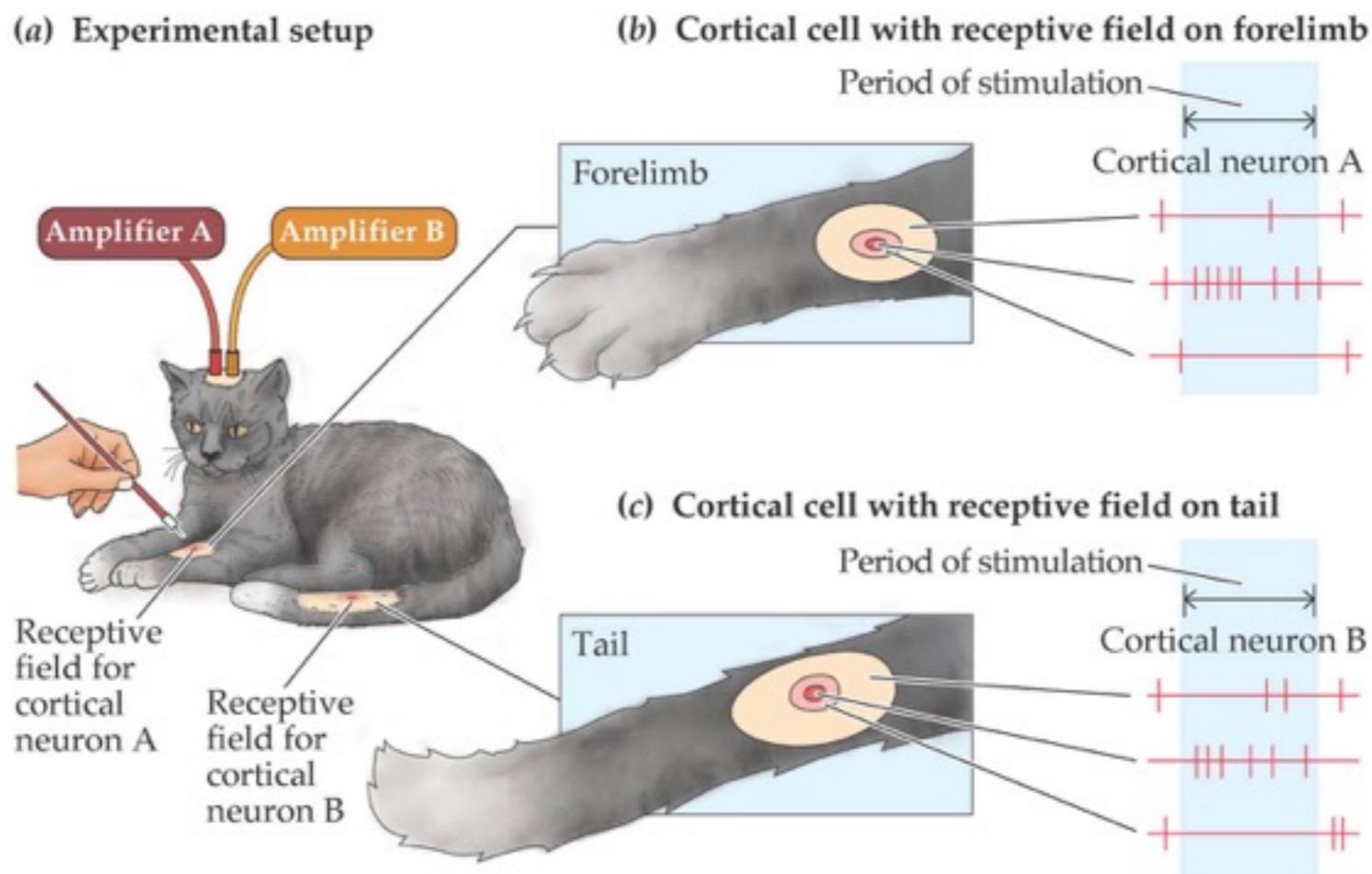


# Today's topics

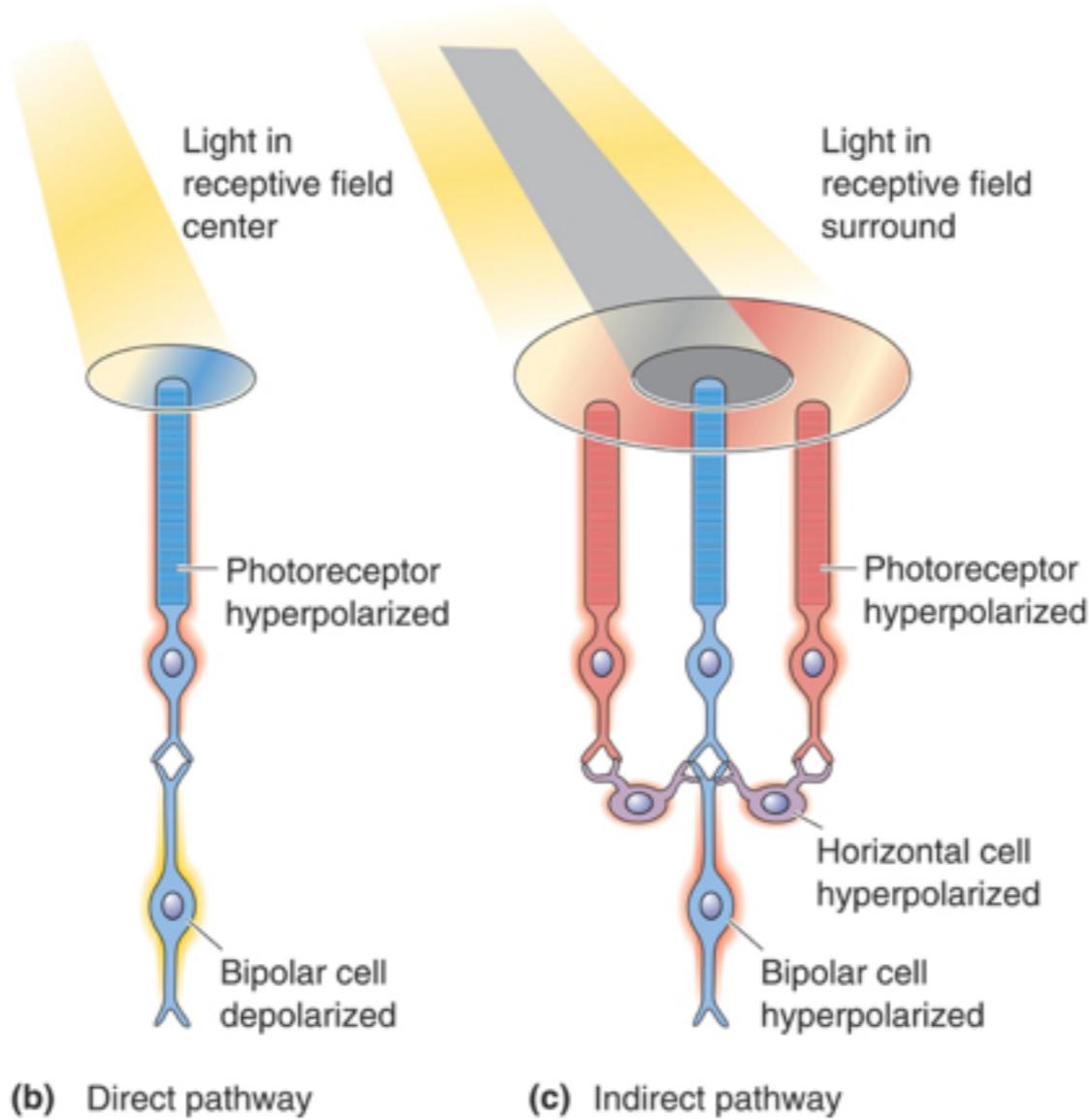
- Perception and action

# Common principles

- Receptive fields
- Area on sensory surface that changes neural activity

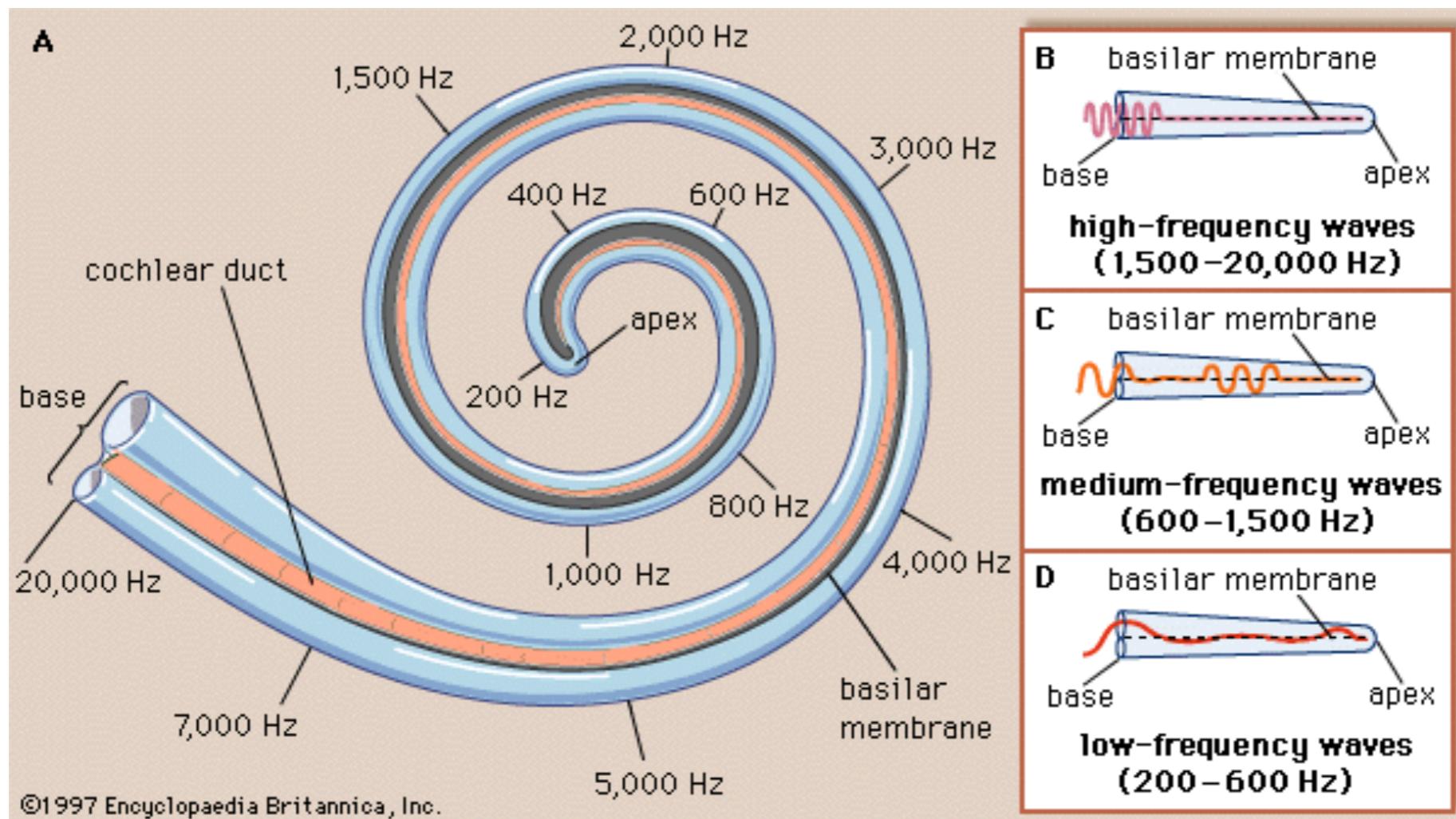


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Neuroscience: Exploring the Brain, 3rd Ed. Bear, Connors, and Paradiso Copyright © 2007 Lippincott Williams & Wilkins

[https://classconnection.s3.amazonaws.com/594/flashcards/1450594/png/untitled\\_picture51356035996428.png](https://classconnection.s3.amazonaws.com/594/flashcards/1450594/png/untitled_picture51356035996428.png)

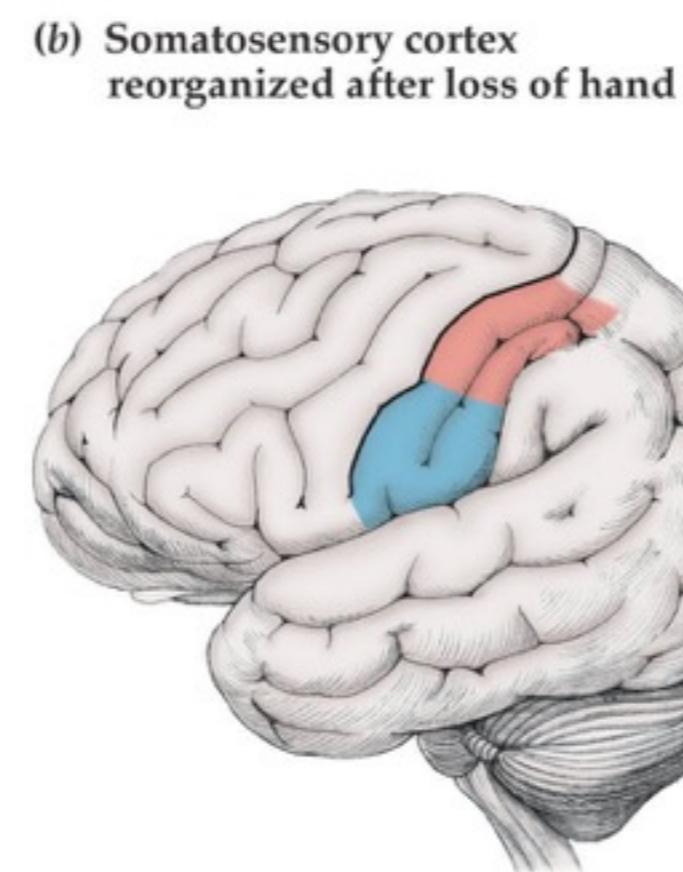
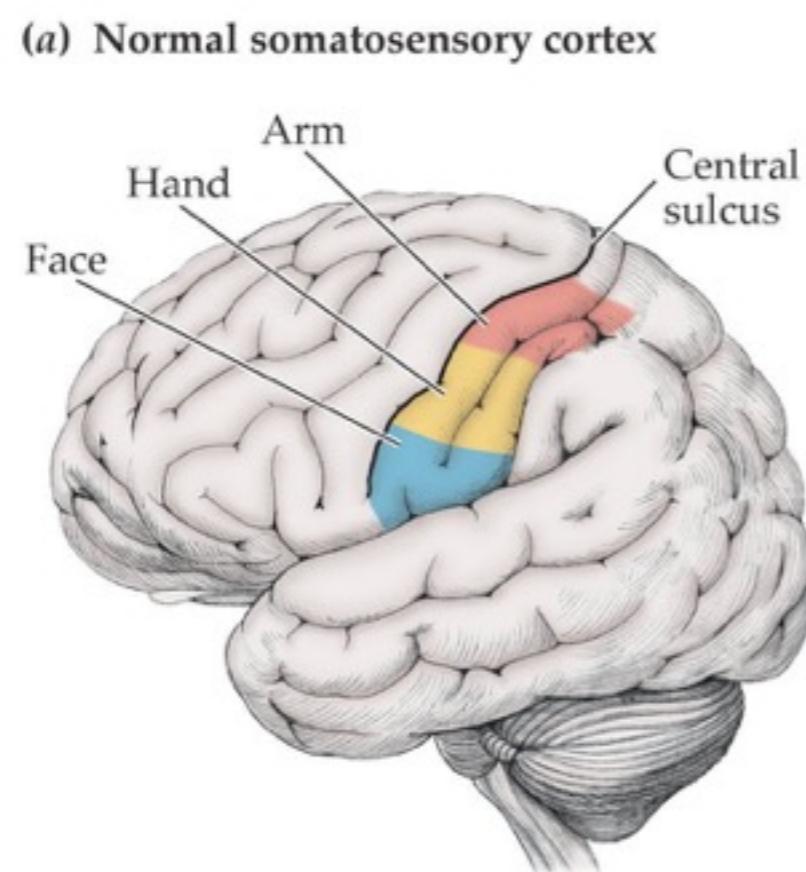


<http://3.bp.blogspot.com/-gAio3iTtgMw/TW23AytUzMI/AAAAAAAABADE/MqfWBPo1ZxU/s1600/14298-004-99934987.gif>

# Common principles

- Topographic maps

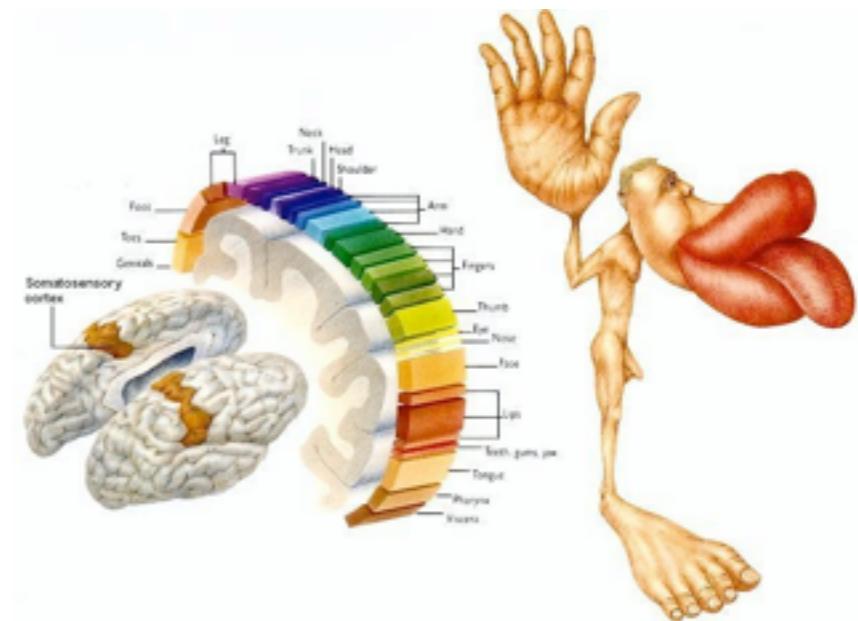
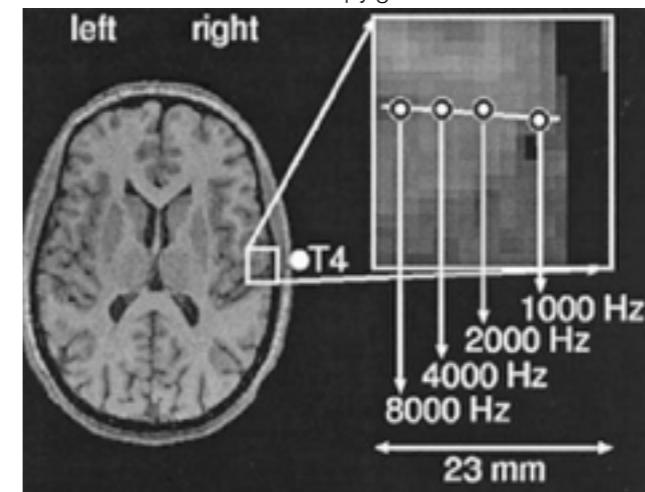
# Sensory maps in cortex



