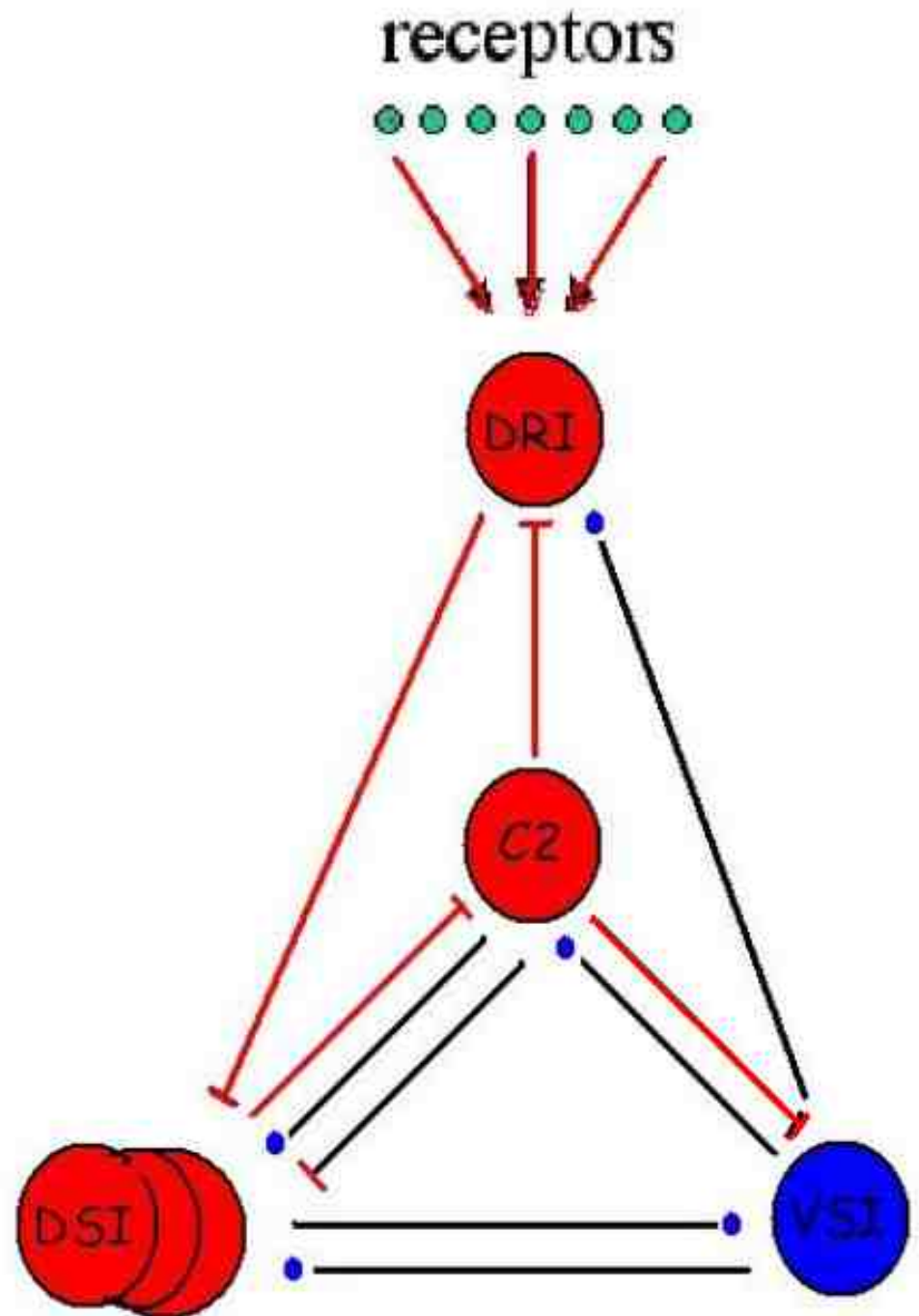
C2



VSI

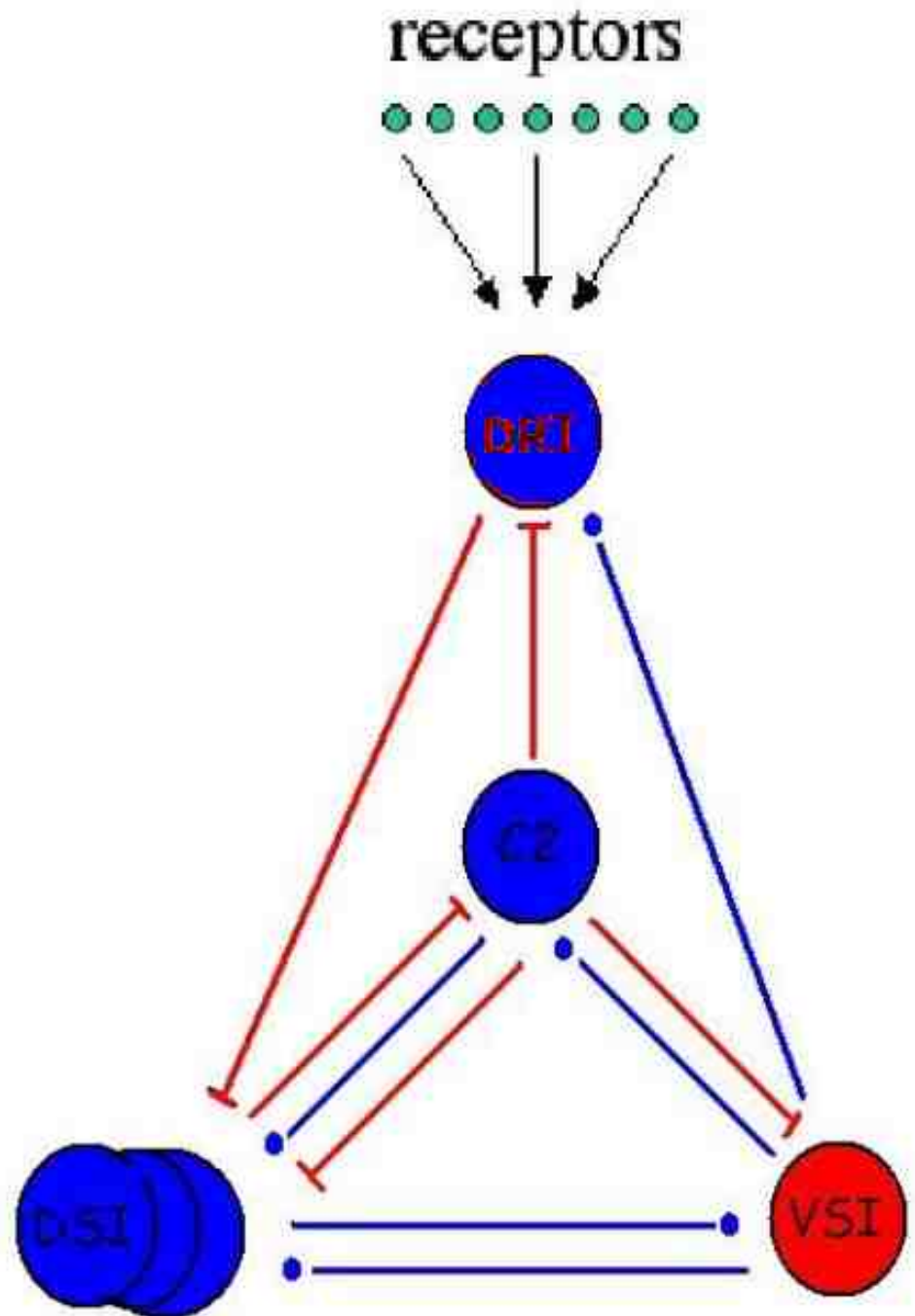


DSI excite C2  
inhibit VSI  
C2 excites VSI,  
C2 inhibits AND  
excites DSI



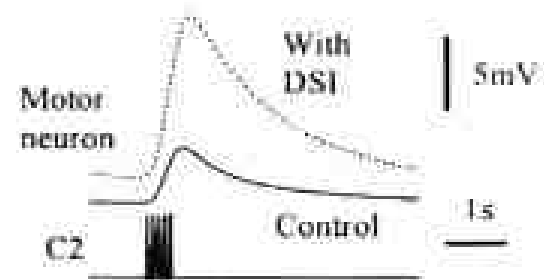
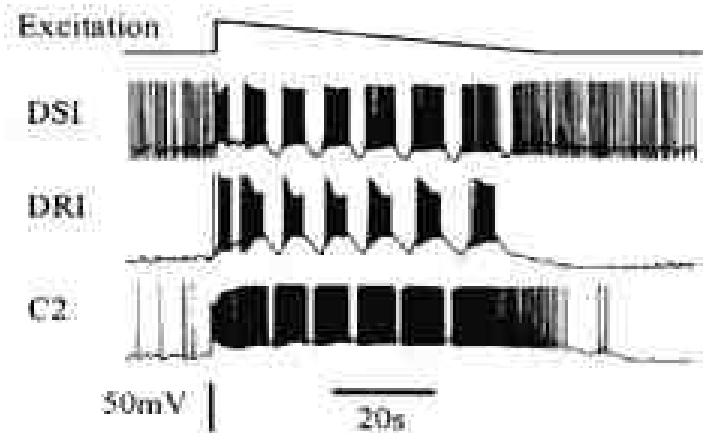
VSI is activated,  
inhibits DRI,  
(DRI cannot excite DSI)  
Inhibits C2, and its own  
activation.

VSI stops and the  
positive feedback cycle  
(C2 és DSI) is activated



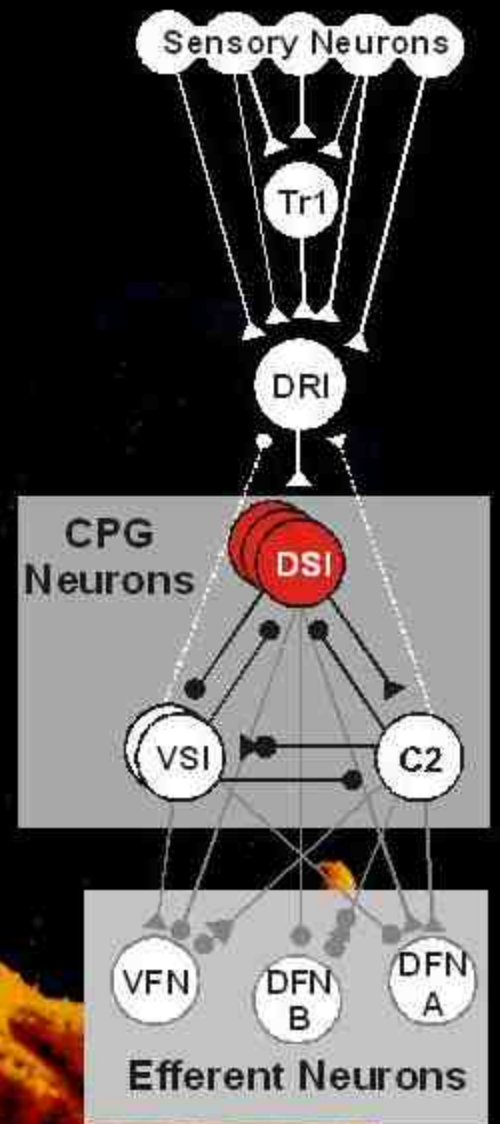
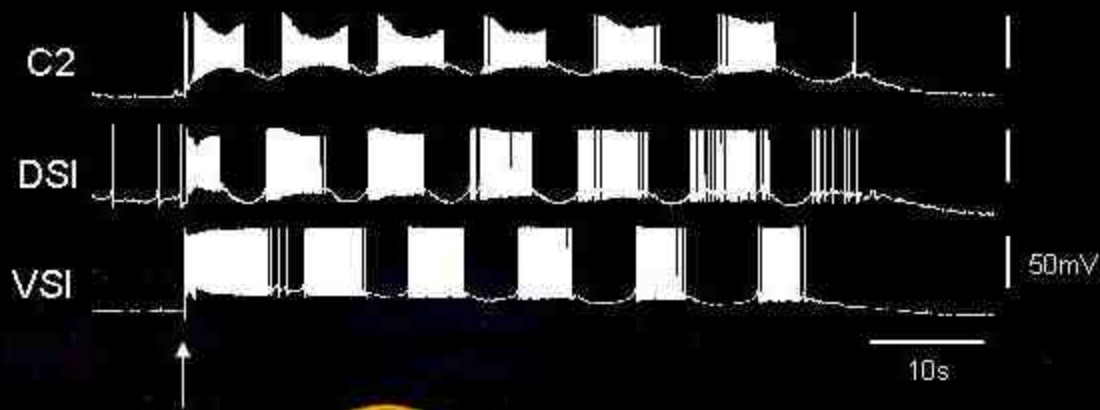
# Central Pattern Generators