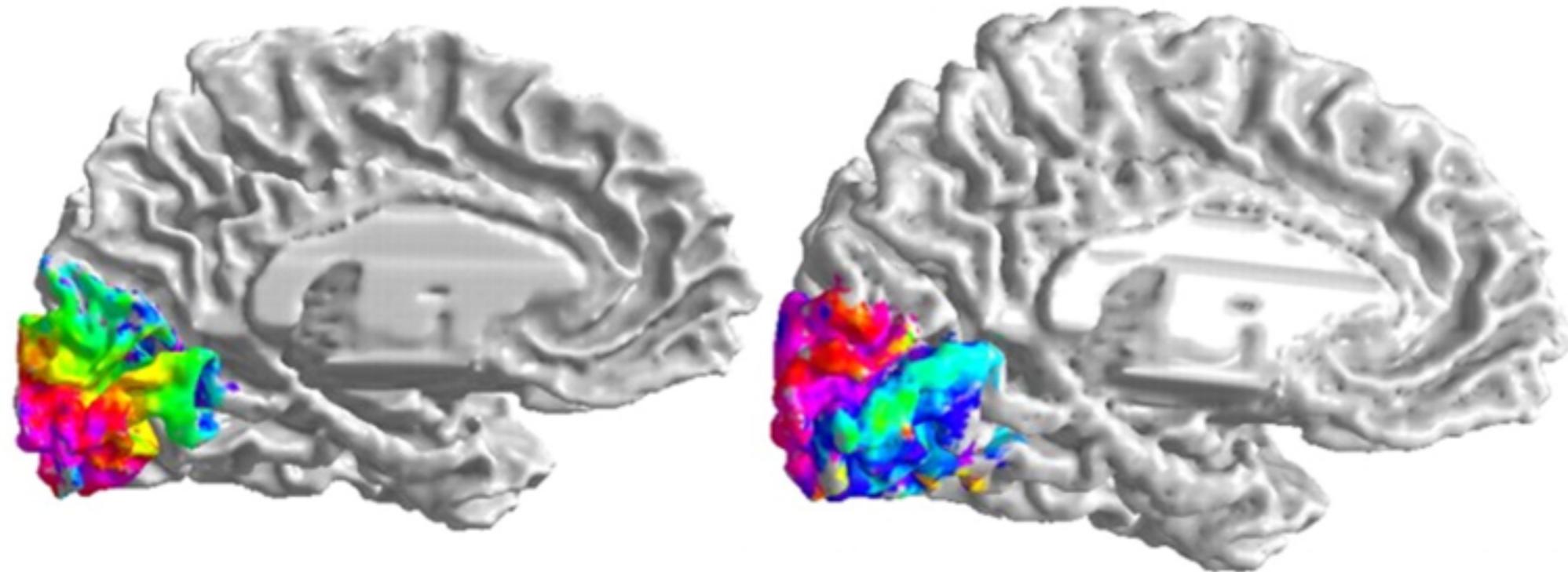
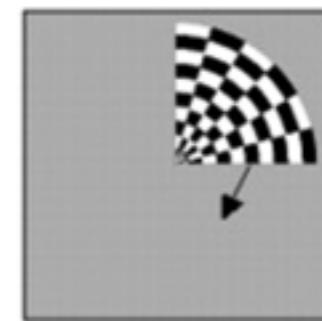
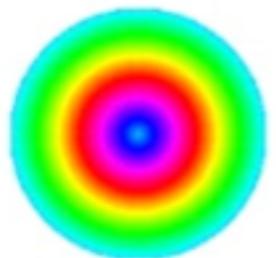
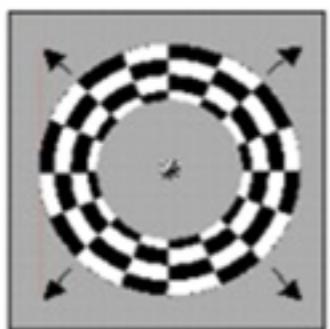
# Topographic maps

- Retinotopy
- Tonotopy
- Somatotopy
  - Somatosensory
  - Motor
- Chemo?
- Place fields?

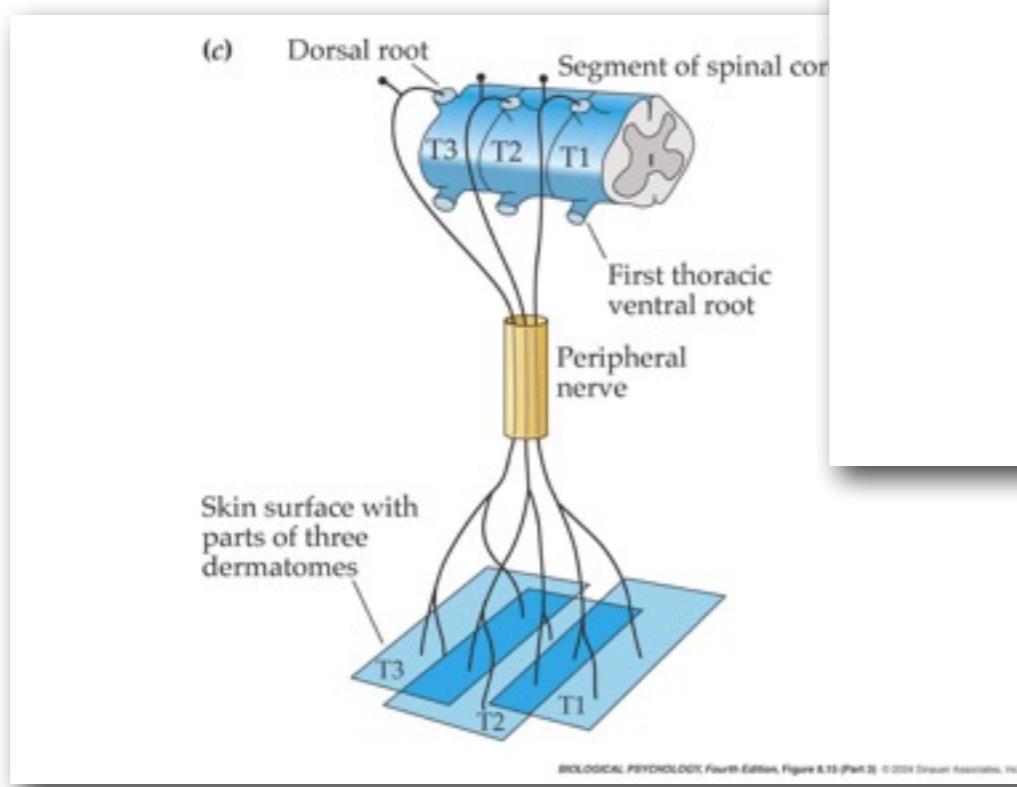
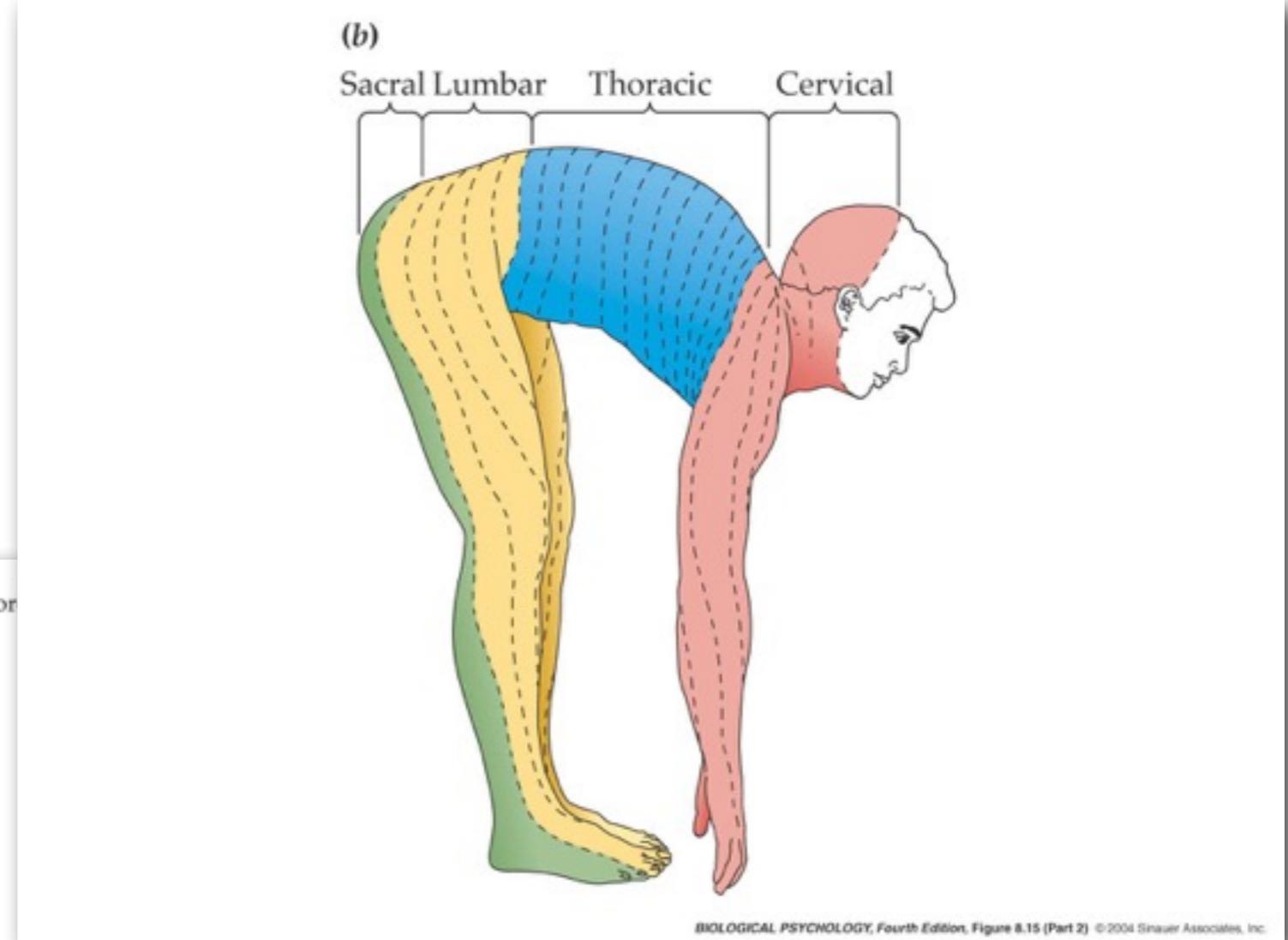
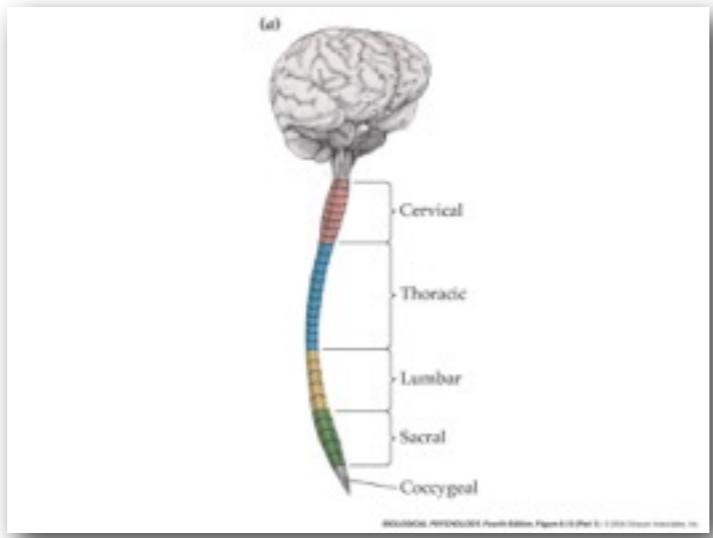
<http://www.his.kanazawa-it.ac.jp/~tomi/public/MEGLab/Auditory/tonotopy.gif>

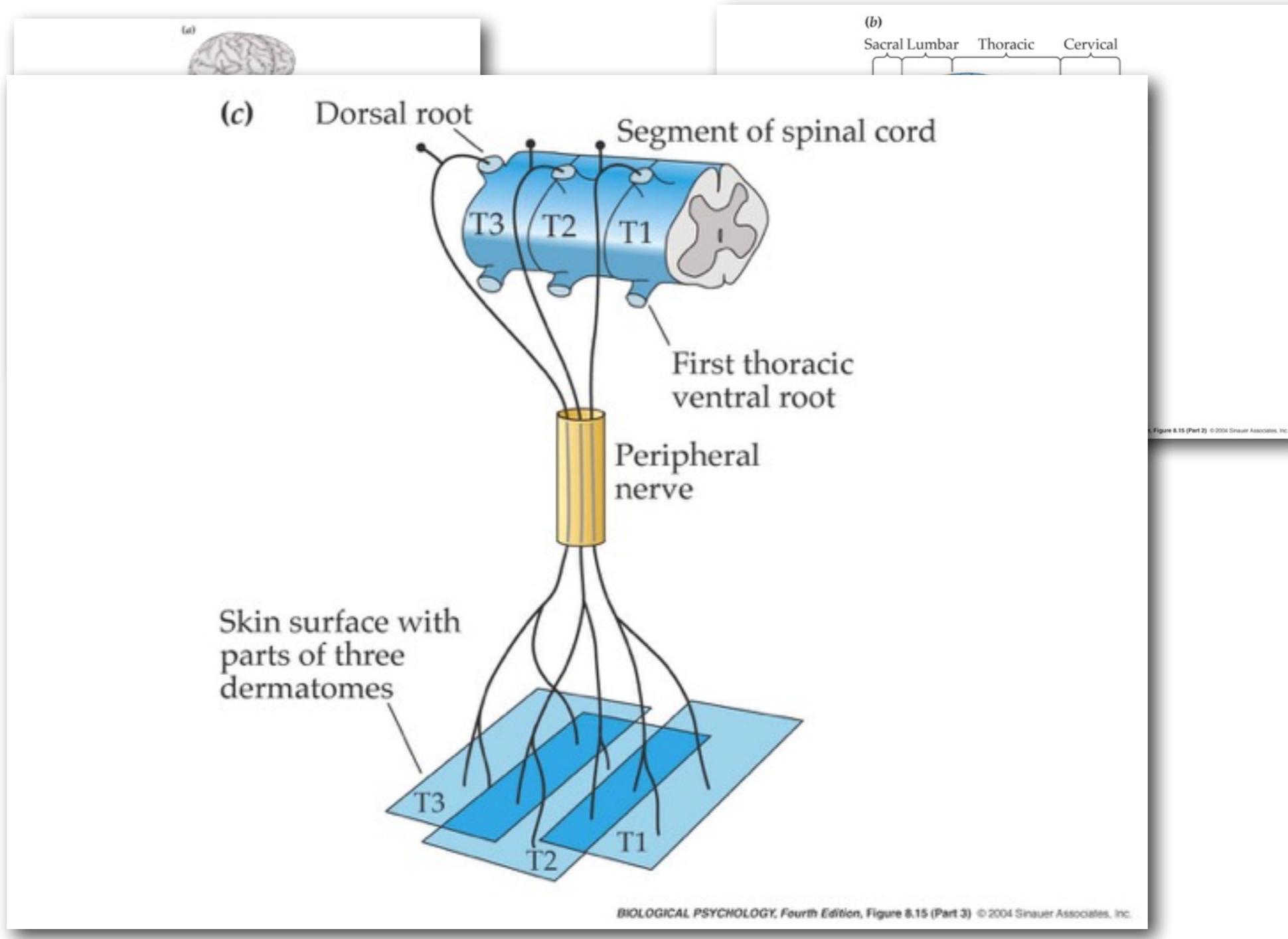


<http://universe-review.ca/I10-13-homunculus.jpg>



[http://jov.arvojournals.org/data/Journals/JOV/933499/  
jov-3-10-1-fig001.jpeg](http://jov.arvojournals.org/data/Journals/JOV/933499/jov-3-10-1-fig001.jpeg)

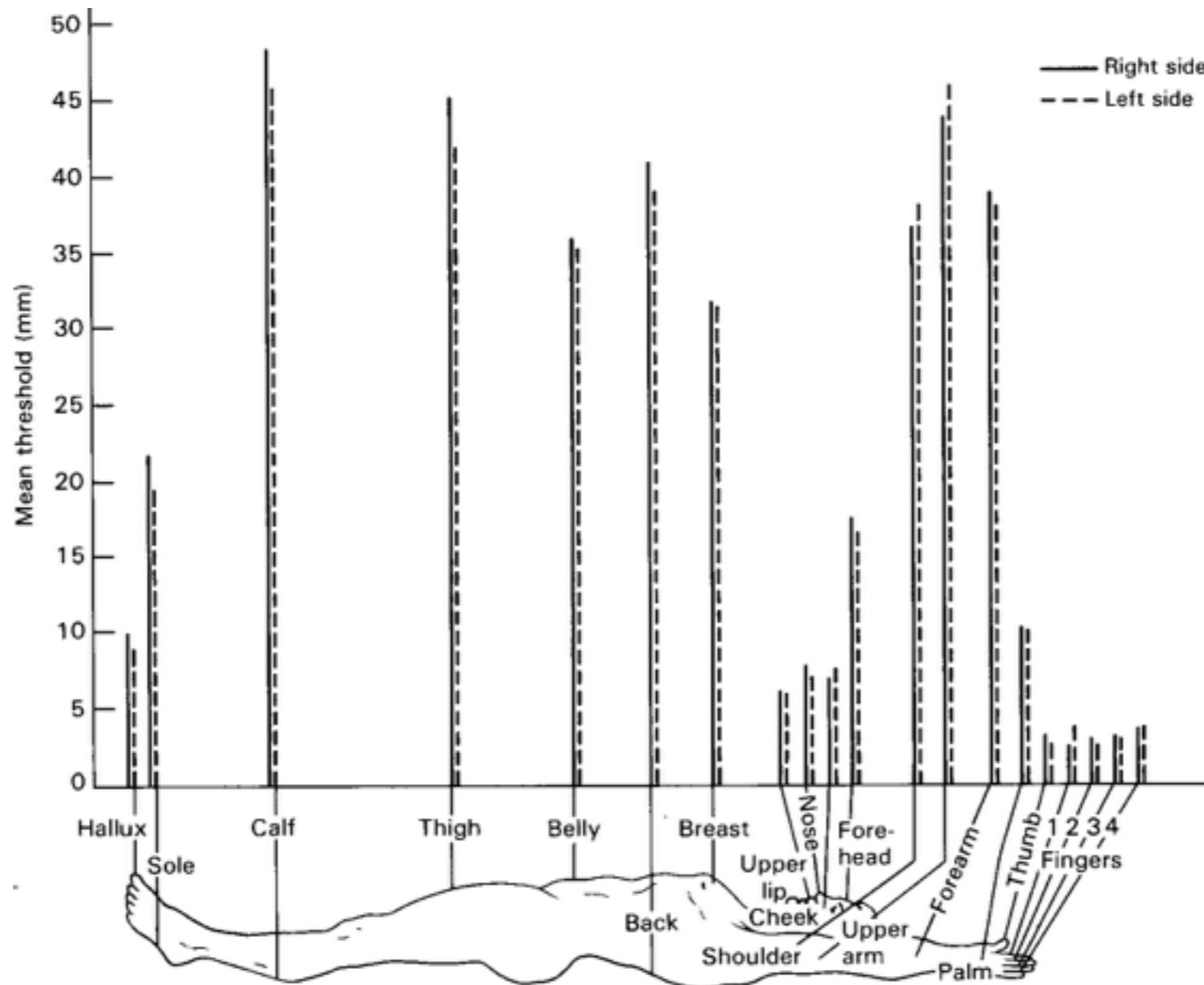


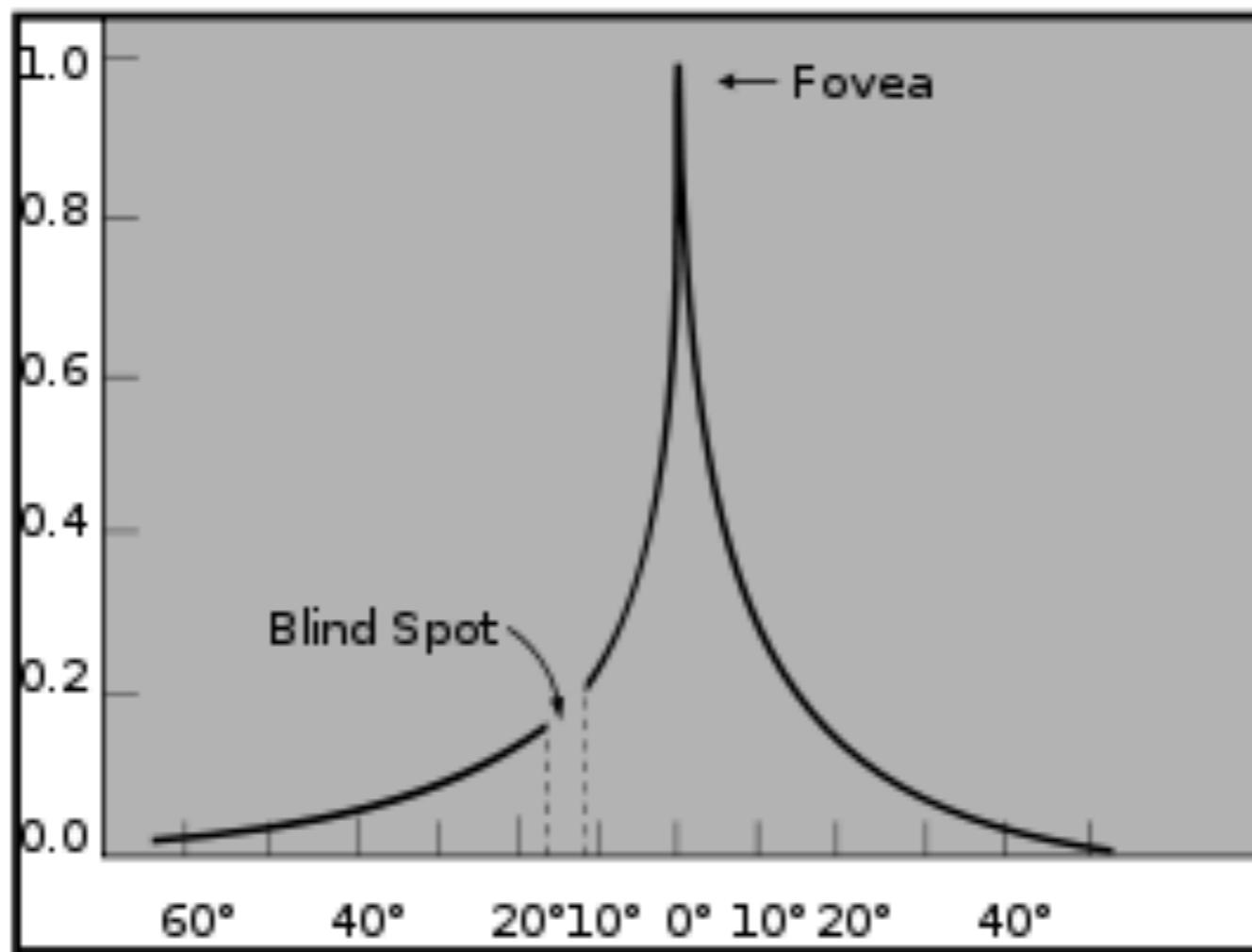


# Common principles

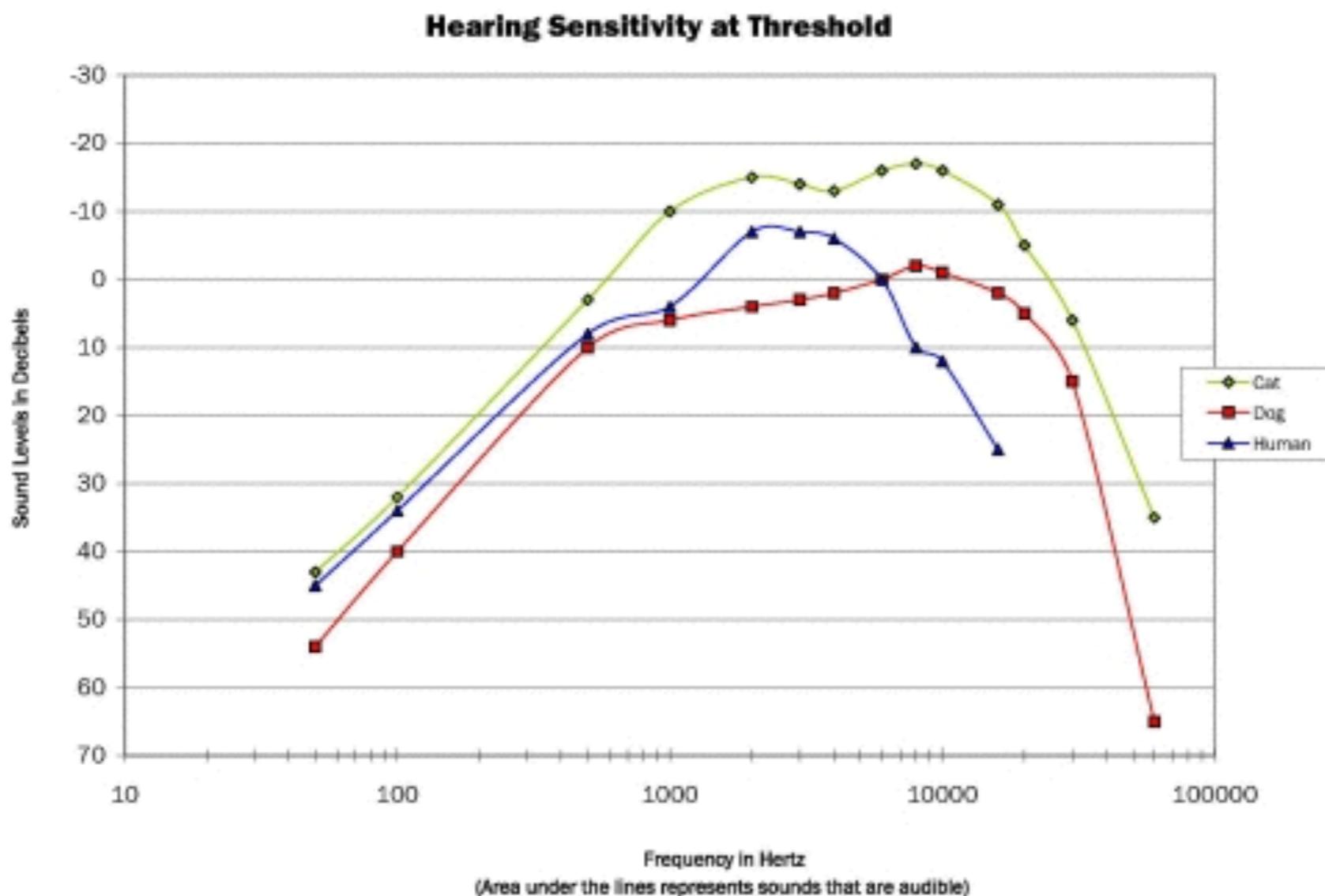
- Sensitivity non-uniform

# Touch sensitivity varies





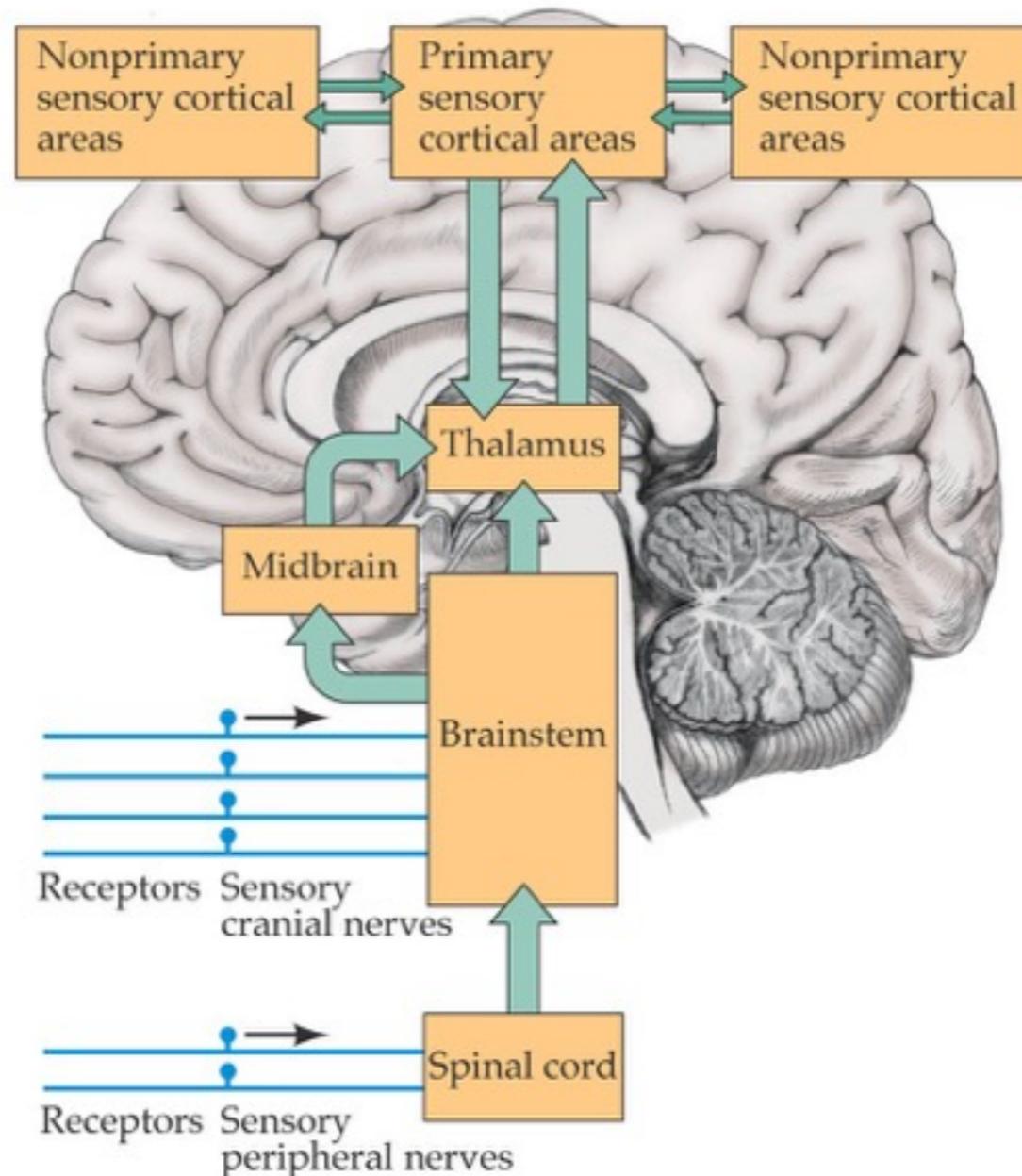
<https://upload.wikimedia.org/wikipedia/commons/thumb/2/27/AcuityHumanEye.svg/270px-AcuityHumanEye.svg.png>



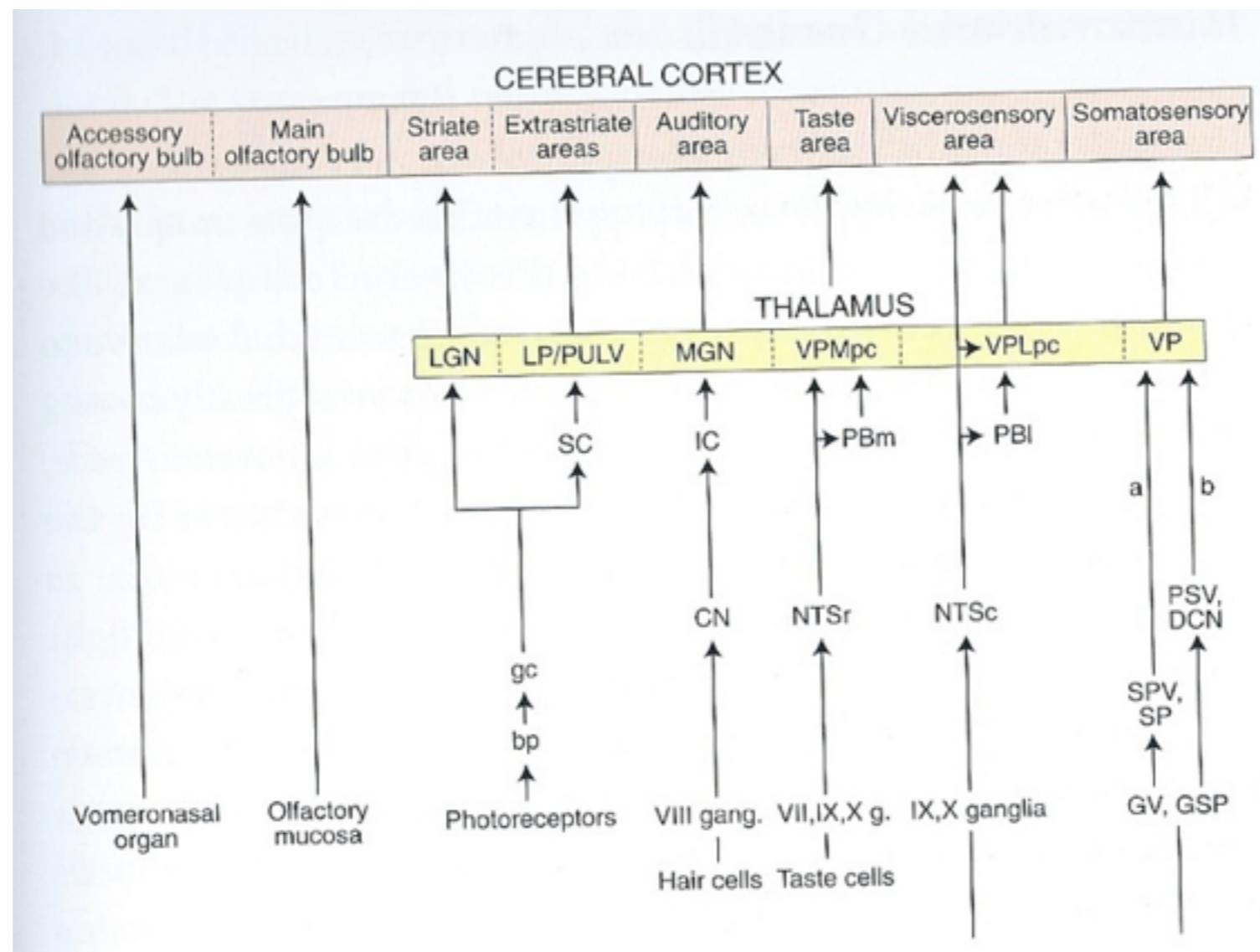
[http://www.hearforever.org/userfiles/image/tools\\_to\\_learn/SS4\\_Hearing\\_Sensitivity.jpg](http://www.hearforever.org/userfiles/image/tools_to_learn/SS4_Hearing_Sensitivity.jpg)