## TRITONIA



DRI is command neuron: firing of DRI is necessary and sufficient to start pattern generator

When activated, behaviour will continue without further activation (Fixed Action Pattern)

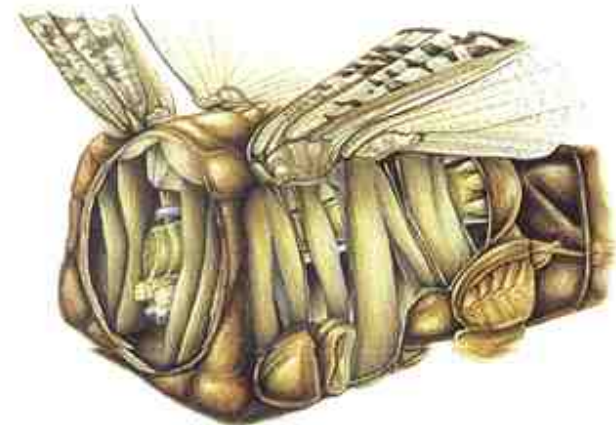
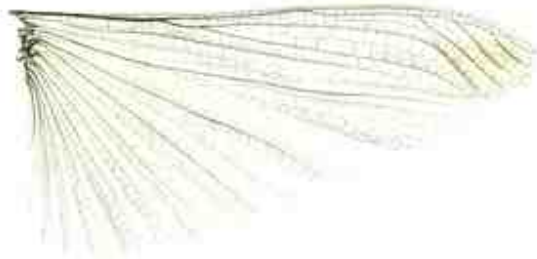
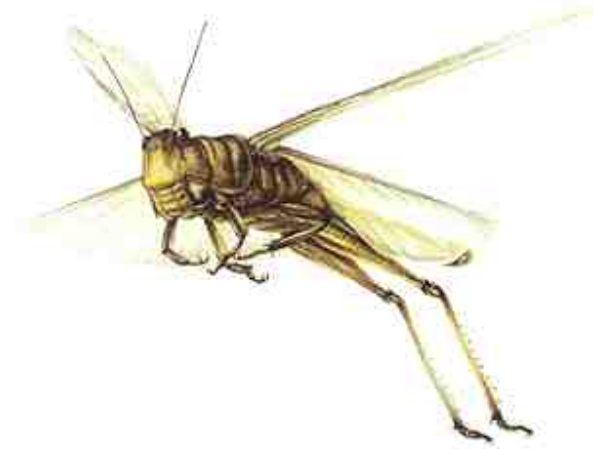
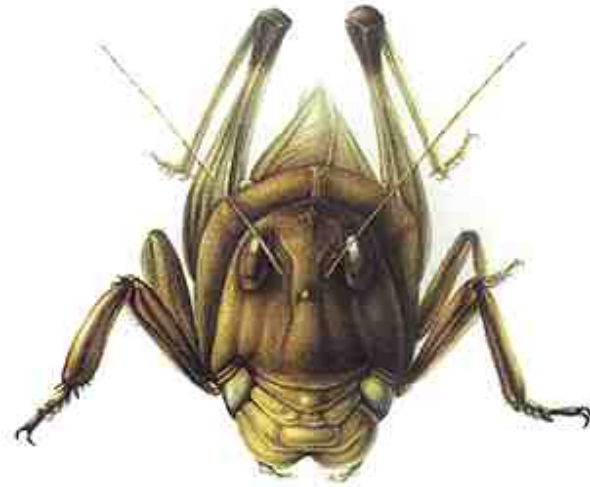


Serotonin increases sensitivity of c2



# Central Pattern Generators

Flying of insects



# Central Pattern Generators

Flight of locust

CPG: rhythmic movement of wings

Feedback from wing stretch sensors

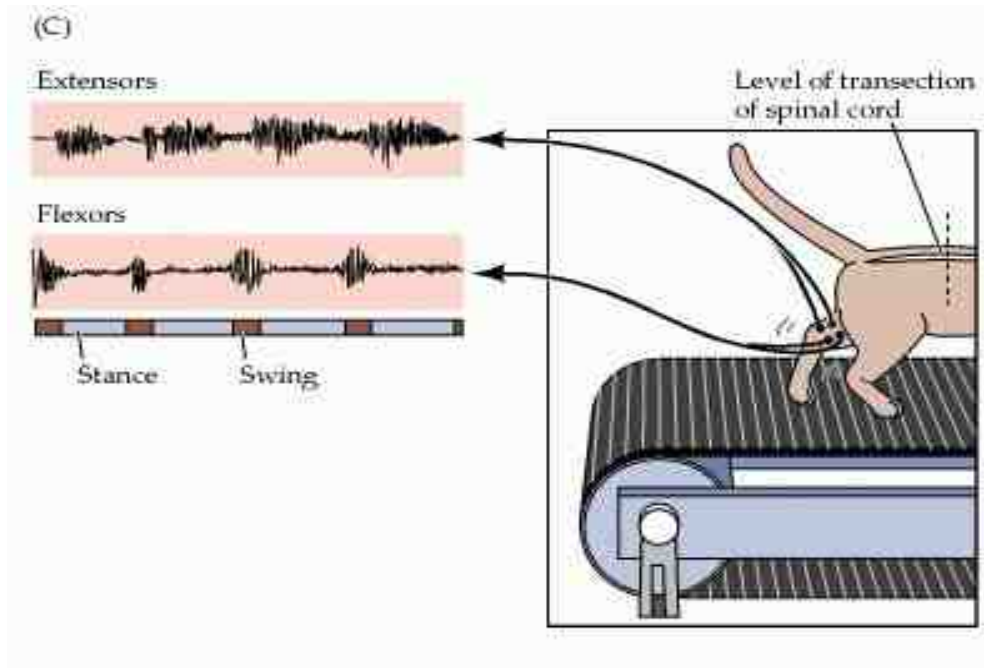
Maintenance:

- 1) Hairs on head moved by air (predator, wind, self-generated)
- 2) Flow in the optic field

Termination:

Legs touch ground, wings stop

# Central Pattern generators



Walking of decerebrate cat

CPG in the spine

Sensory feedback: with an injured leg you limp

# Central Pattern Generators

Newborn: walking reflex from day 4  
Disappears, walking from age 1 year old

CPG:  
Generates many FAPs in invertebrates  
Important in vertebrates (walking,  
breathing, swallowing etc.)



# Simple Neural Network

Small number of identified neurons

Known connections

Controls adaptive (natural) behaviour

# Simple Neural Network



Nocturnal moths

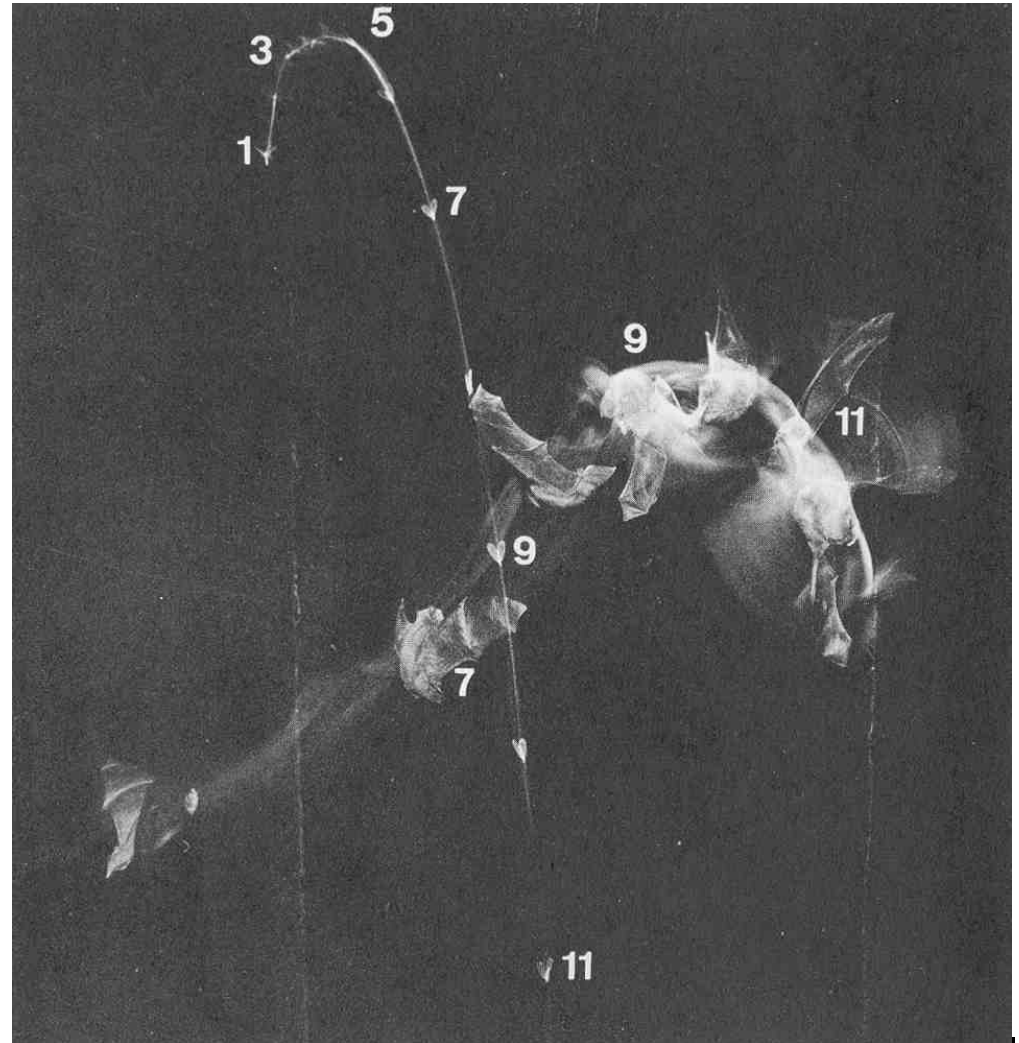
Bats: echolocation (Griffin)