# Parallel processing

- Receptors
- Brainstem
- Thalamus
- Cerebral cortex



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Swanson 11.4

# Action

# Components

- Somatic
- Autonomic
- Neuroendocrine

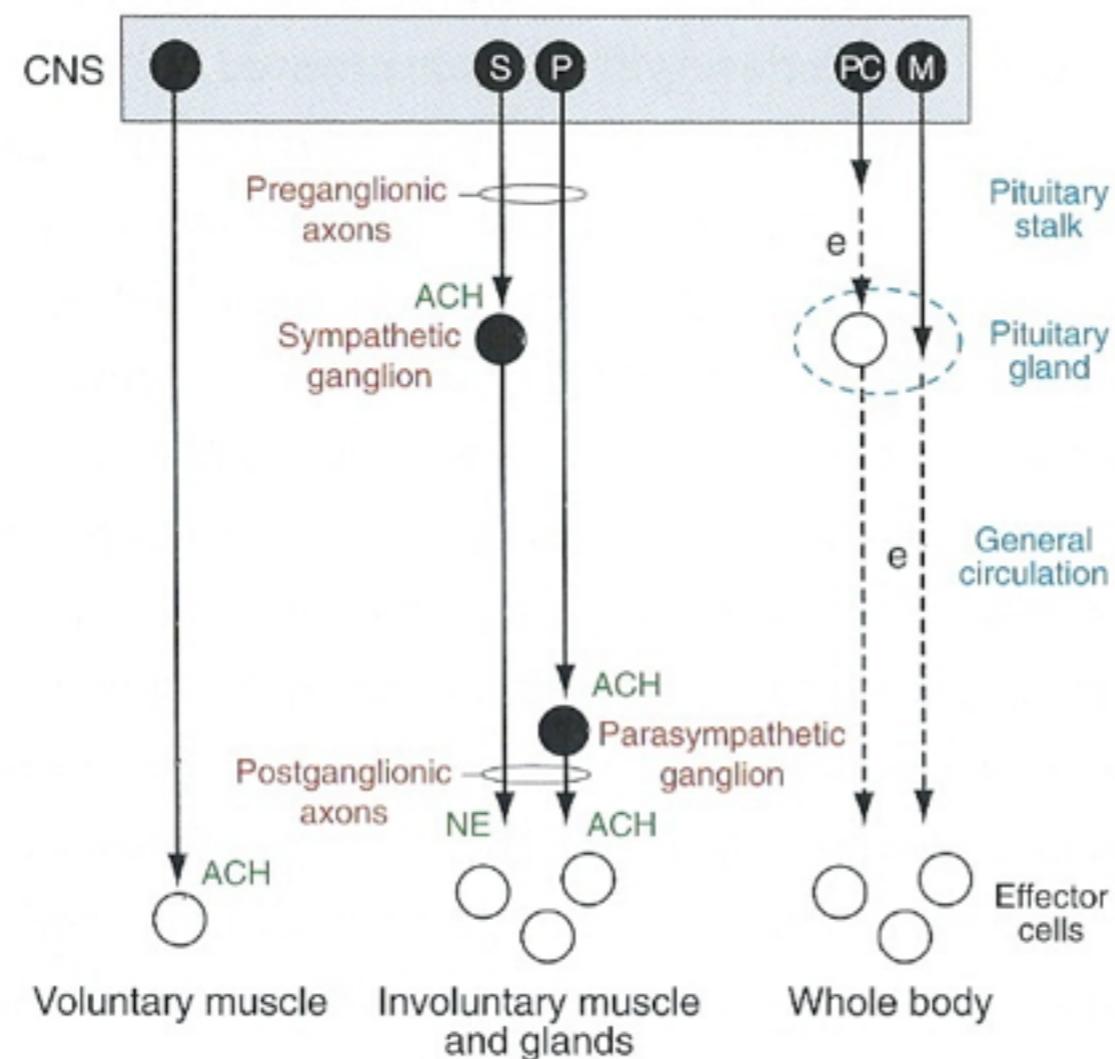
# Action types

- Locomotion
- Reaching, grasping, manipulating
- Postural control
- Signaling

# “Symphony of behavior”

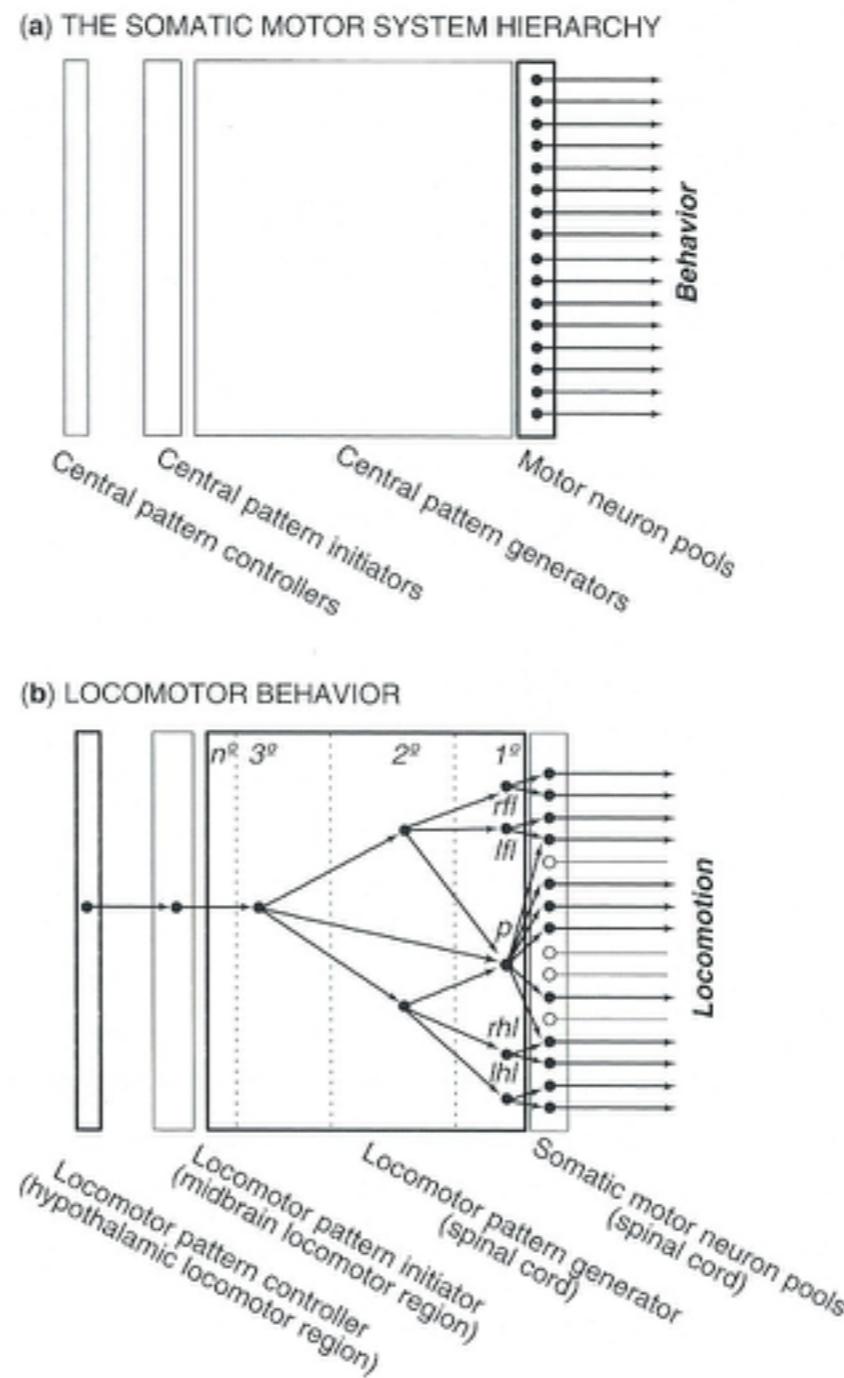
- Hierarchy of motivated behaviors
- Hierarchy of central pattern generators, initiators, and controllers
- Motor neuron pools
  - Excitatory, inhibitory innervation
  - Flexors and extensors
  - Agonist and antagonist muscles
- Target organs of autonomic, endocrine signals

**(a) Somatic:** synaptic      **(b) Autonomic:** paracrine      **(c) Neuroendocrine:** endocrine



Swanson 8.1

## Swanson 8.7

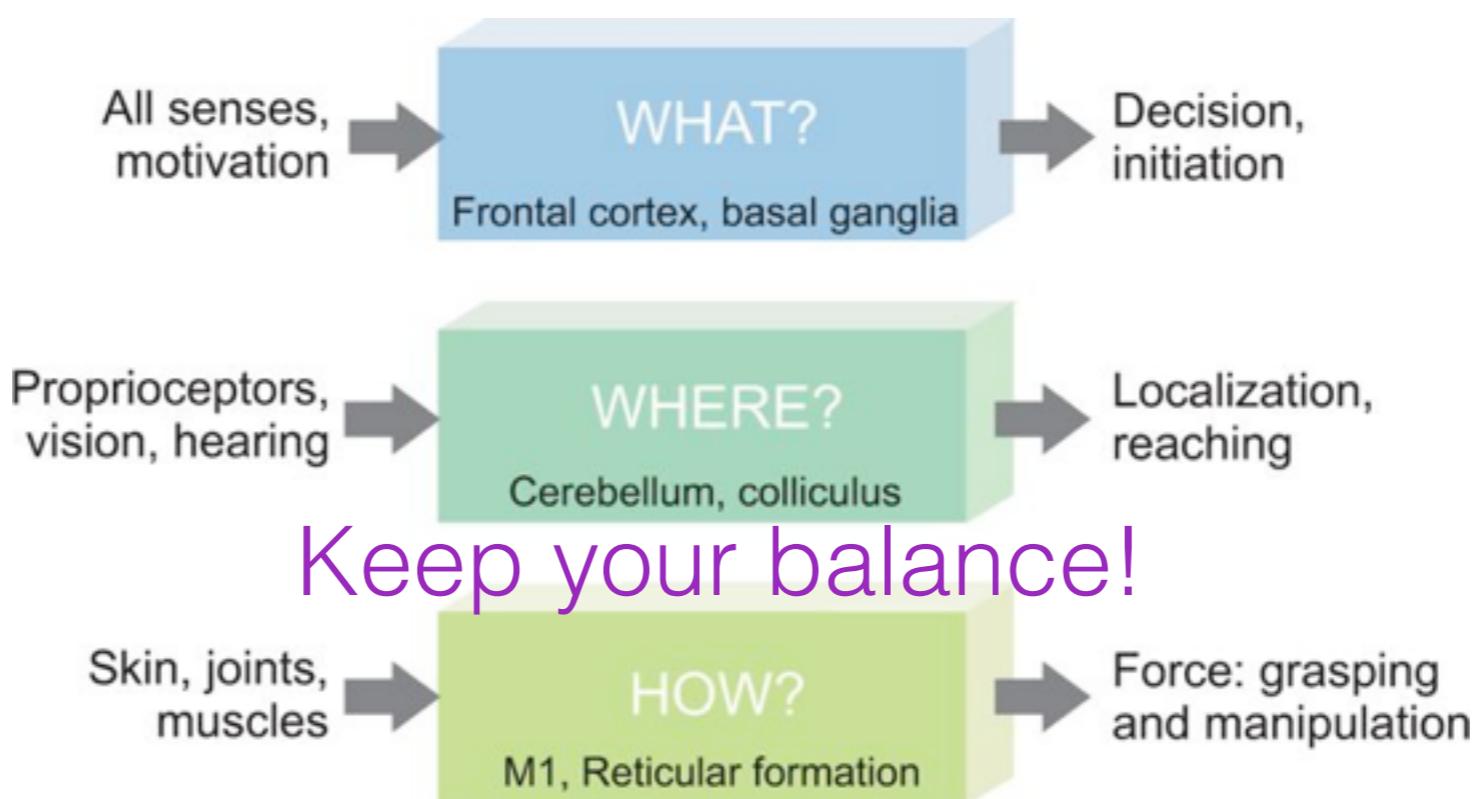




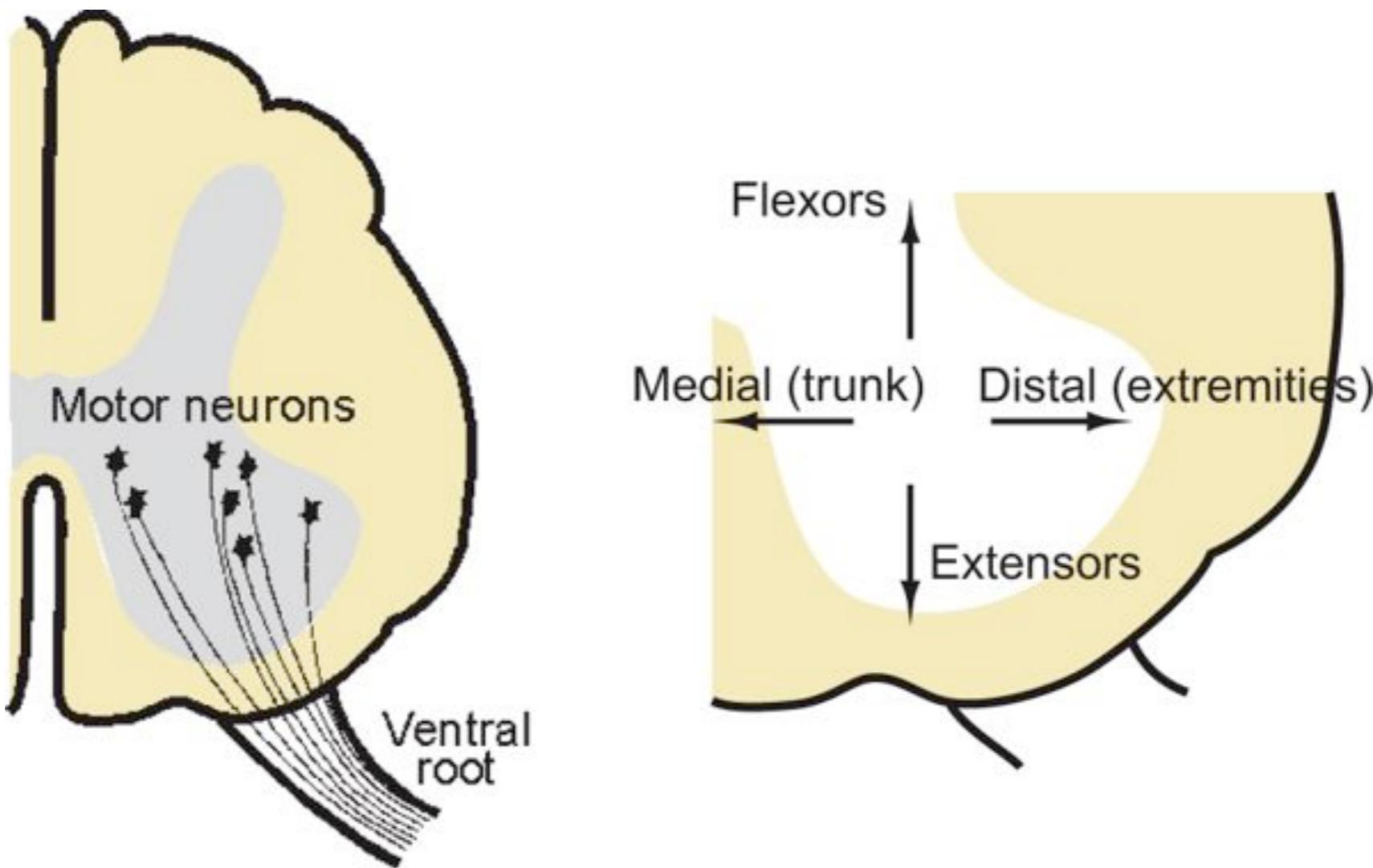
**Decide, initiate**  
Basal ganglia, frontal cortex

**Reach**  
Cerebellum, PMA

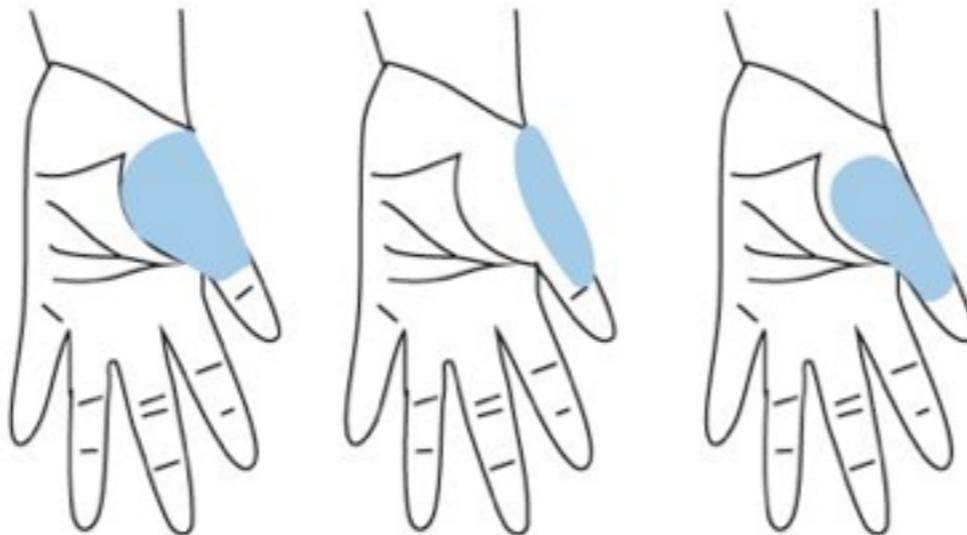
**Grasp**  
Primary motor cortex



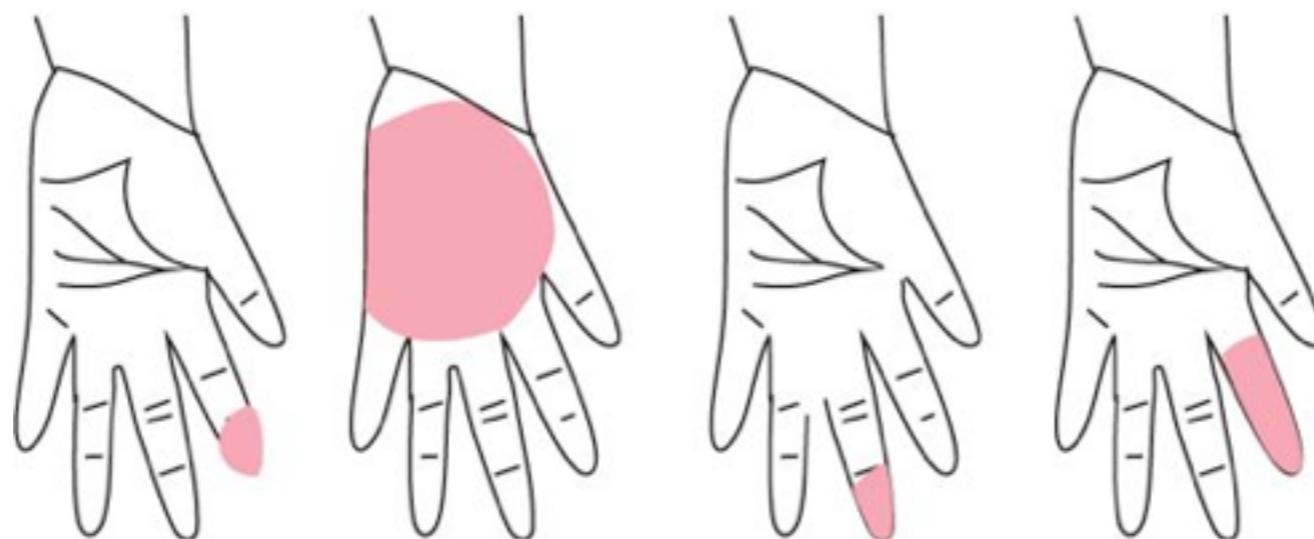
# Topographic maps



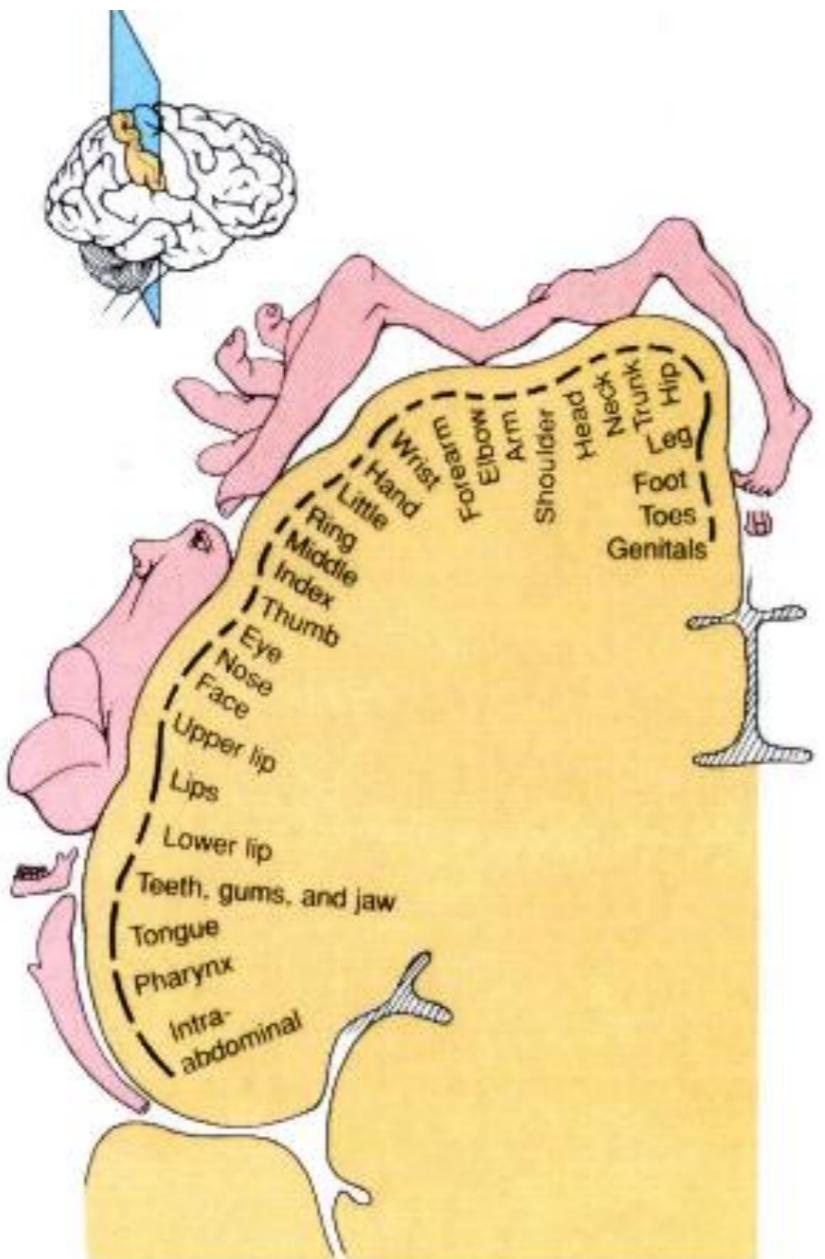
Cutaneous sensory fields of monkey pyramidal cells



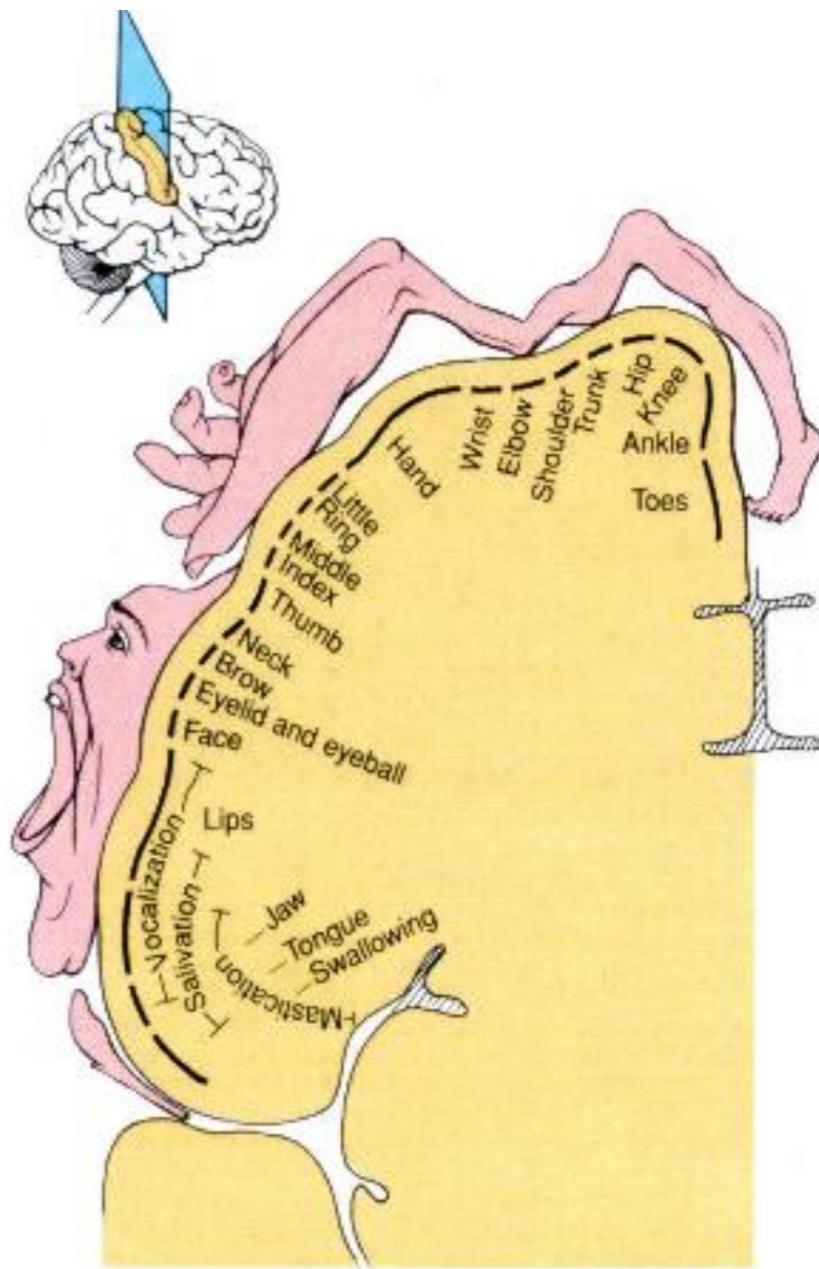
Pyramidal cells generating thumb flexion



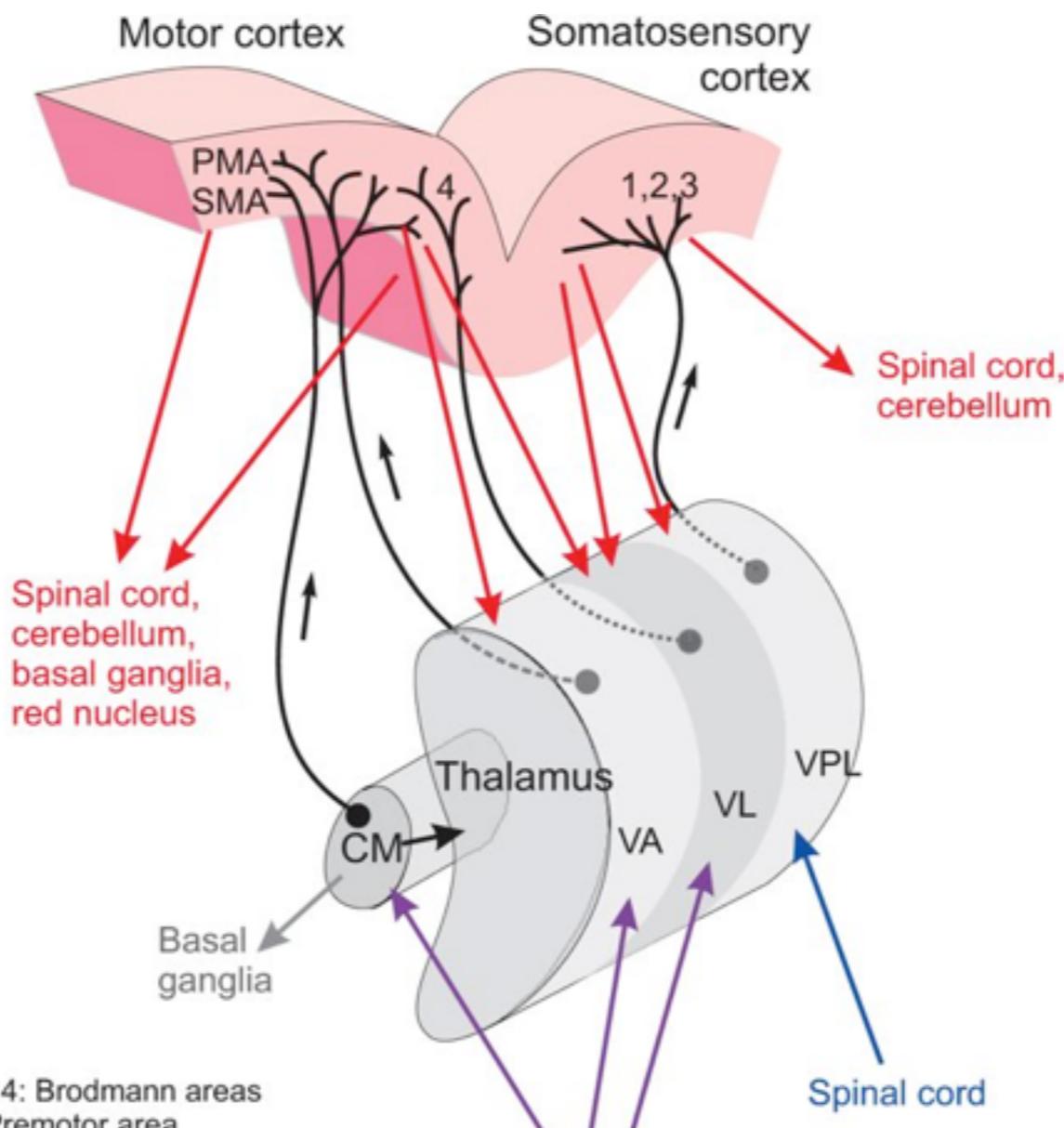
Pyramidal cells generating digit flexion



(a) Somatosensory cortex in right cerebral hemisphere



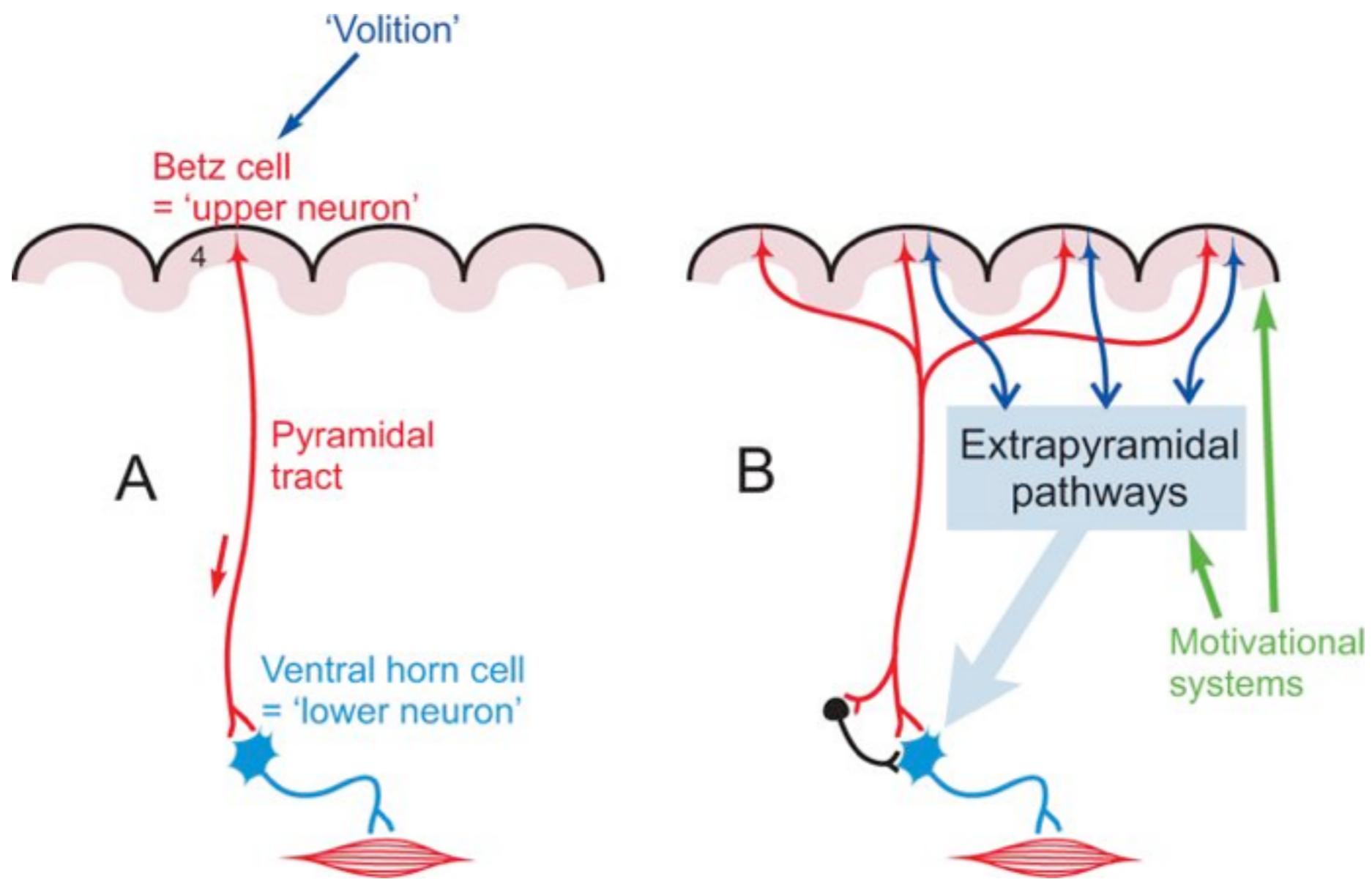
(b) Motor cortex in right cerebral hemisphere