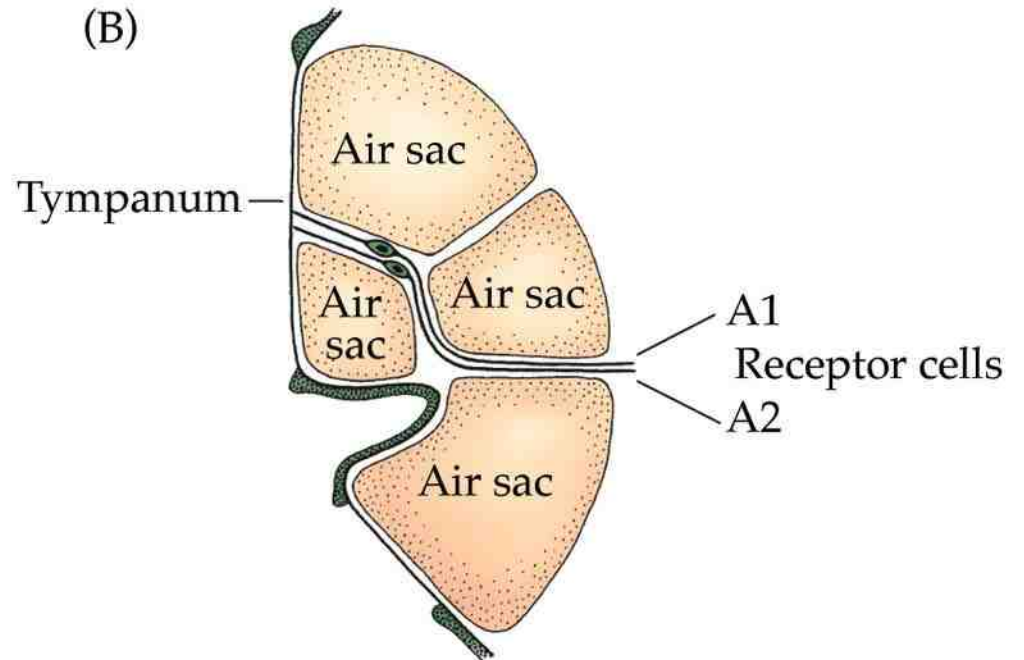
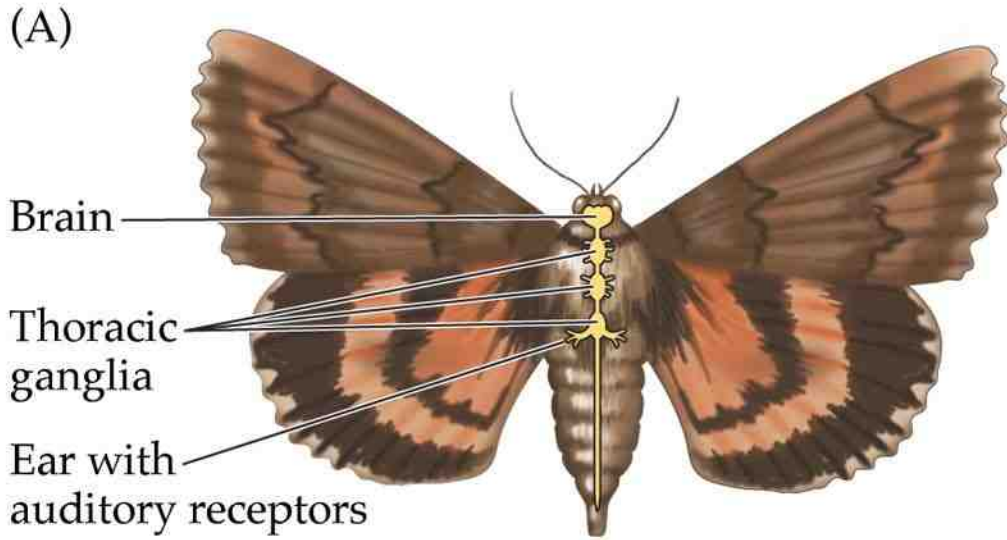
ultrasound (10 - 150 kHz), intensive (110 dB) short clicks (5 - 10 msec)

# Simple Neural Network

Escape flight

Moth survived

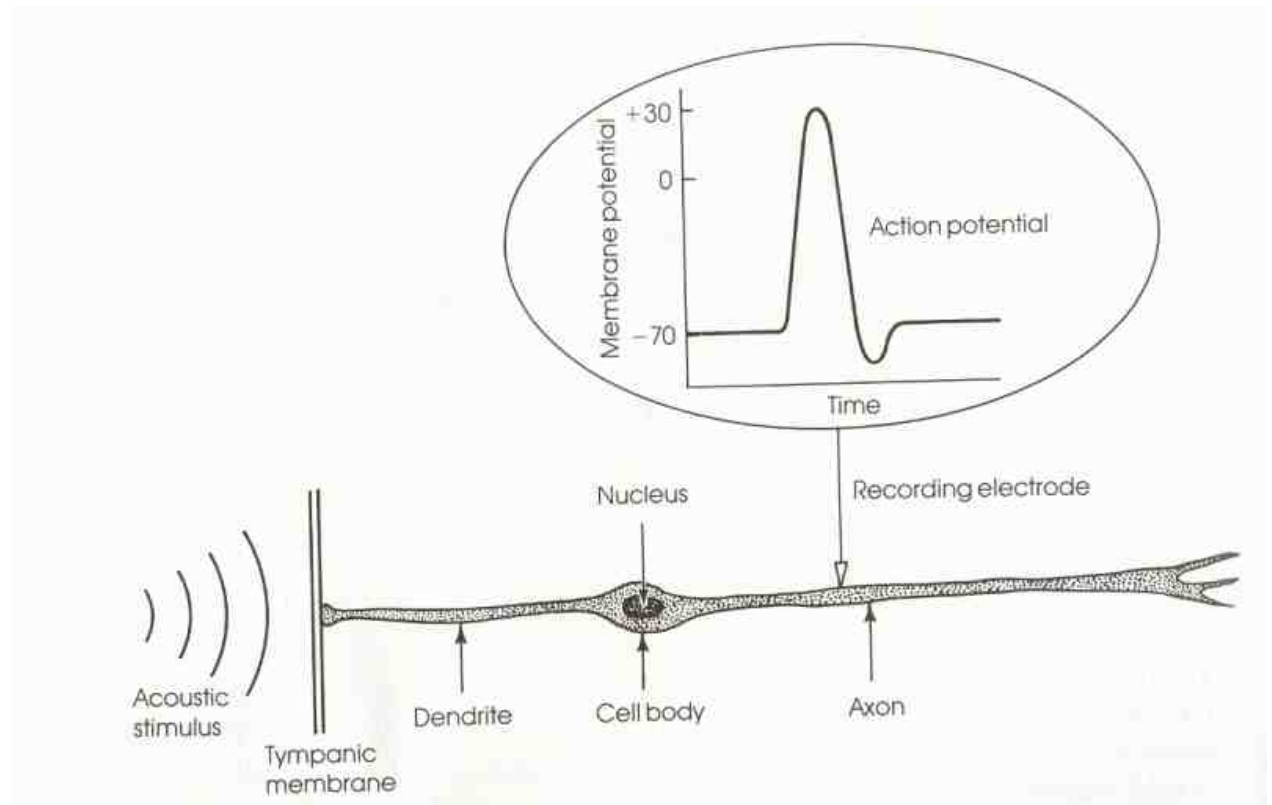




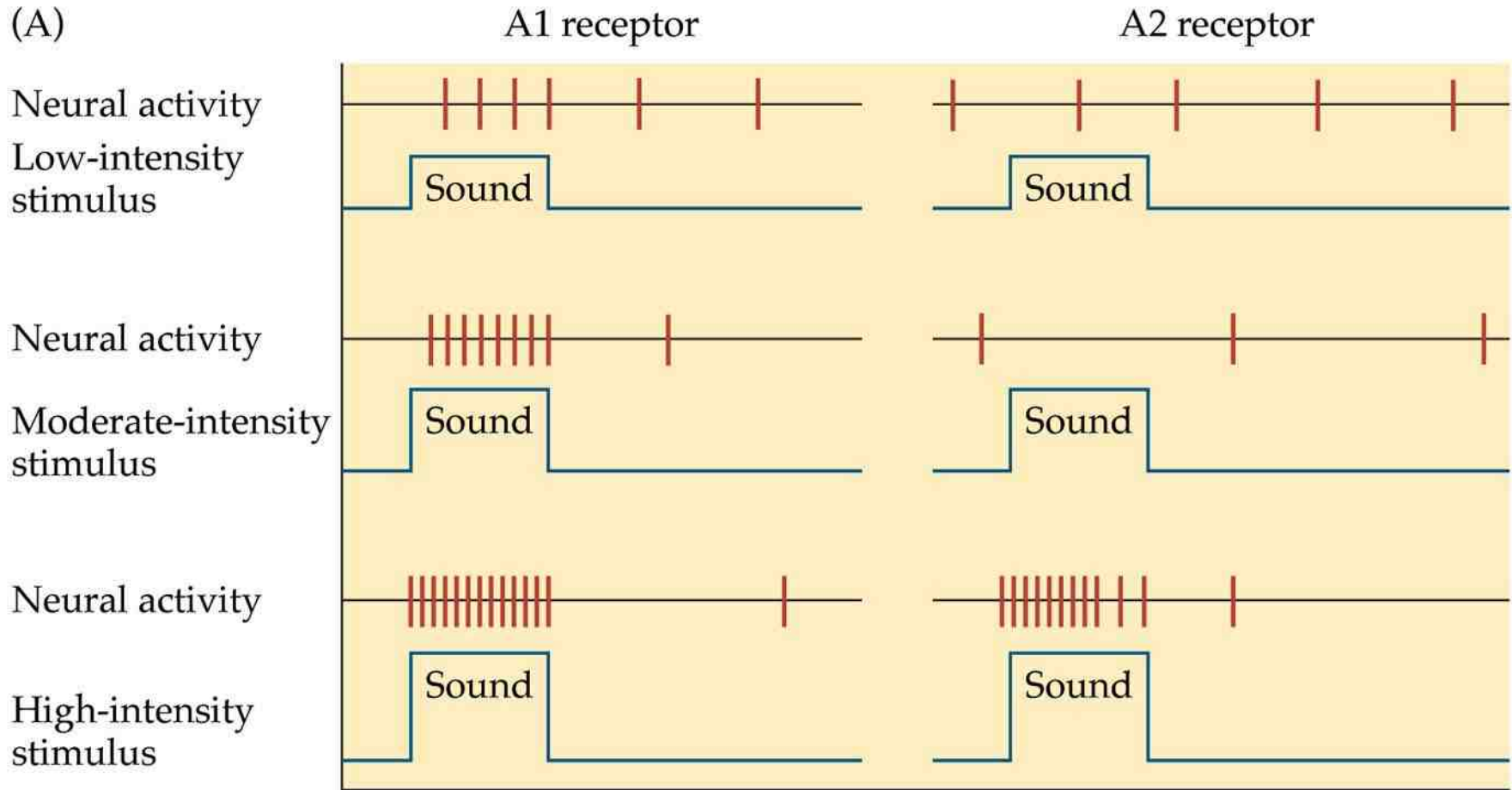
Ears: 2-2 neurons

# Simple Neural Network

Escape flight



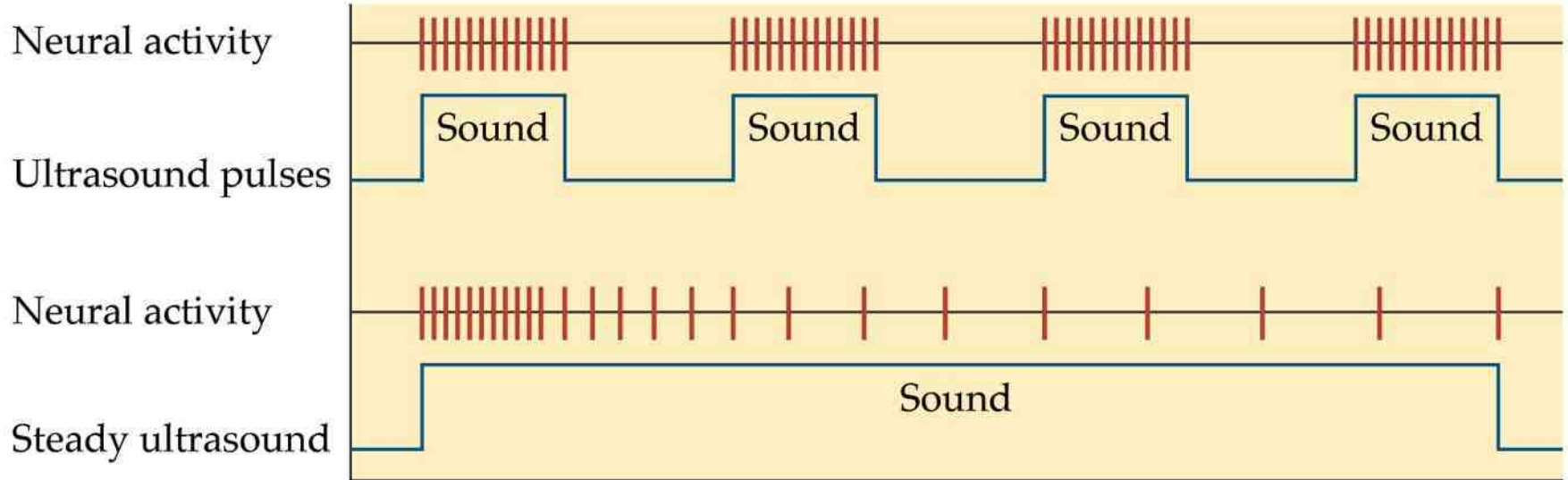
Recording sensory response



What is the function of A2 receptor?