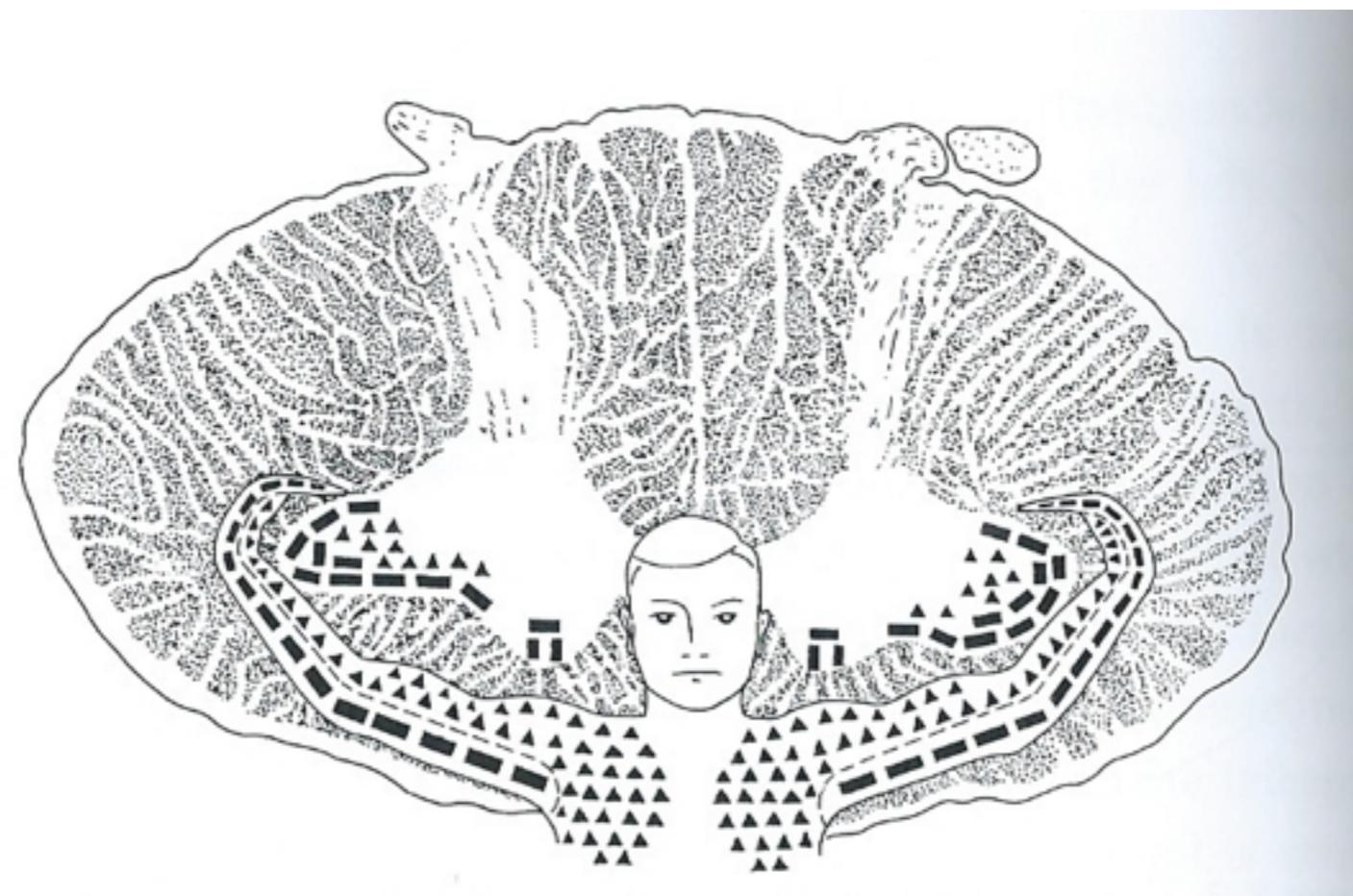


**Key:**

- 1, 2, 3, 4: Brodmann areas
- PMA: Premotor area
- SMA: Supplementary motor area
- VA: Ventroanterior
- VL: Ventrolateral
- VPL: Ventroposterolateral
- CM: Centromedian

Cerebellum,  
basal ganglia,  
reticular formation



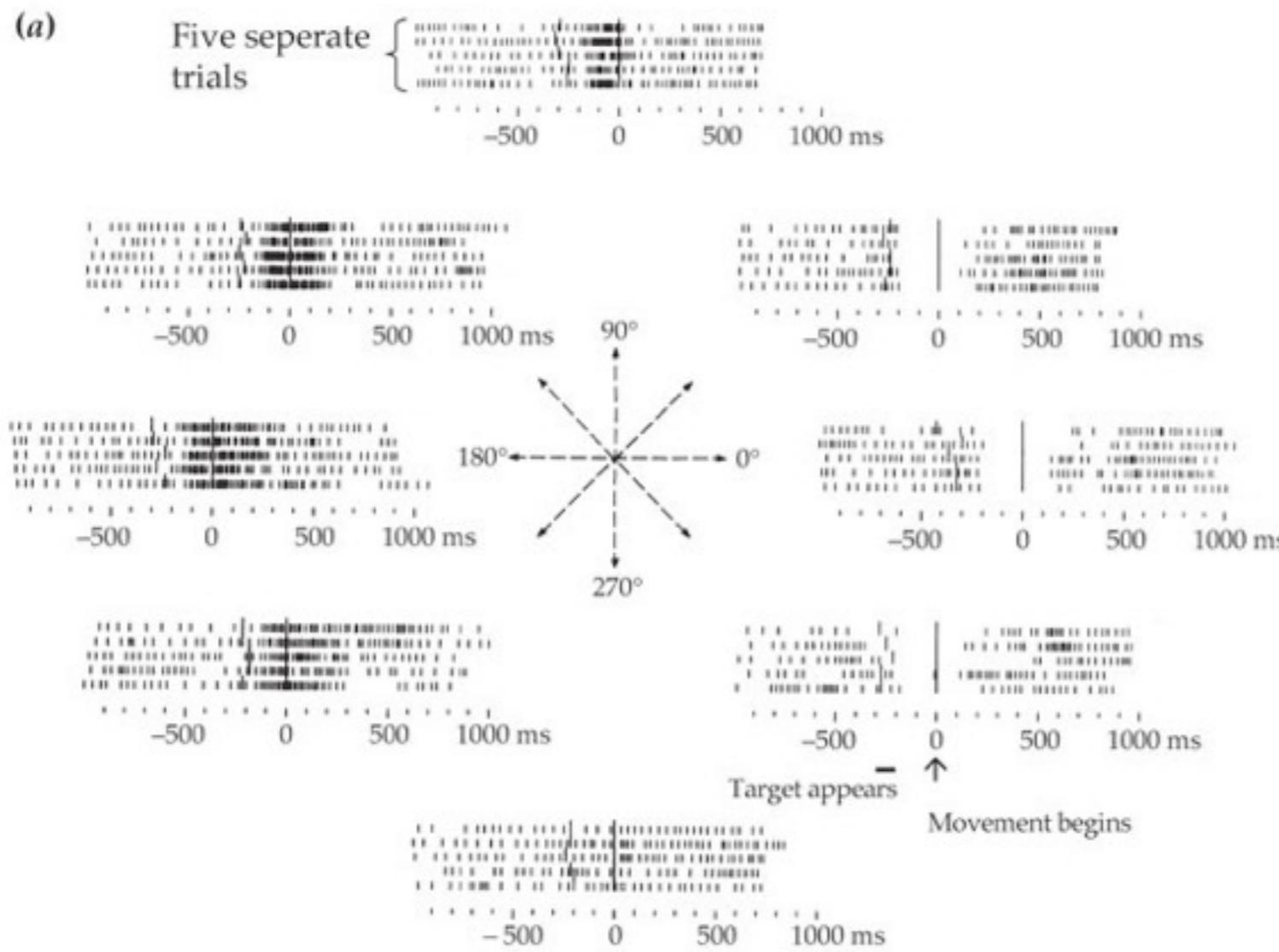


Swanson 8.3

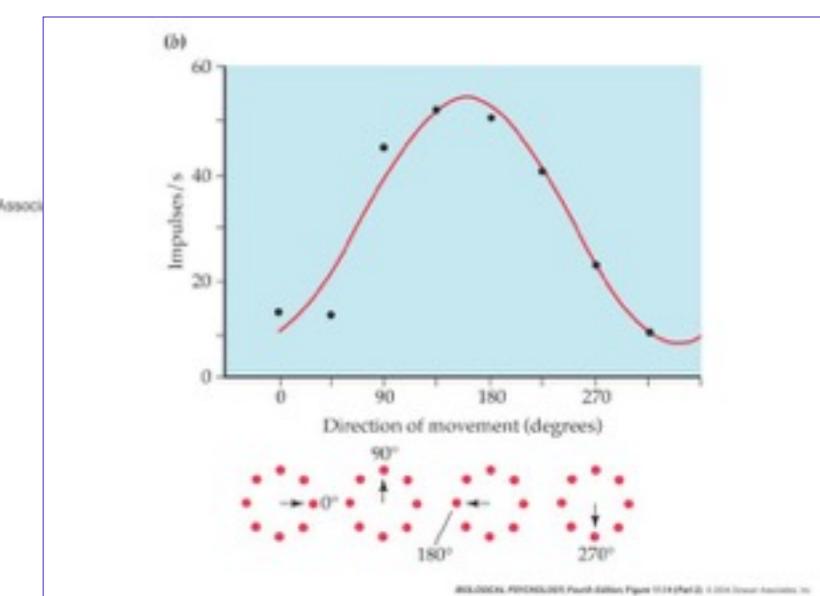
Encode muscles or  
movements?

# What does M1 encode?

- Direction of movement?

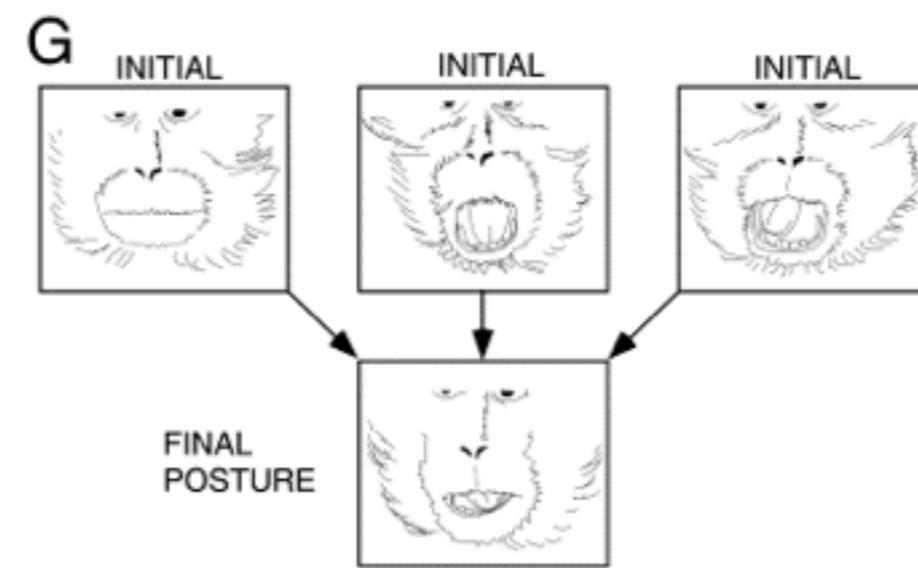
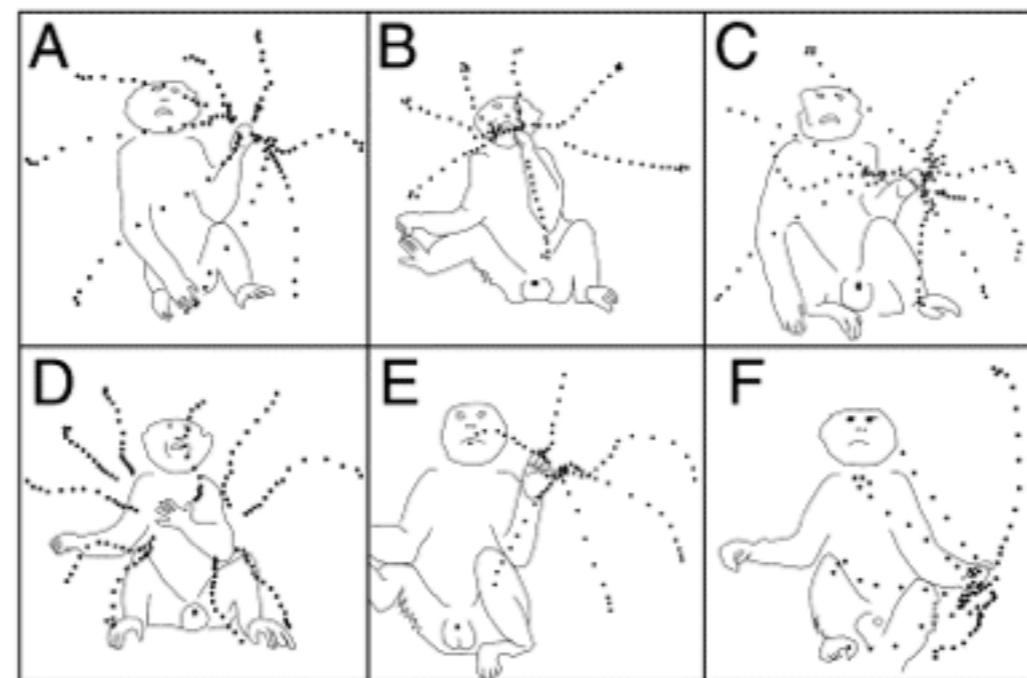


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- Longer stimulation of M1 = complex action sequences



# What does M1 encode?

- Movement patterns?

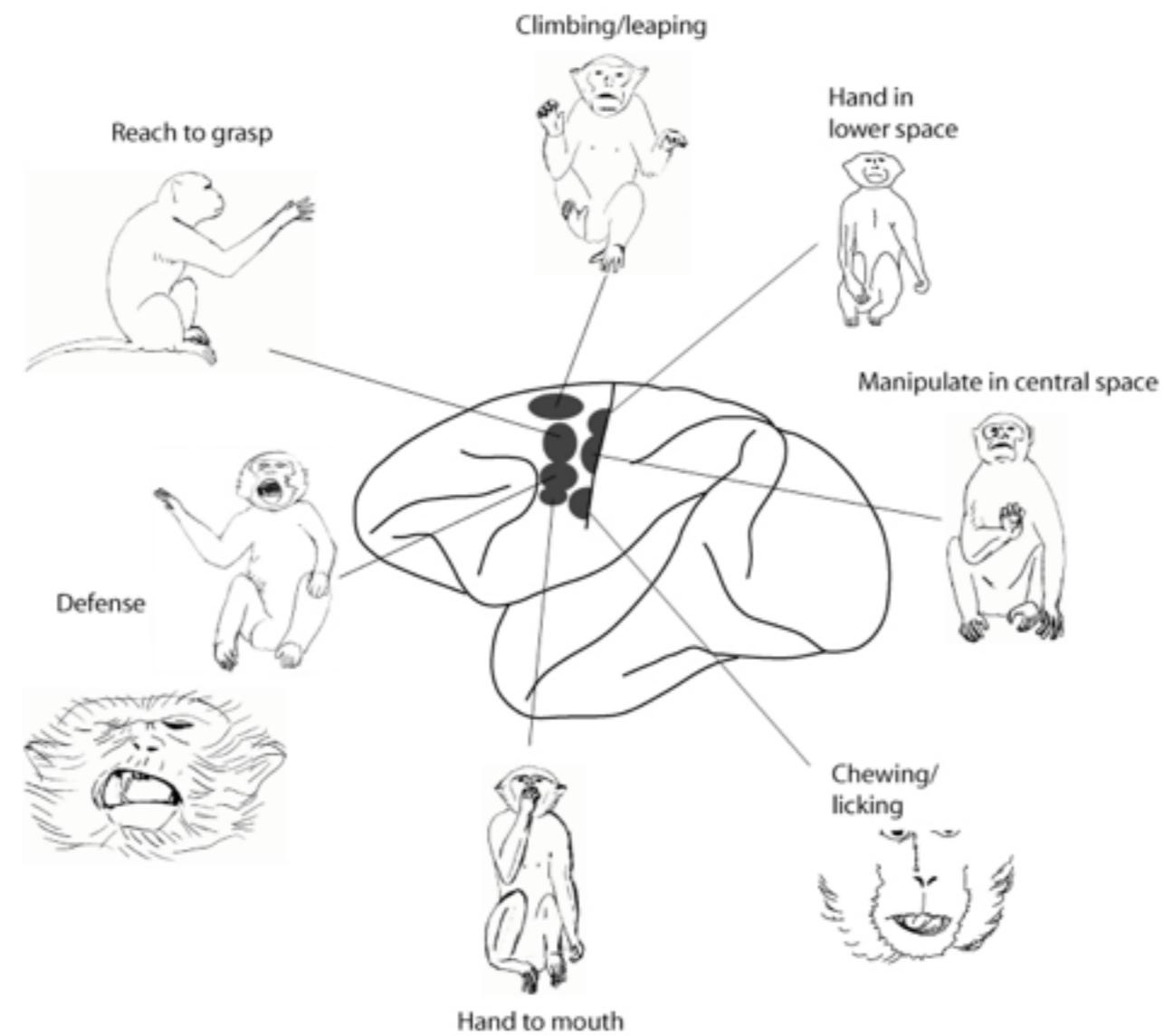


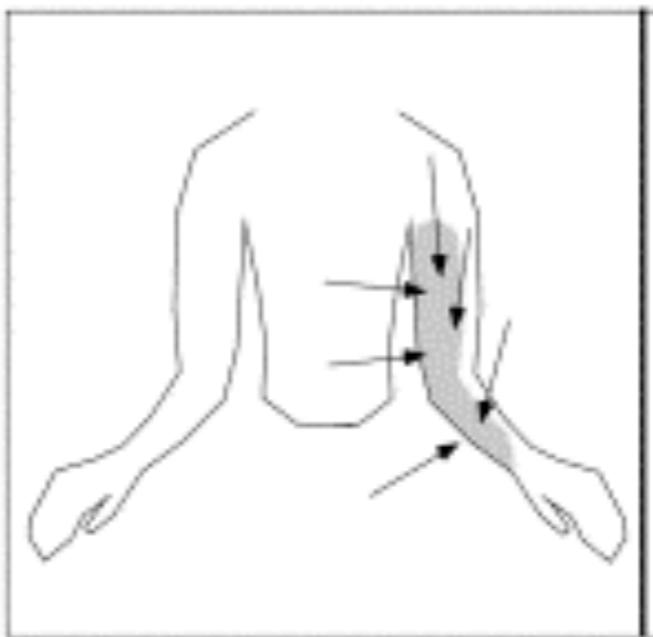
Figure 1: Seven common categories of movement evoked by electrical stimulation of the monkey motor cortex on a behaviorally relevant time scale.