(B)

A1 receptor



# Simple Neural Network

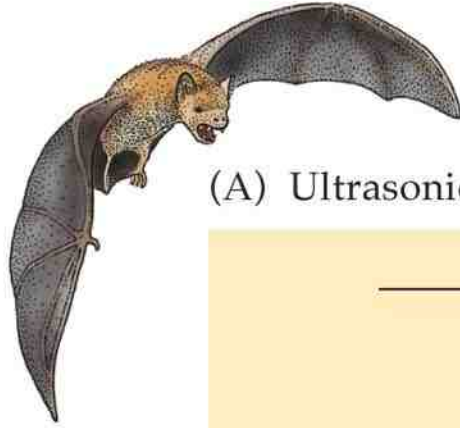
A1:

Increase firing with higher pitch  
Stops firing if constant ultrasonic

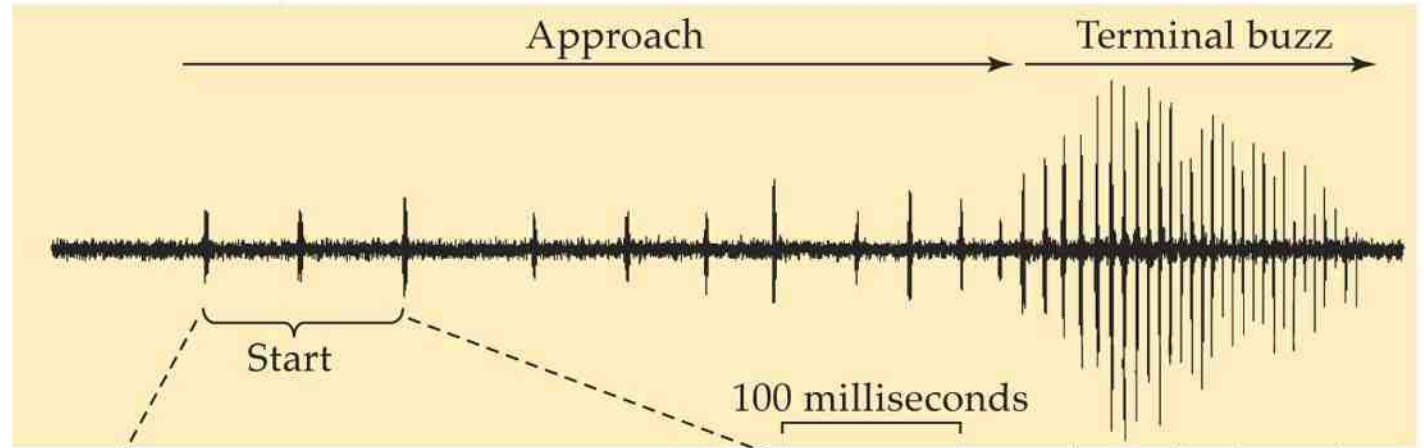
A2:

Does not respond to low level sounds  
Activated by intense stimulus

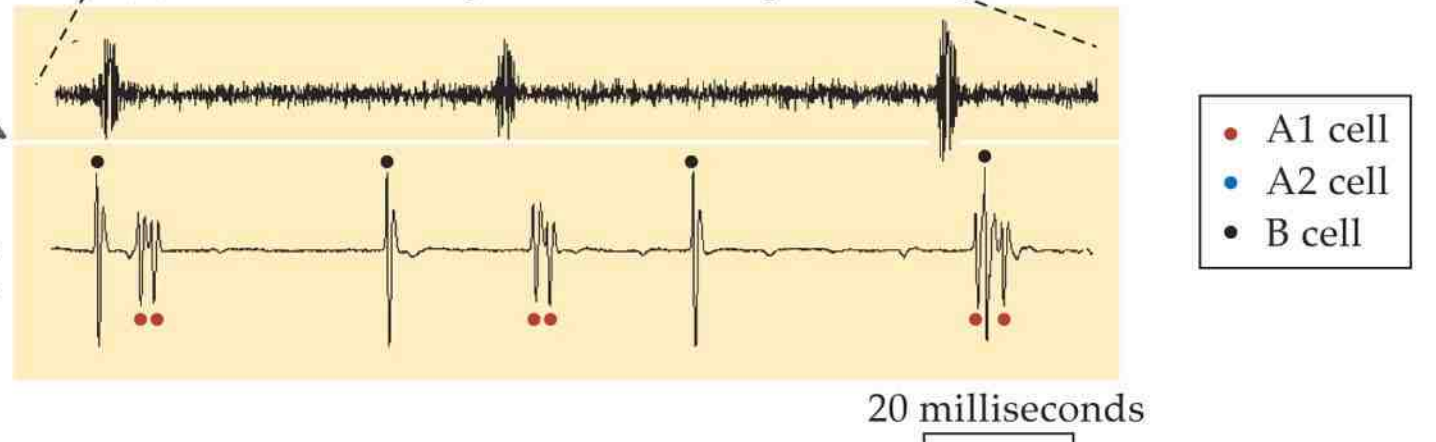
# Is the A2 cell necessary for anti-interception behavior by moths?



(A) Ultrasonic cry of hunting bat

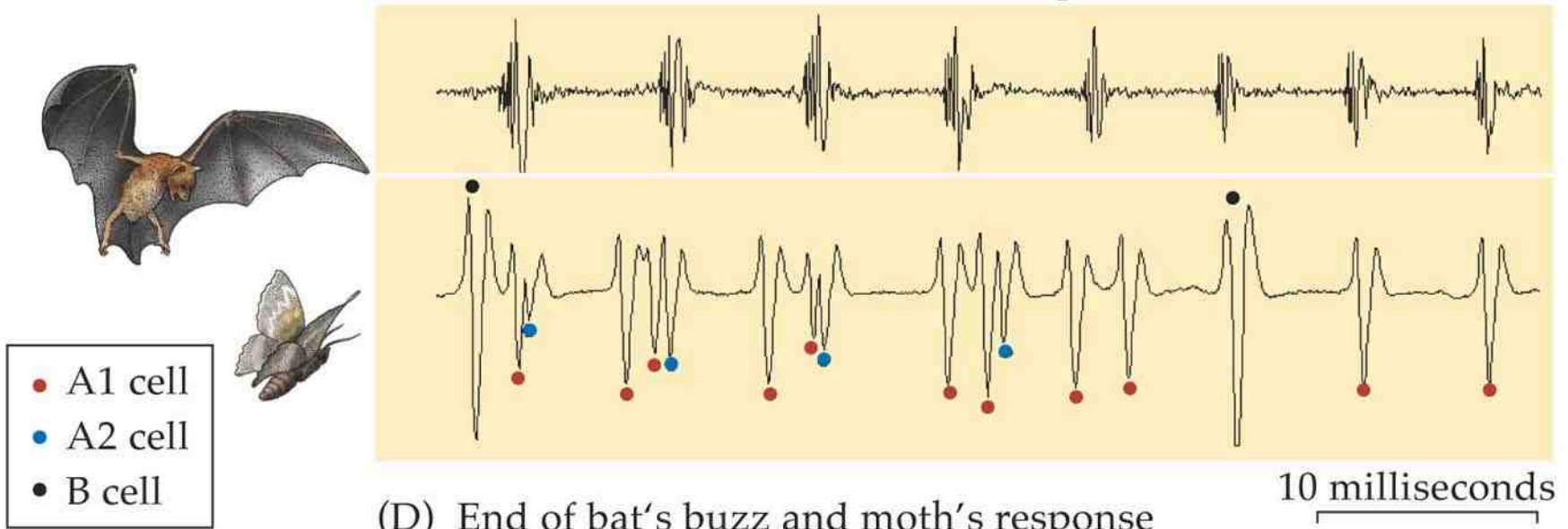


(B) Start of bat's cry and moth's response

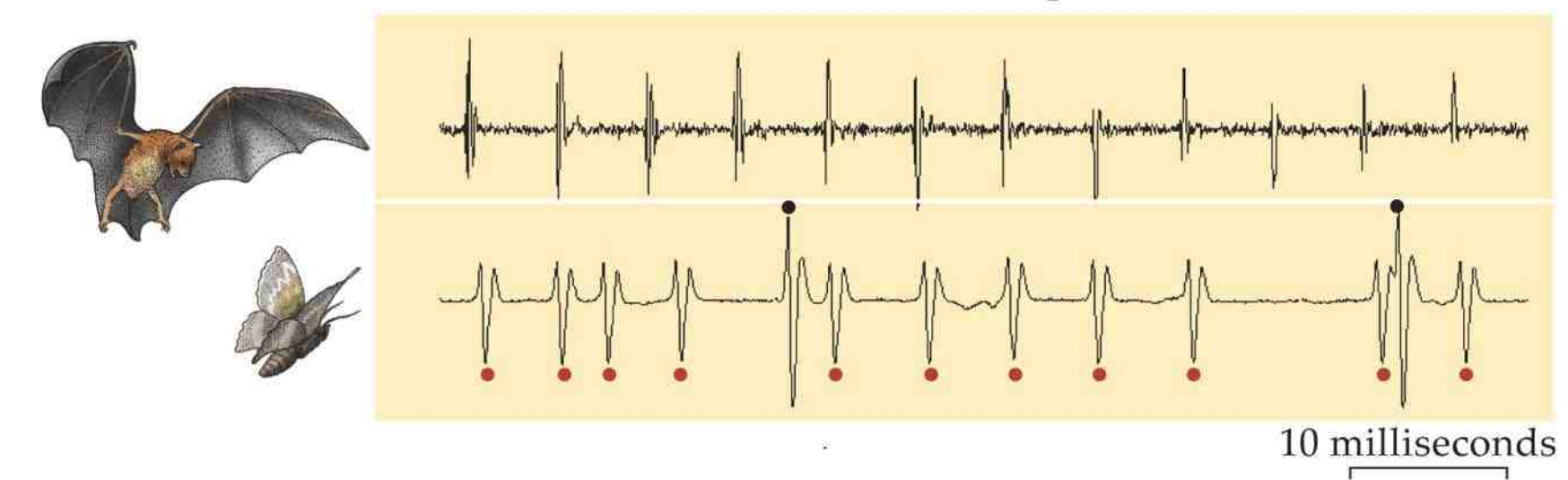


# Is the A2 cell necessary for anti-interception behavior by moths? (Part 2)

(C) Start of bat's buzz and moth's response



(D) End of bat's buzz and moth's response



# Simple Neural Network

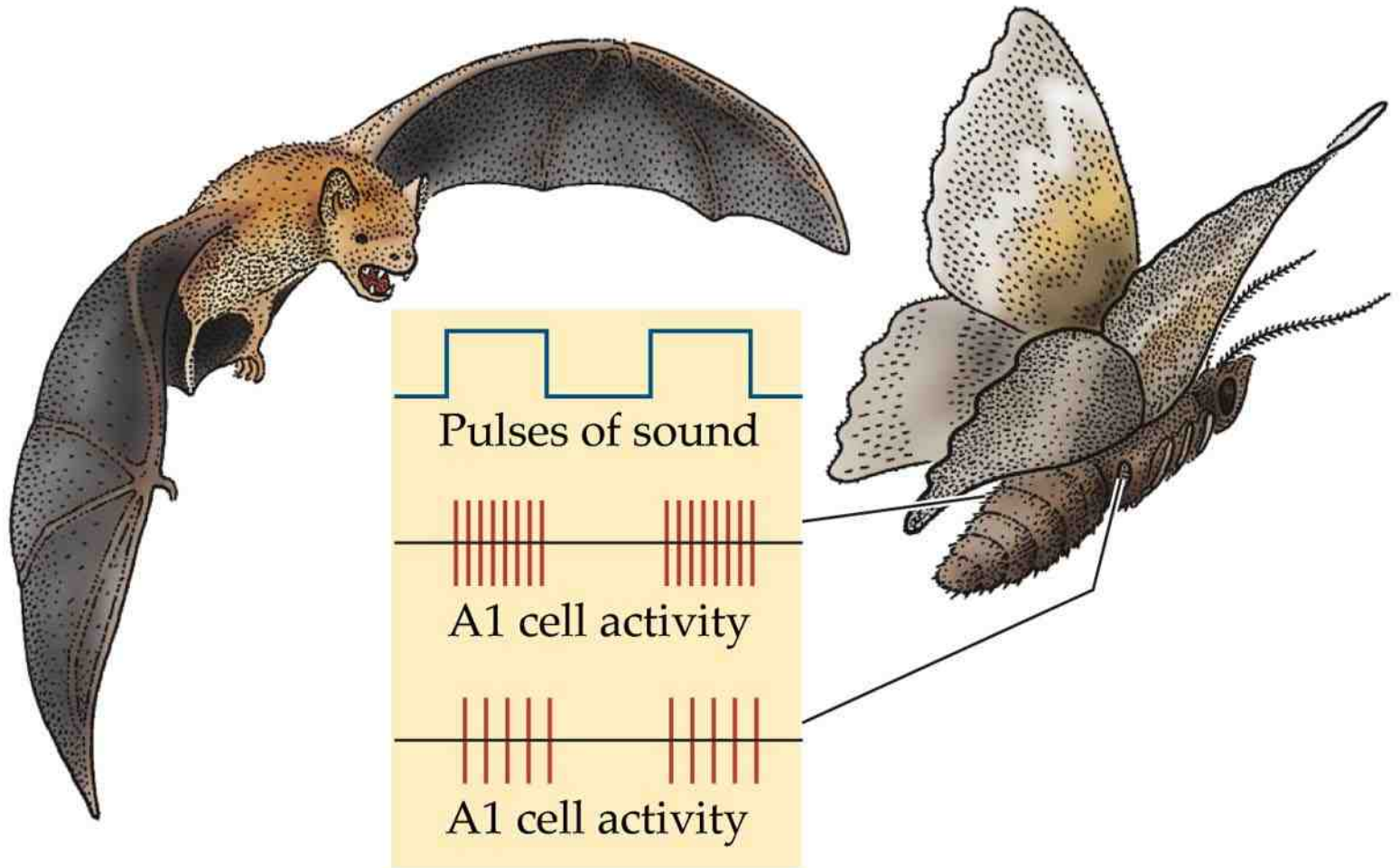
A1 receptor: primary bat detector

- From a distance of 30 m
- A1 fires, moth turns away

A2 receptor: emergency

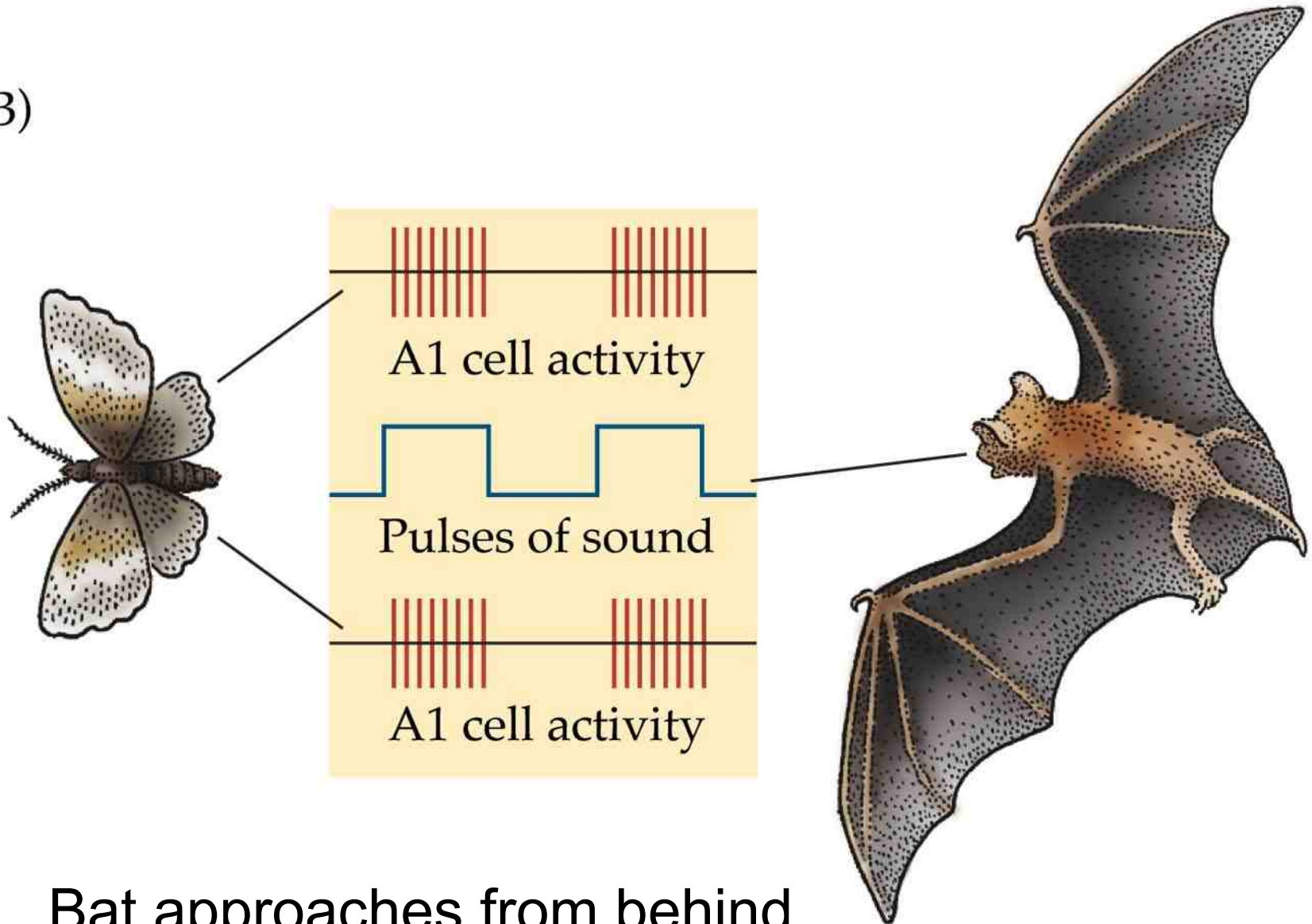
- Induces drop and erratic flight of unpredictable path

(A)



Bat approaches from left

(B)



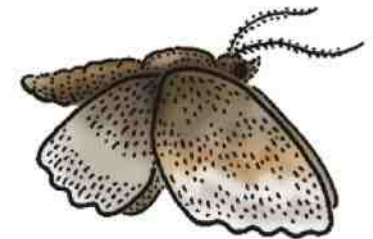
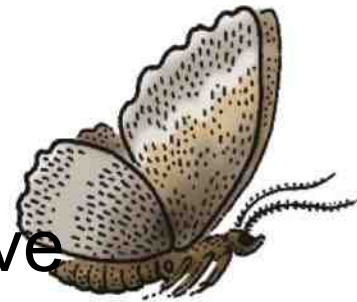
Bat approaches from behind

(C)



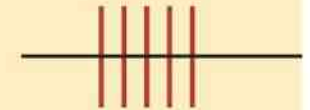
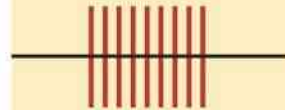
Wings up

Wings down



Bat approaches from above

A1 cell activity



Sound stimulus



# Simple Neural Network

Escape flight

More recent studies:

A number of interneurons filtering information.

Repeating neurons transmit information without altering it

Pulse neurons fire at start of clicks

The ears filter relevant information, a neural network abstracts distance and position of the bat and determines appropriate response

# Simple Neural Network

## Escape flight

Bat far away (30 m) – the moth turns so that the activity of the two A1 neurons would be equal: moth reduces reflecting surface and flies away from bat.

Bat very close – A2 cell fires → thoracic ganglion → inhibits synchronisation of wing muscles

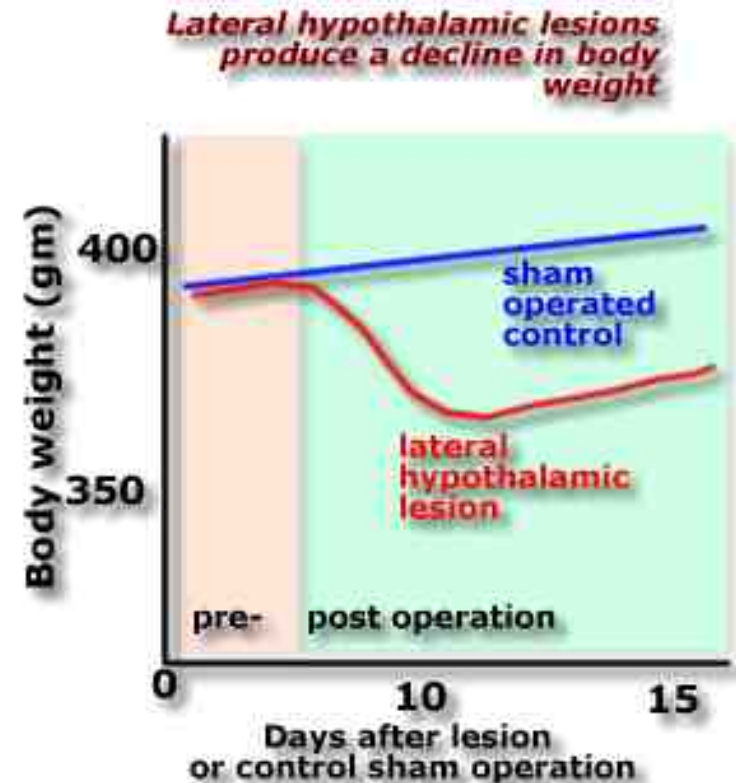
# Simple systems (?)

LH (lateral hypothalamus)  
„hunger center”

- 1) Body weight drops
- 2) Balance at a lower level

Phases of recovery:

- Accepts wet palatable food
- Eats dry food if hydrated
- Eats dry food and drinks water



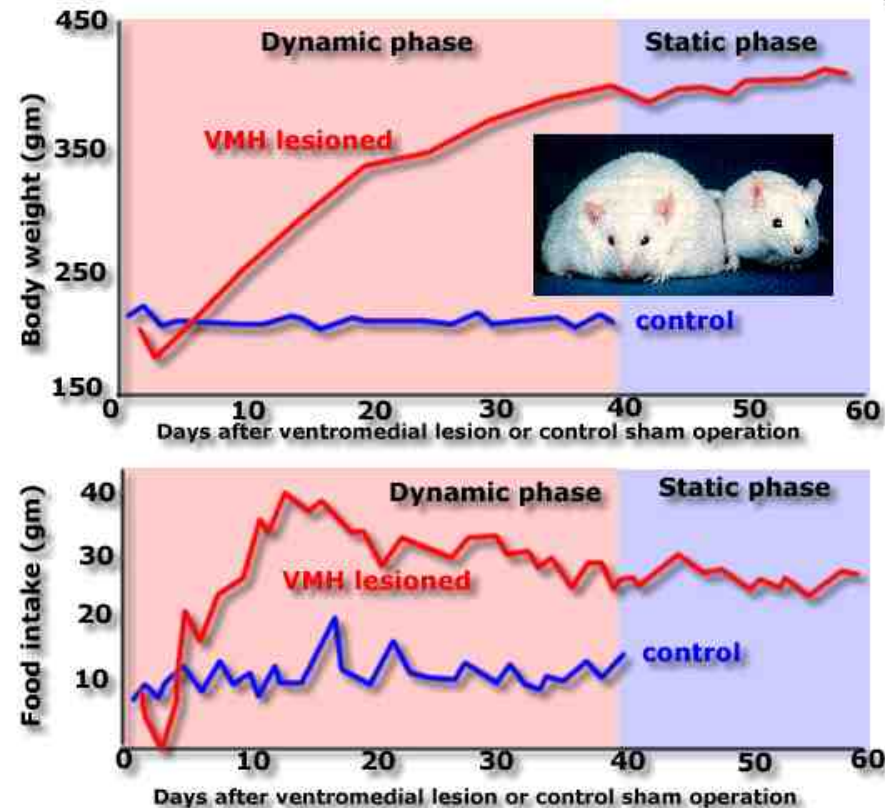
# Simple systems (?)