# Multimodal integration

- Neurons sensitive to visual AND tactile stimulation
- Evoke arm movement when stimulated

TACTILE AND VISUAL  
RECEPTIVE FIELDS

A



EVOKED POSTURE

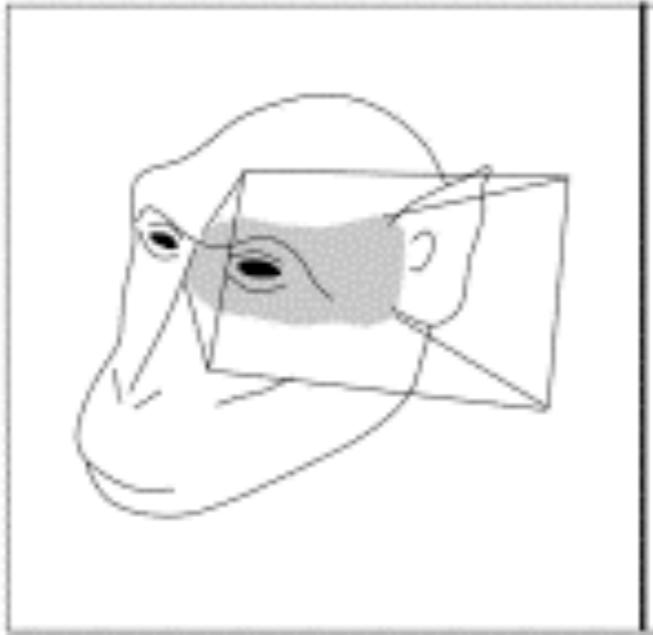
SIDE VIEW



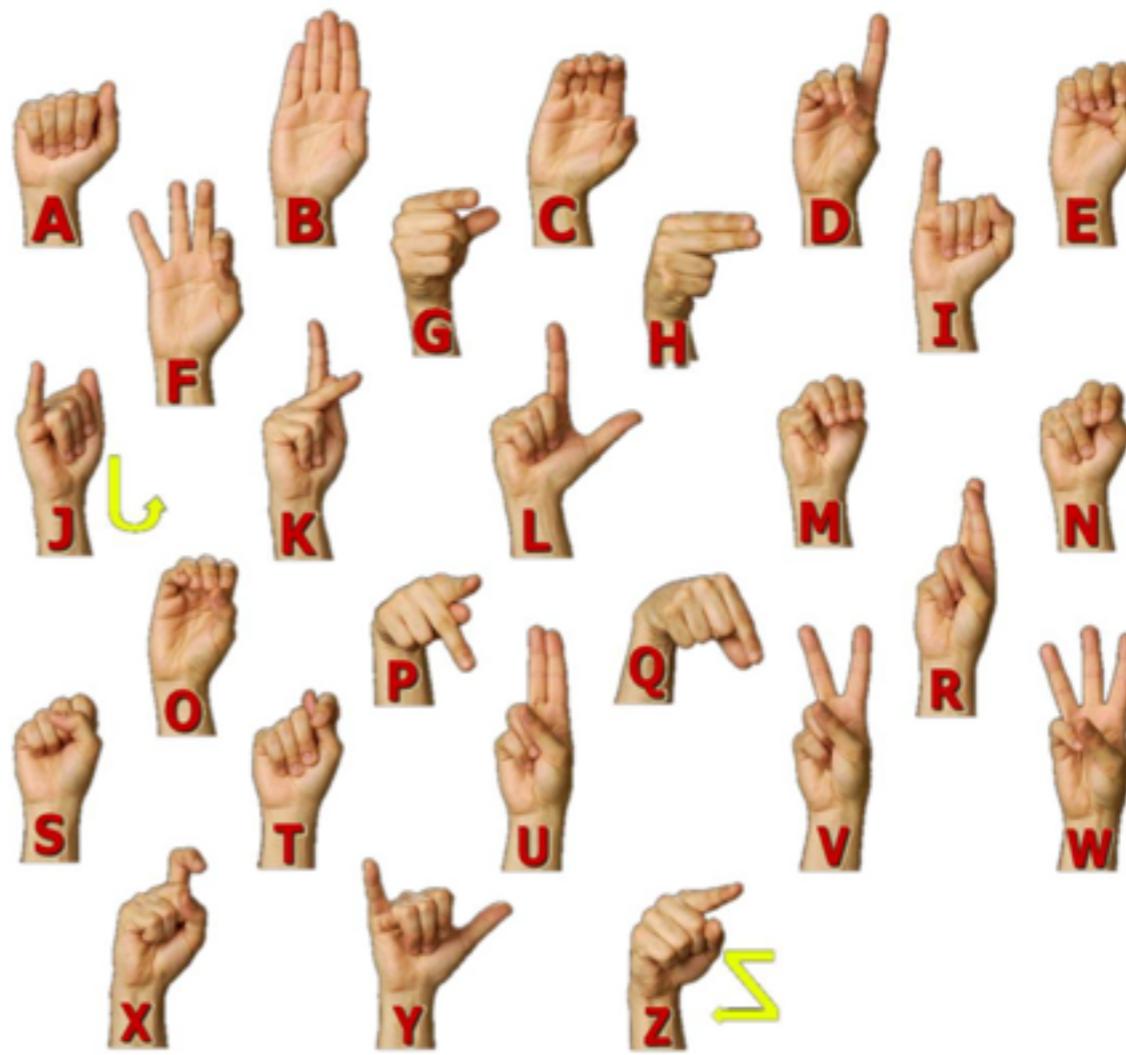
BACK VIEW



B



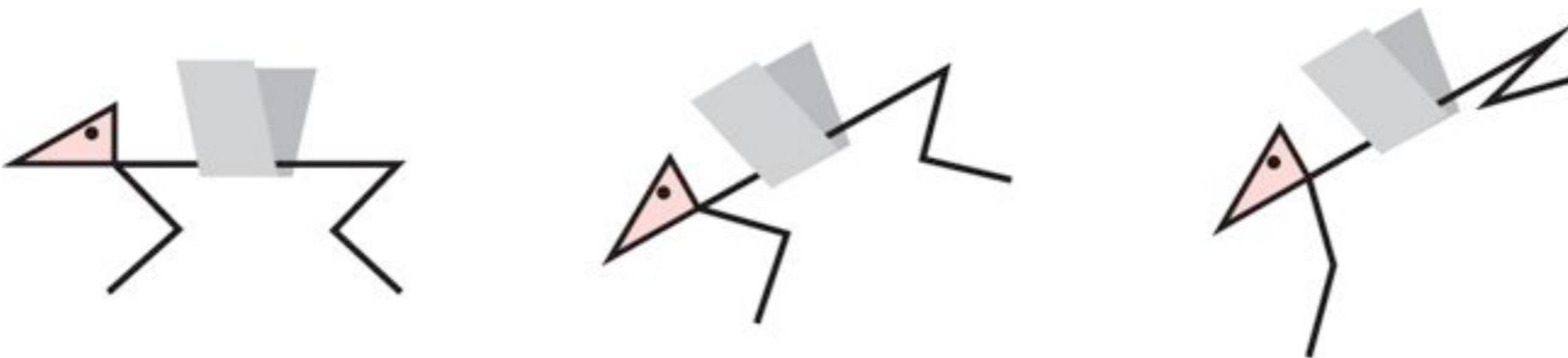
# Fine vs. coarse control

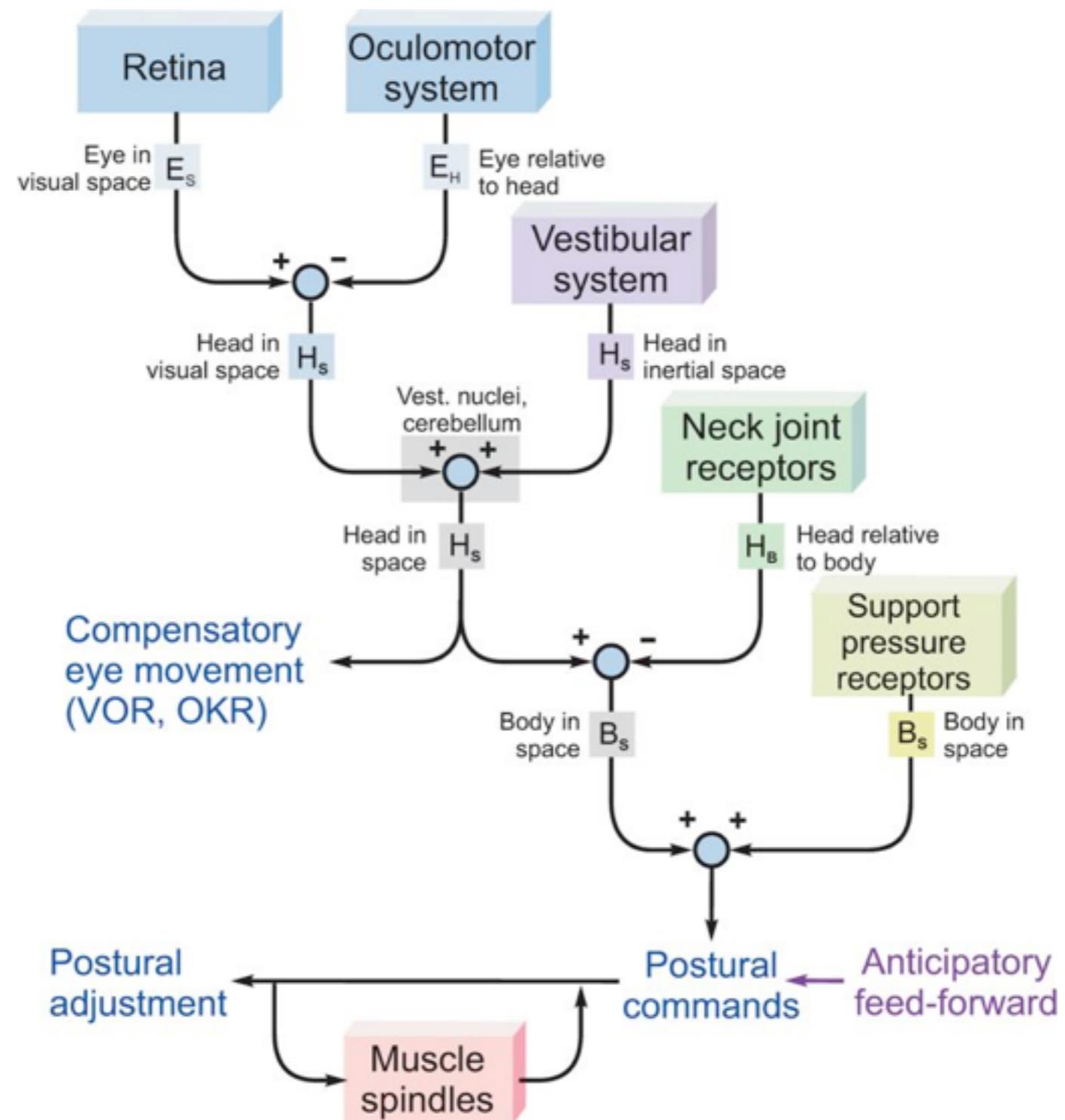


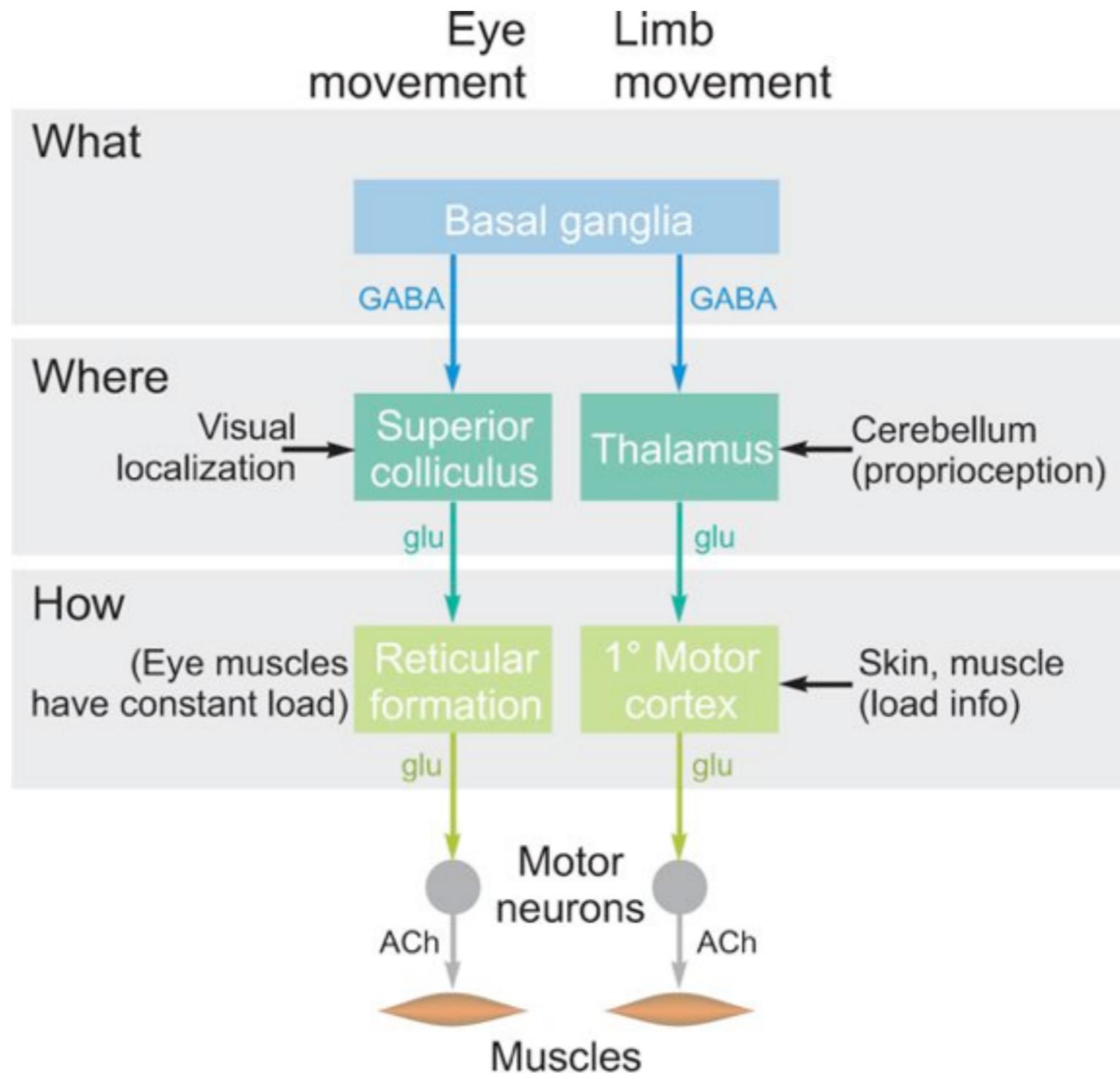
# Processing hierarchy

# Posture

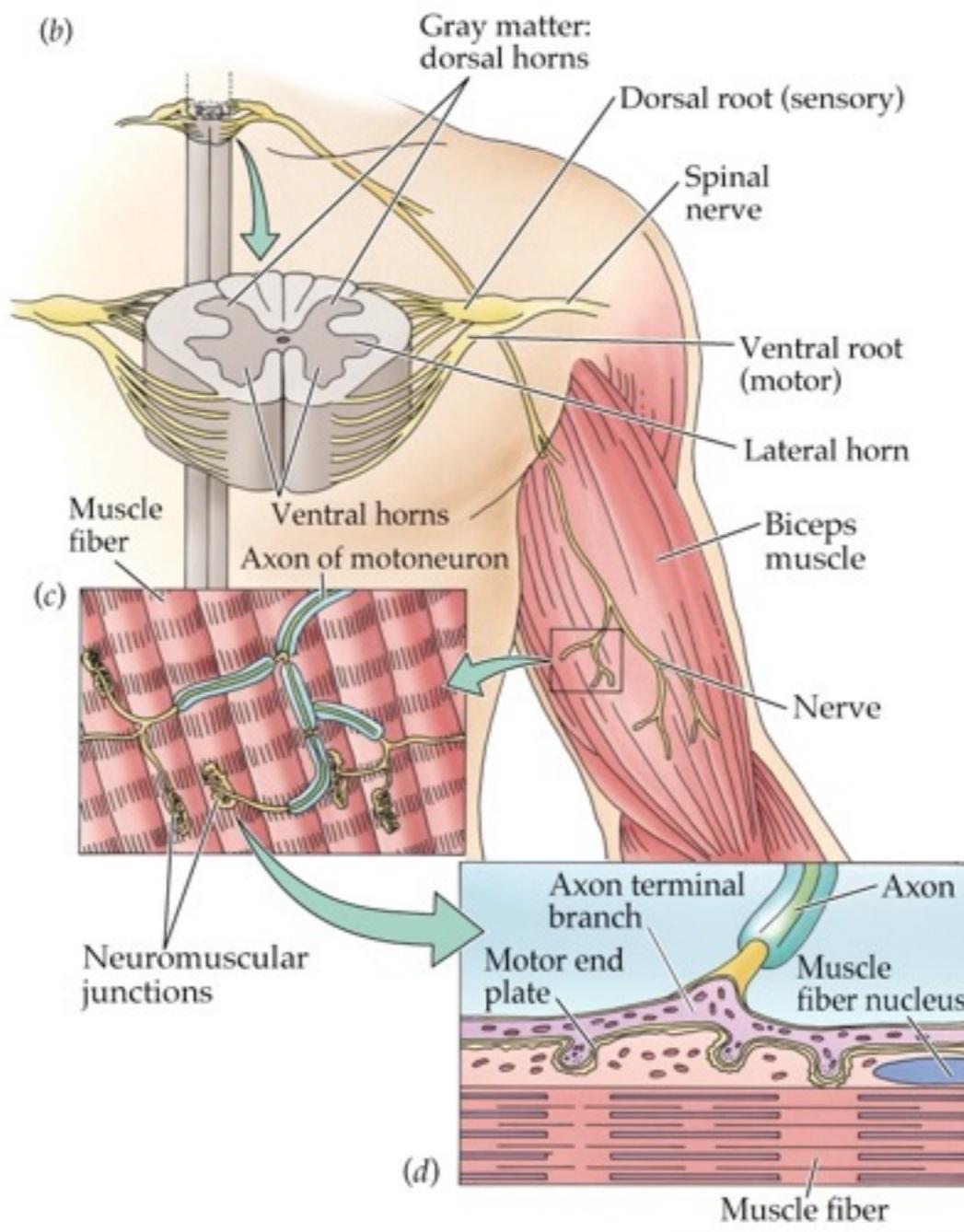
- Pressure, position receptors
- Vestibular receptors
- Change body, limb, neck, eye position