VMH (Ventromedial Hypothalamus) „satiety centre”

- 1) Dynamic phase: excessive eating
- 2) Static phase: balance at a higher level

source:

<http://www.flyfishingdevon.co.uk/salmon/year3/psy337EatingNeuralFactors/PSY337EatingNeuralFactors.htm>



# Simple Neural Network

Barn owl: localisation of sound source



# Simple Neural Ne

Detects sound

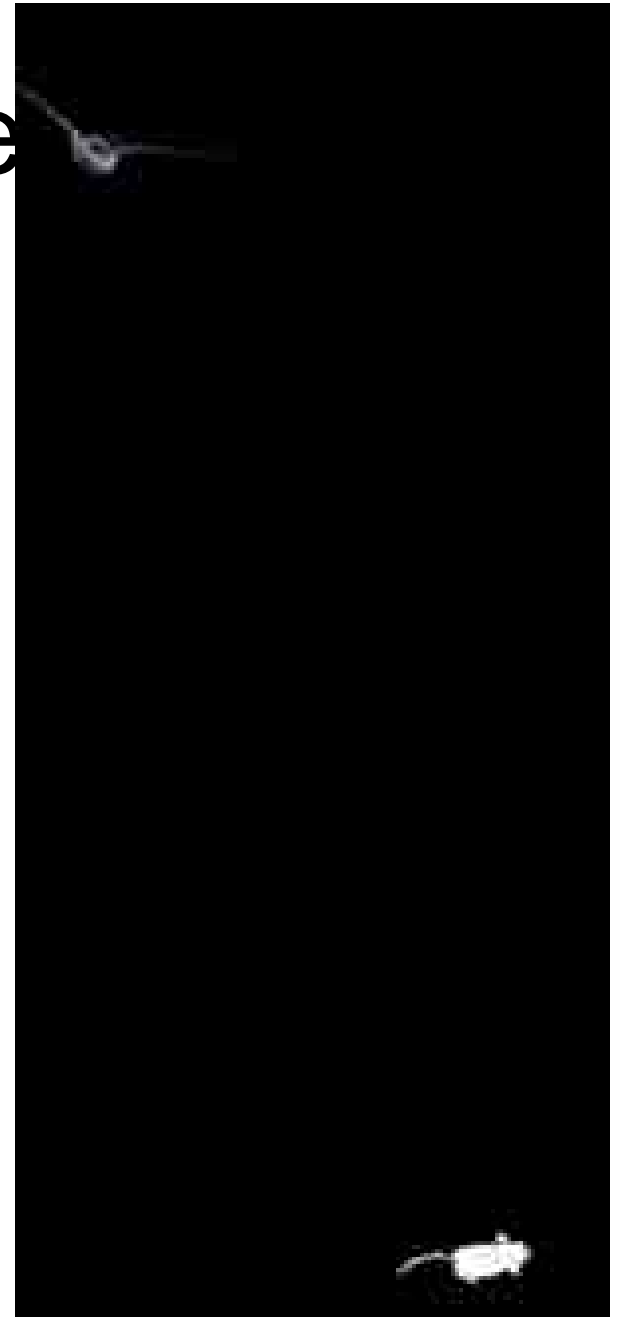
Turns head (eyes do not move)

Flies toward source of sound

Vision is topographic, hearing is not

What are the cues for localisation?

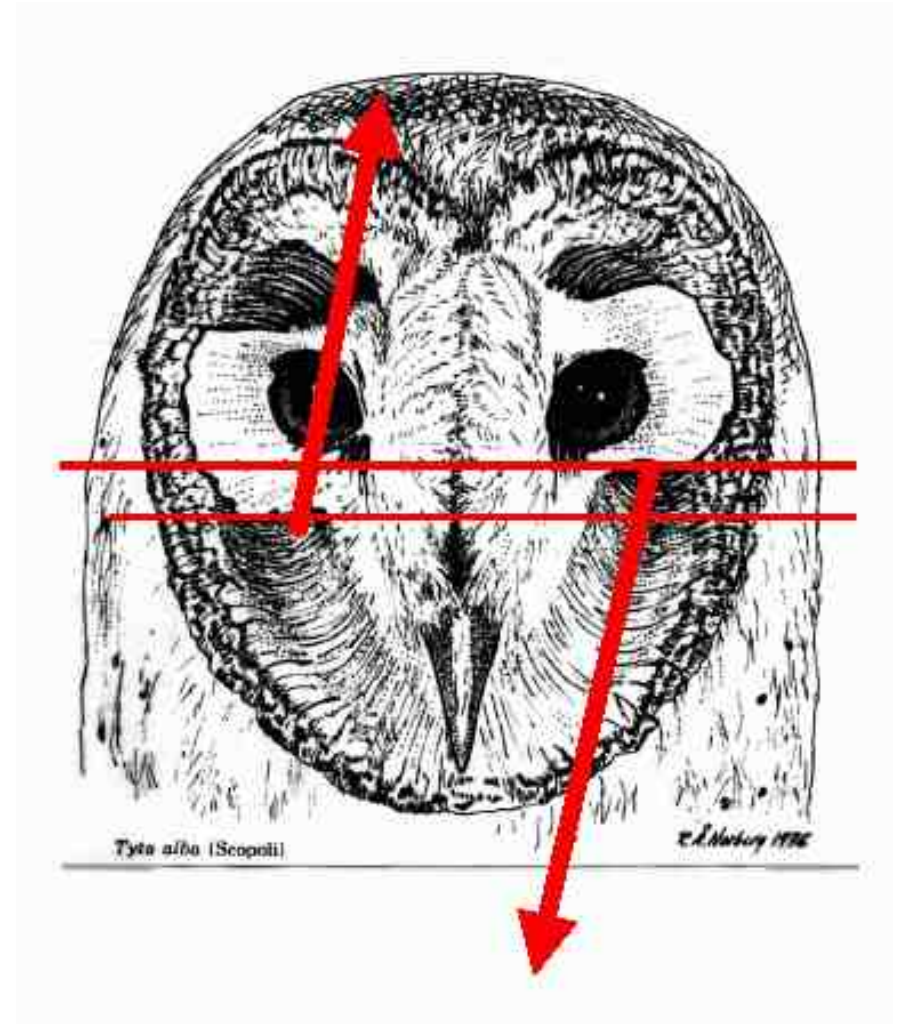
In 3D: horizontal AND vertical!



# Simple Neural Network

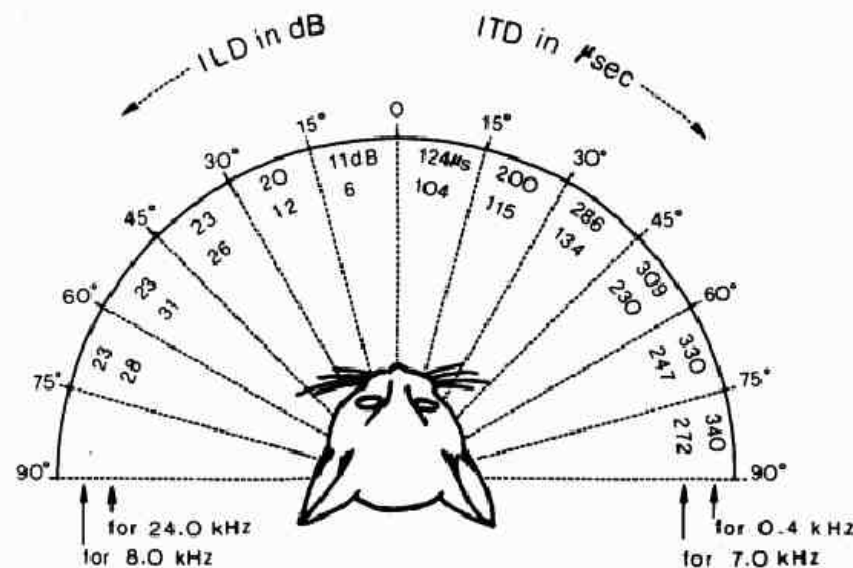
Owl ears

Asymmetric: helps estimation  
of height



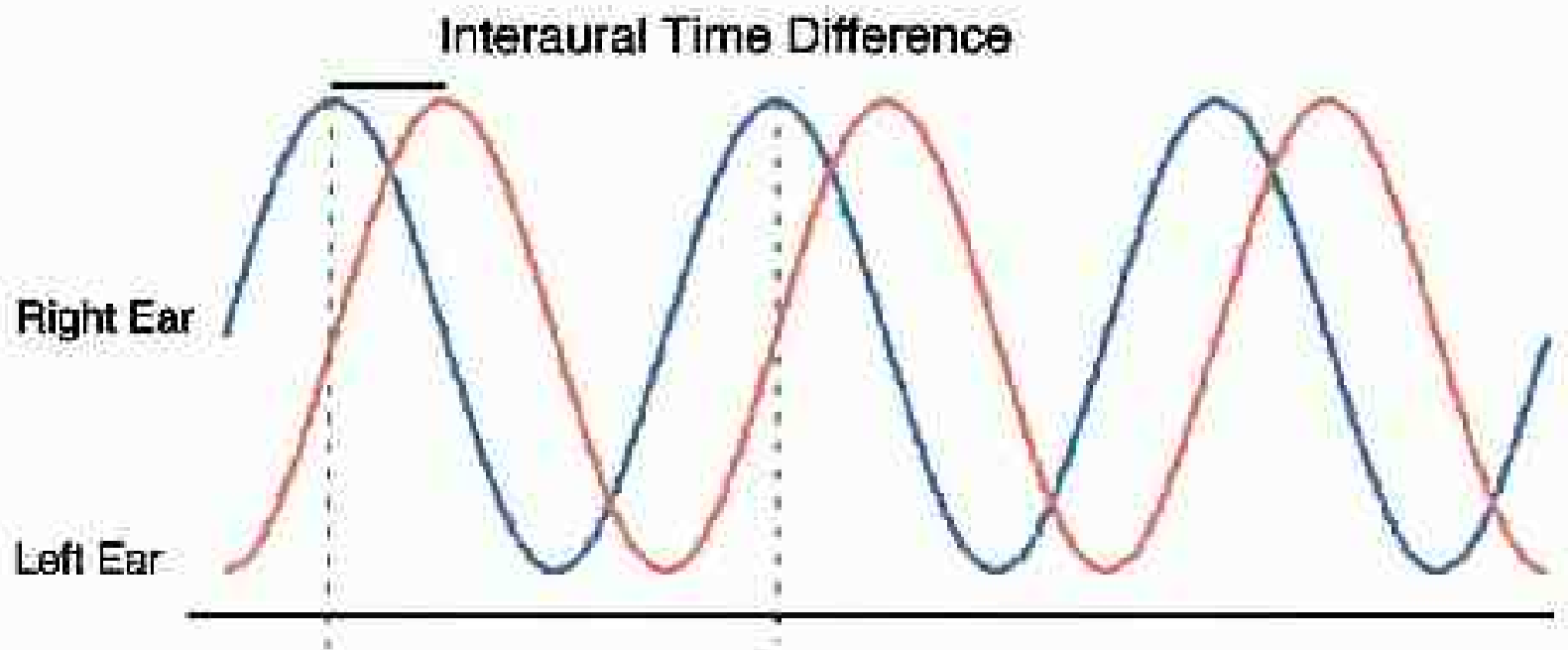
# Simple Neural Network

## Binaural Cues



- Two cues are available:
- Interaural Time Differences (ITD)
- Interaural Level Differences (ILD)
- ITD: depends on distance between ears  
(varies between 0 and 400 microsec)
- ILD is strongest at high frequencies  
>5 kHz for cats,  
>2 for humans

Two cues: ITD and ILD



### Neural Representation of Temporal Dispartties

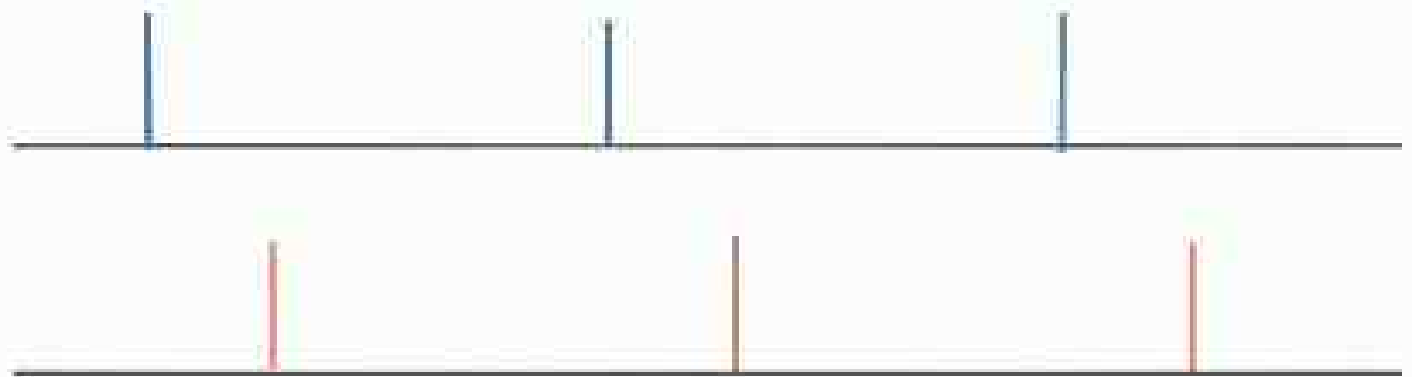
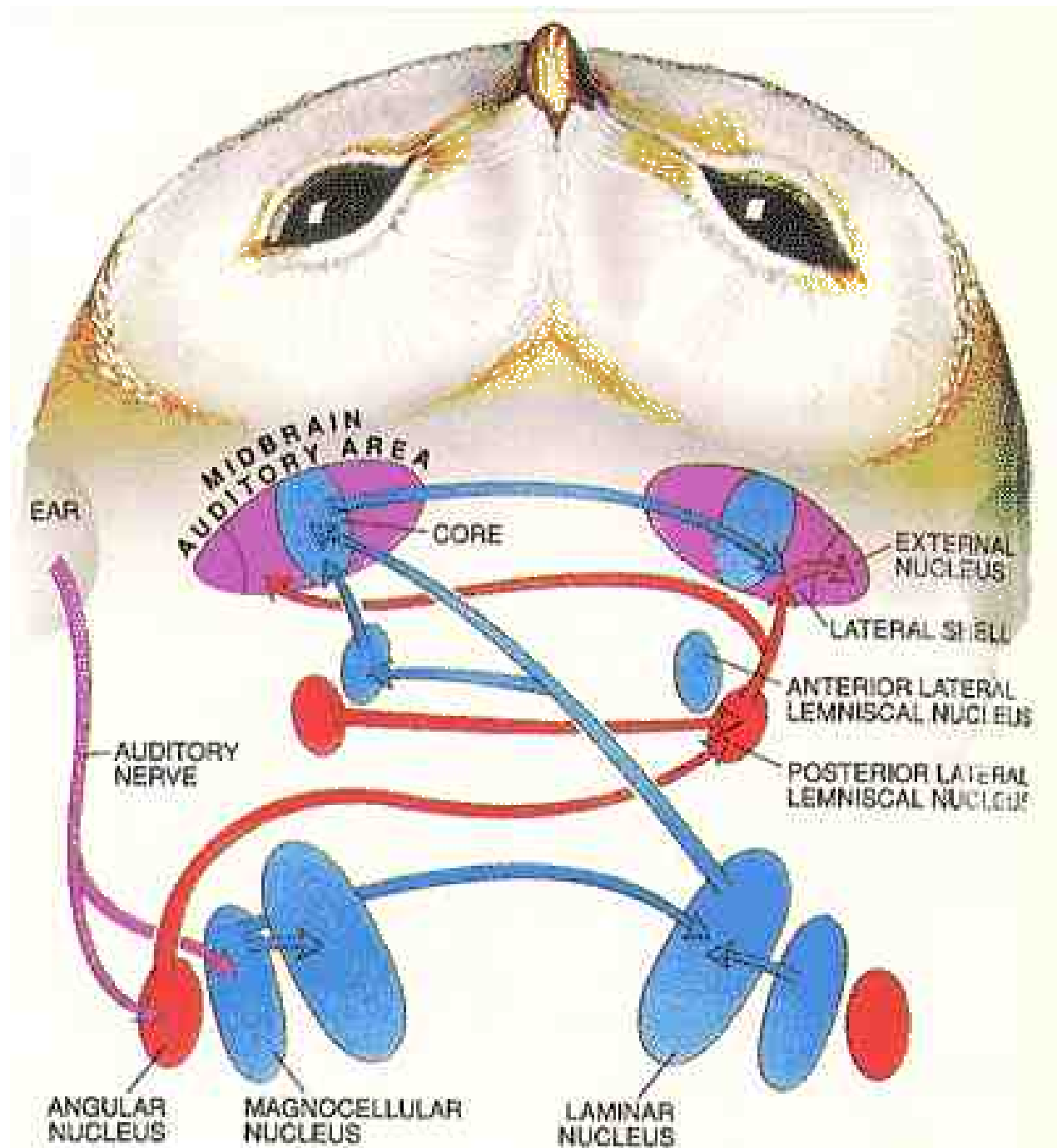


Fig. 4

Network

Midbrain  
auditory  
area

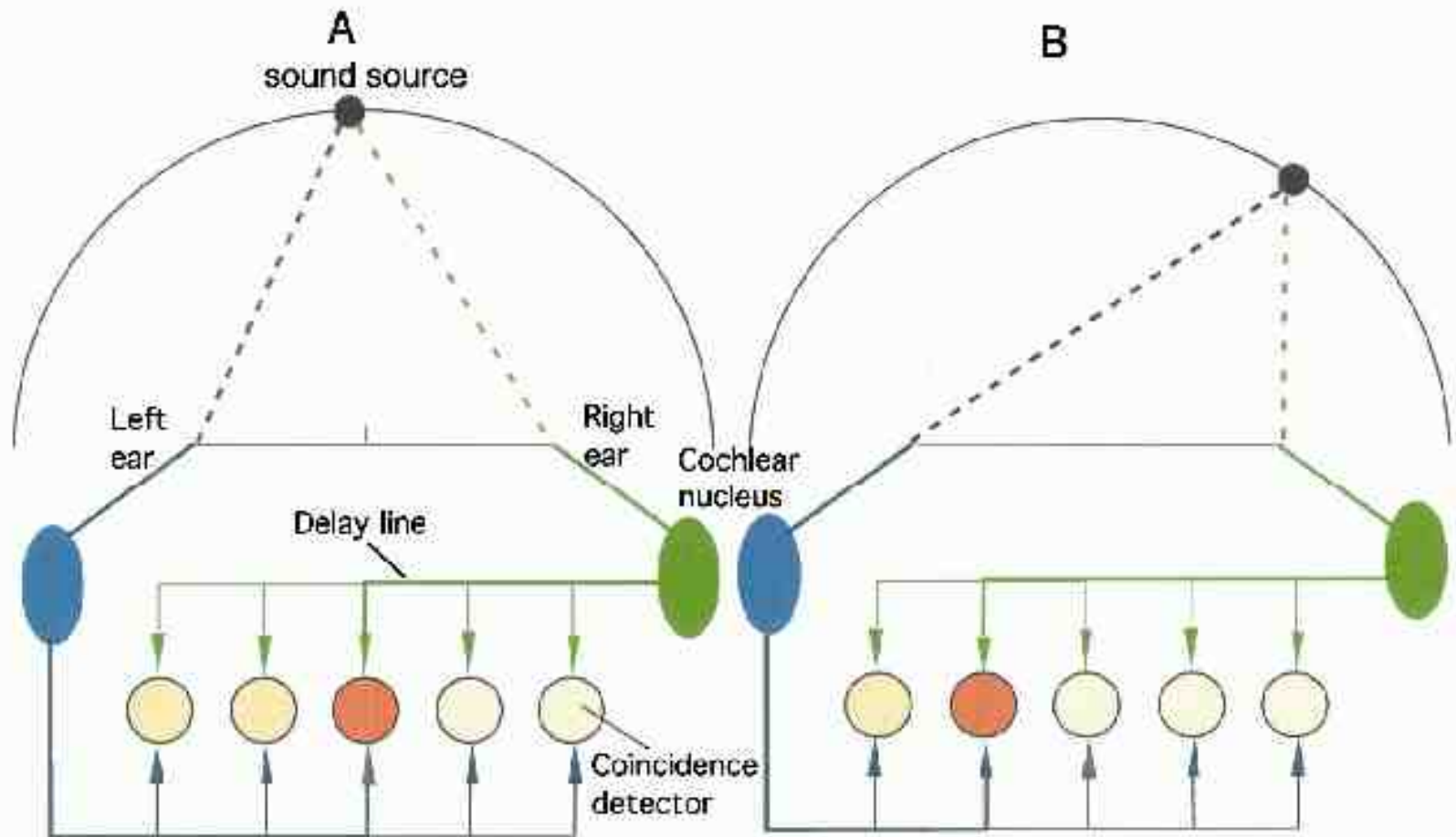


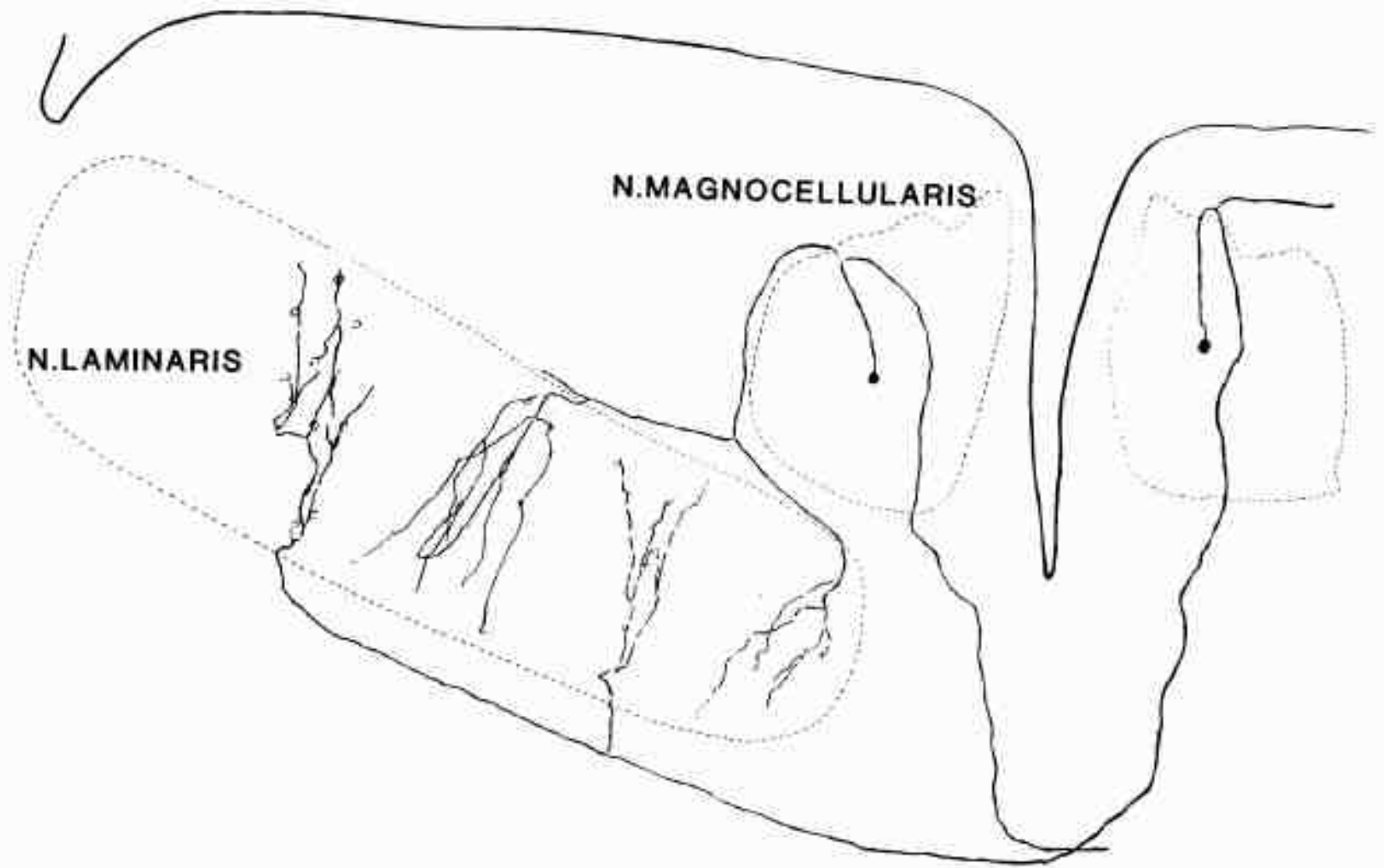
# Simple Neural Network

A: sound from middle

B: sound from the right

Fig. 4

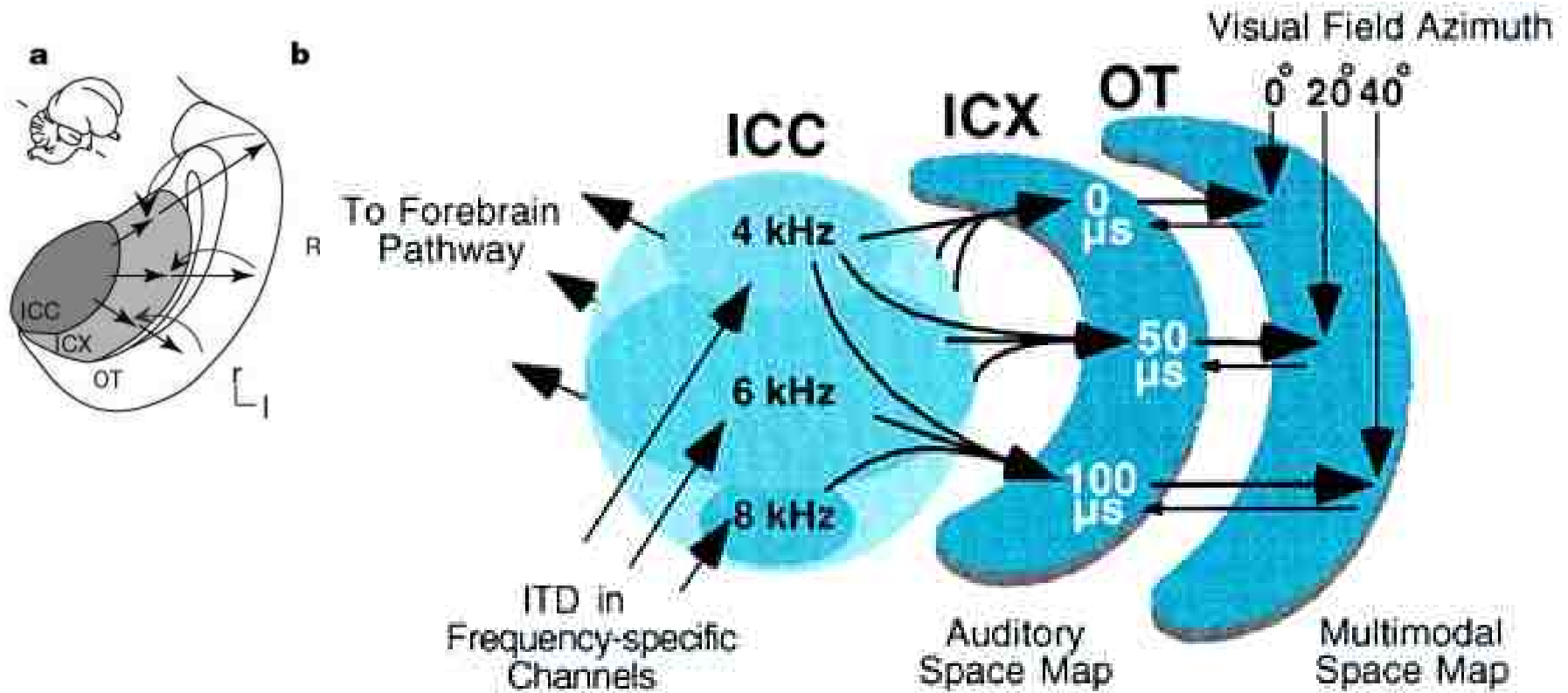




N. magnocellularis: delay

N. laminaris: coincidence detectors

# Simple Neural Network



Calculation of ITD:

Summed up:

Integrated:

Inferior colliculus (ICC) by frequencies (tonotopic)

ICx

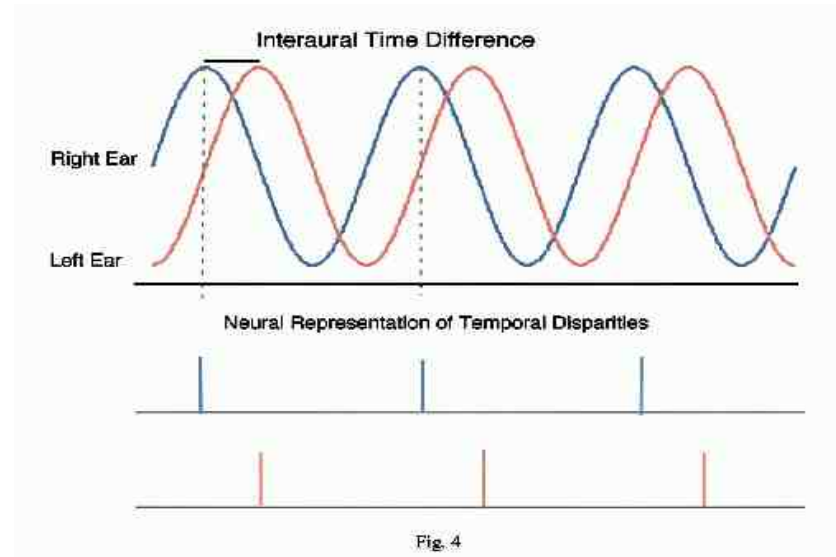
Tectum opticum (OT) with visual (topographic)

» Please remember: Optic Tectum

# Simple Neural Network

Design a machine which can estimate ITD

Problems: young owl grow, distance between ears gets bigger



# Simple Neural Network

ITD increases as skull grows

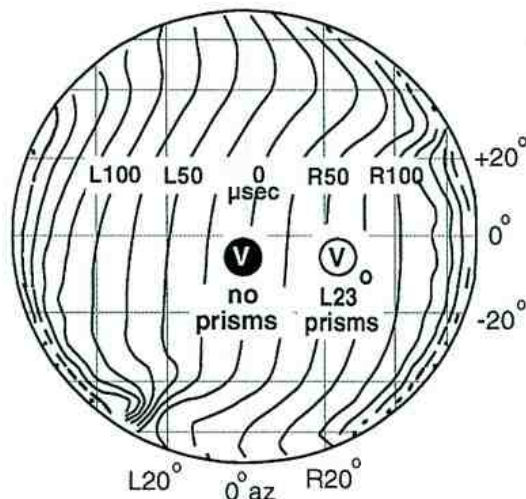
How does the brain control for it?

Experiment: seen image shifted by  
prism

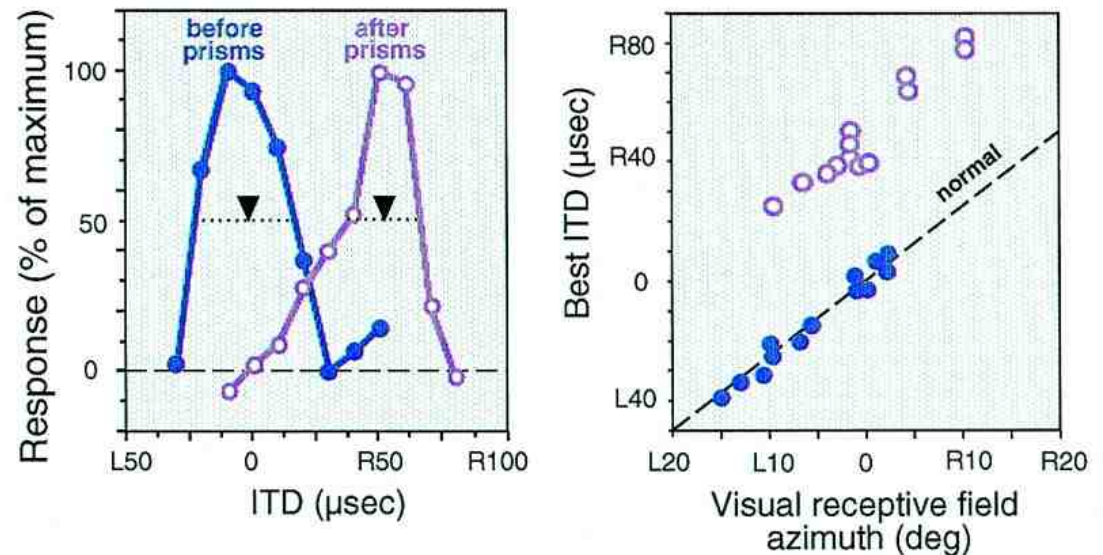


# Simple Neural Network

**A** Prismatic Displacement of Visual Receptive Field



**B** Shift of Auditory Tuning After 8 Weeks of Experience



Following 8 weeks of practice: ITD (Interaural Time Distance) shifts. Visual information guides the estimation of ITD

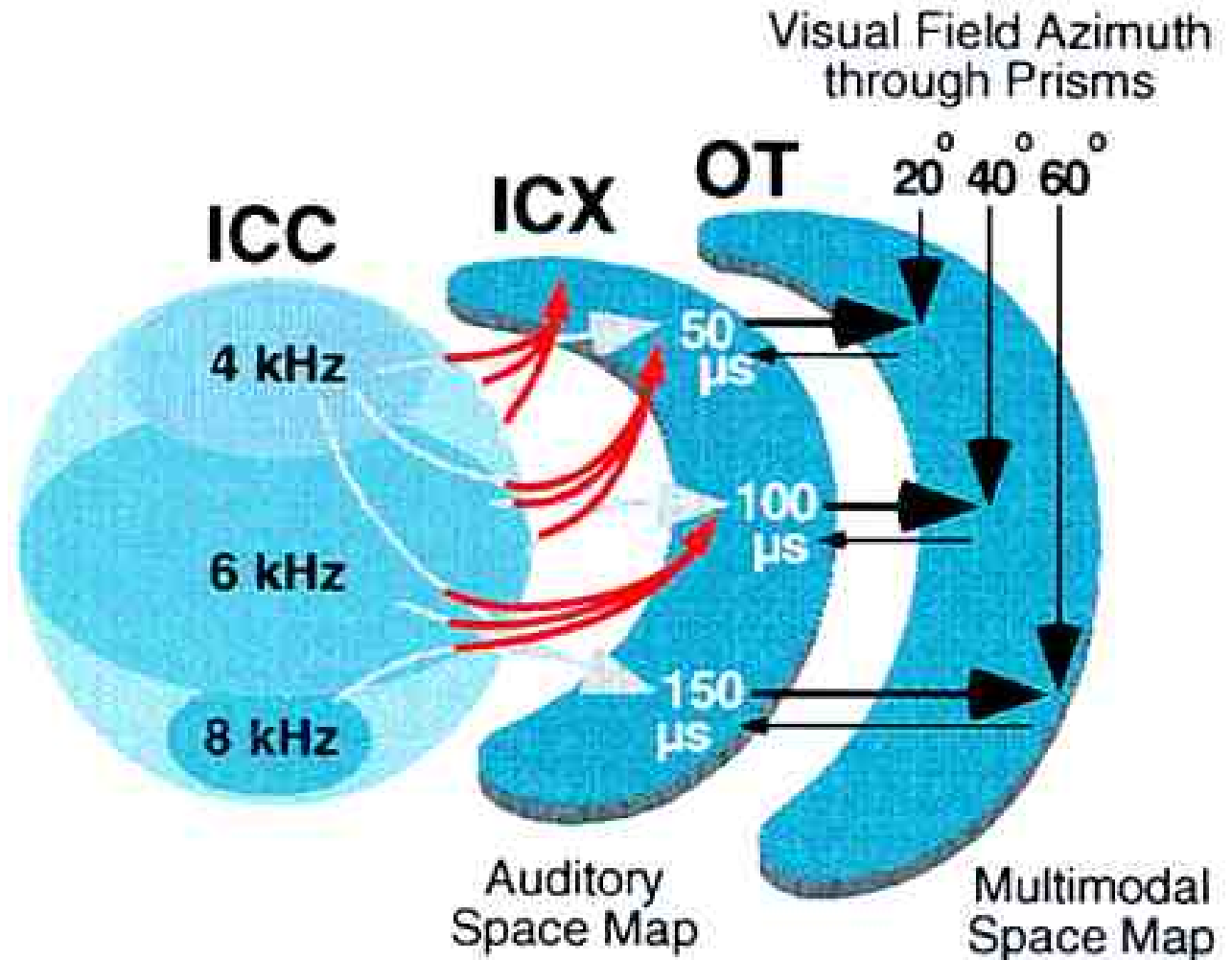
What is the mechanism?

# Simple Neural Network

New axons grow !!!

When prism  
removed, all gets  
back to original

Are new axons lost?



# Simple Neural Network



Older birds cannot adjust to prism.

Older birds which practised with prisms were retested

Adaptation very soon, but only in the practised direction.

New connections are not lost but inhibited.

Can you draw the line between learned and innate?