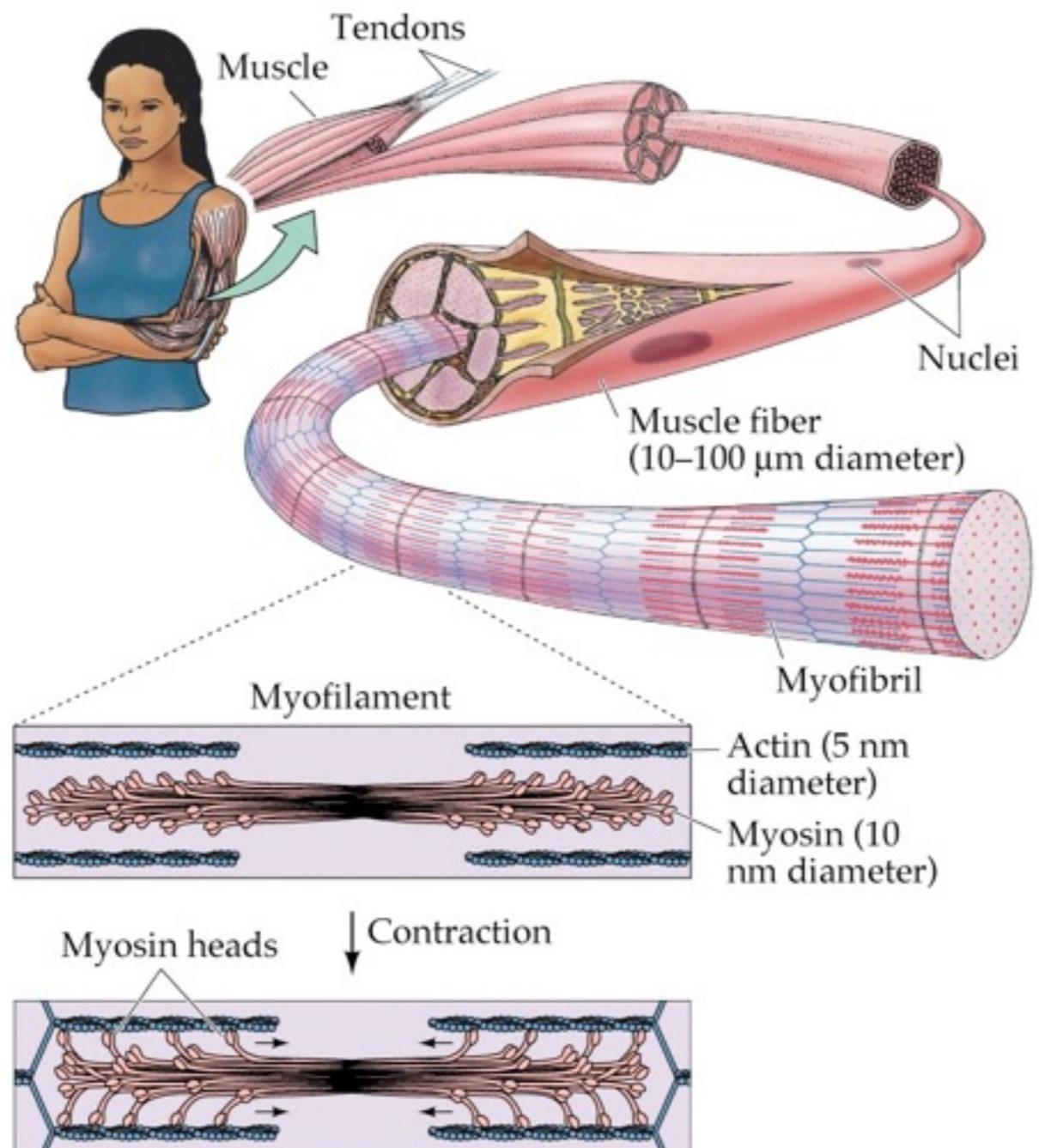




Sensorimotor  
feedback

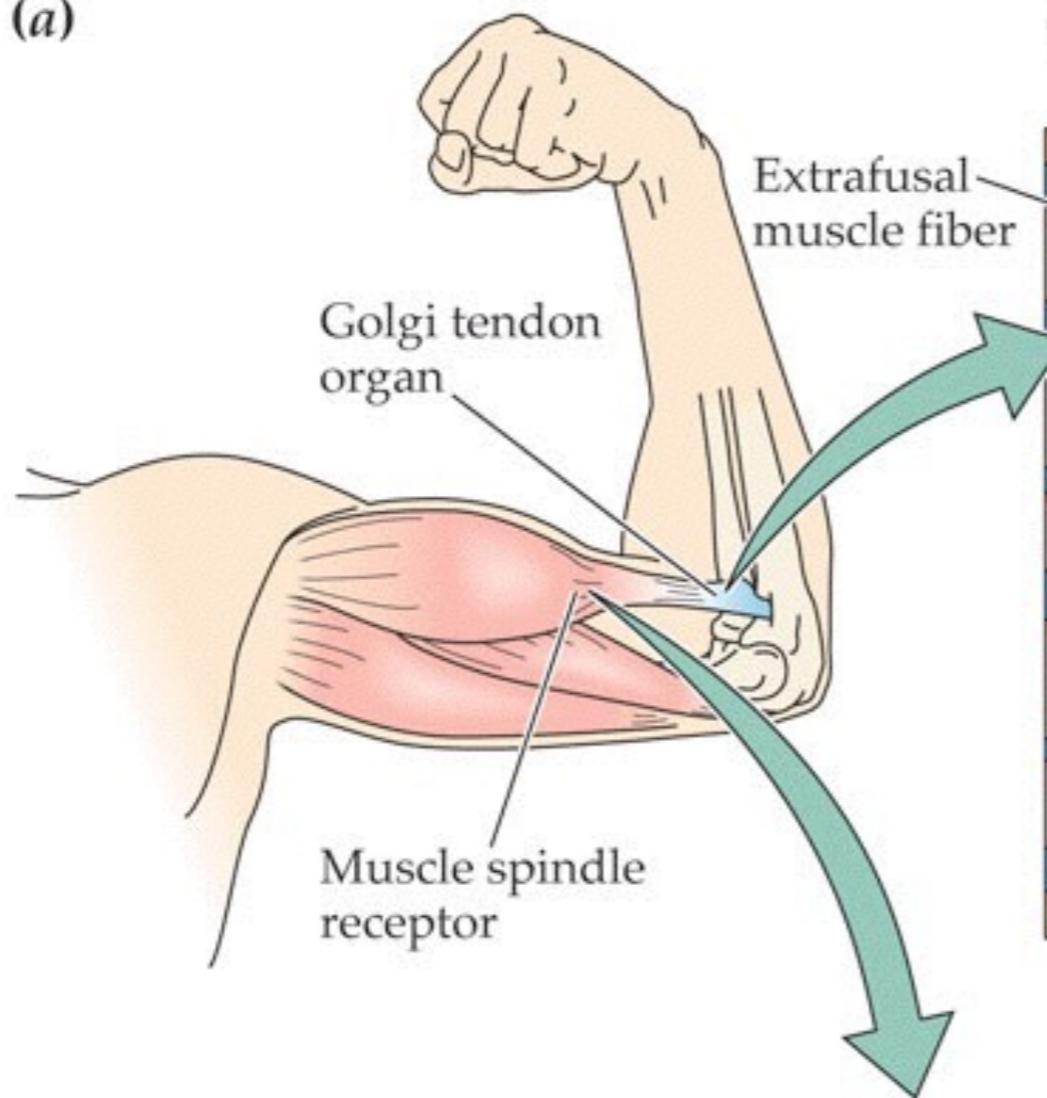


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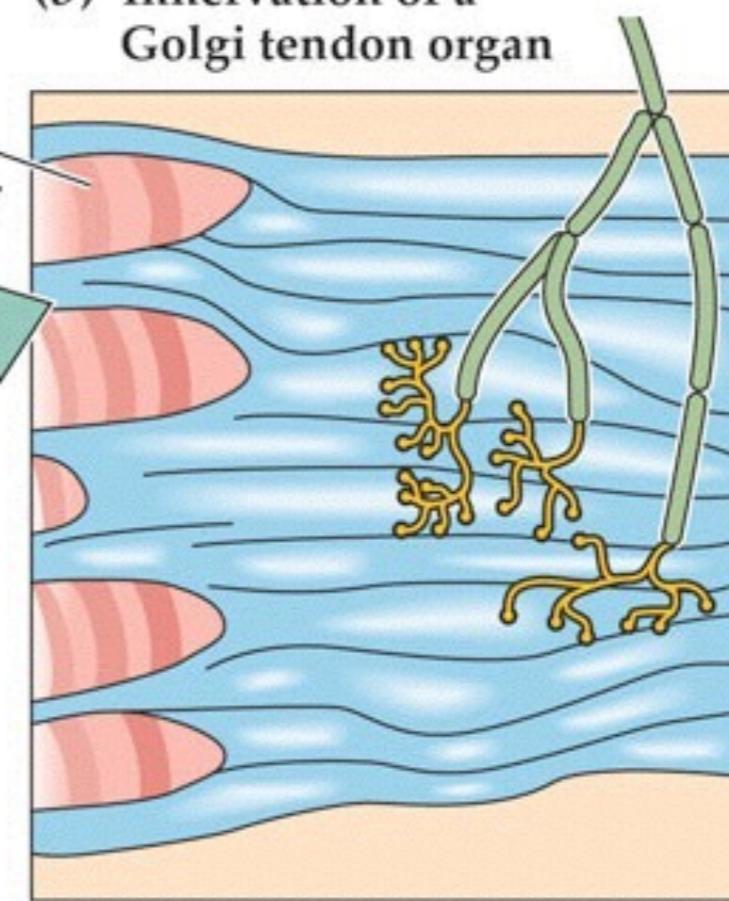


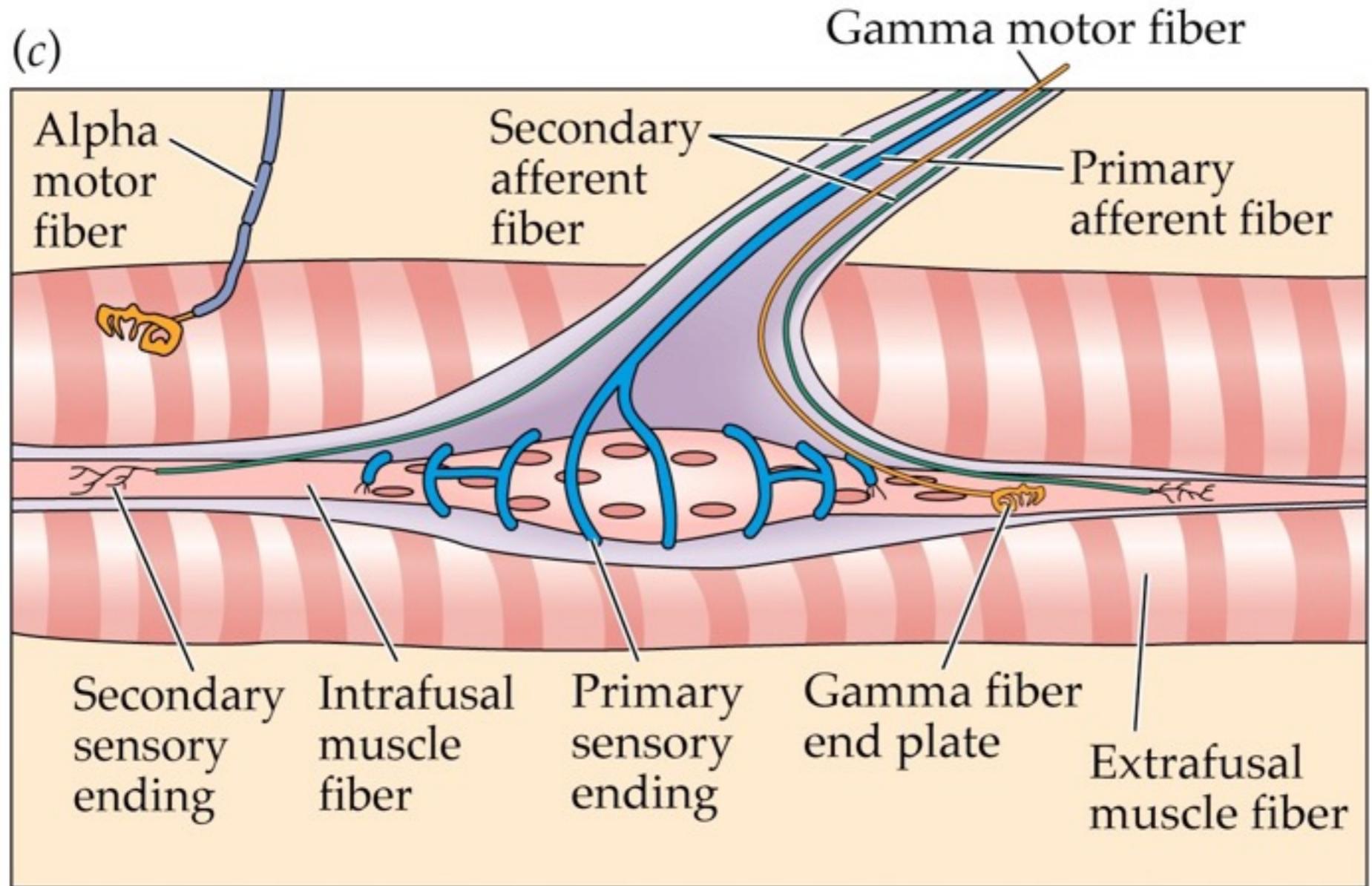
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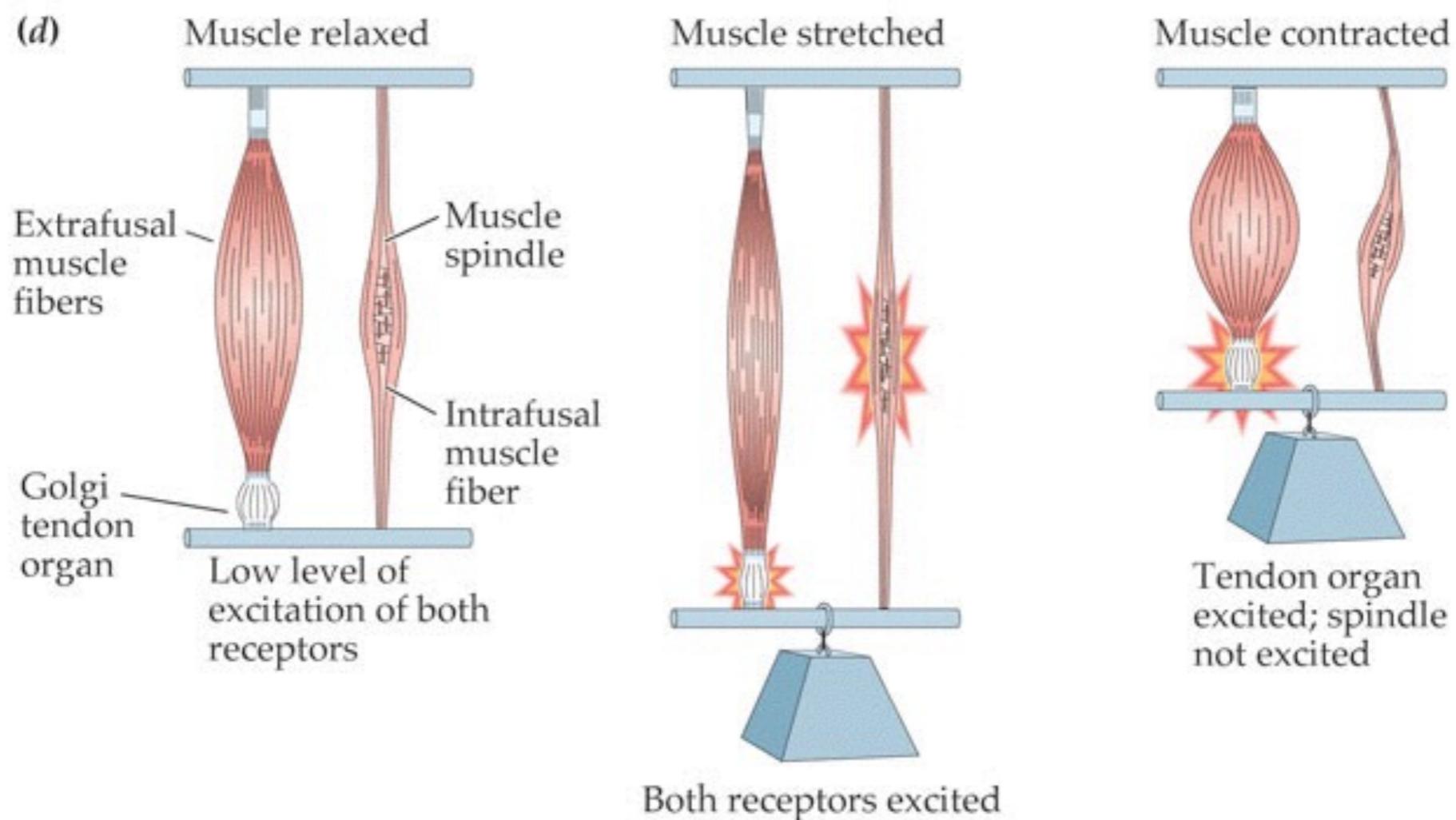
(a)

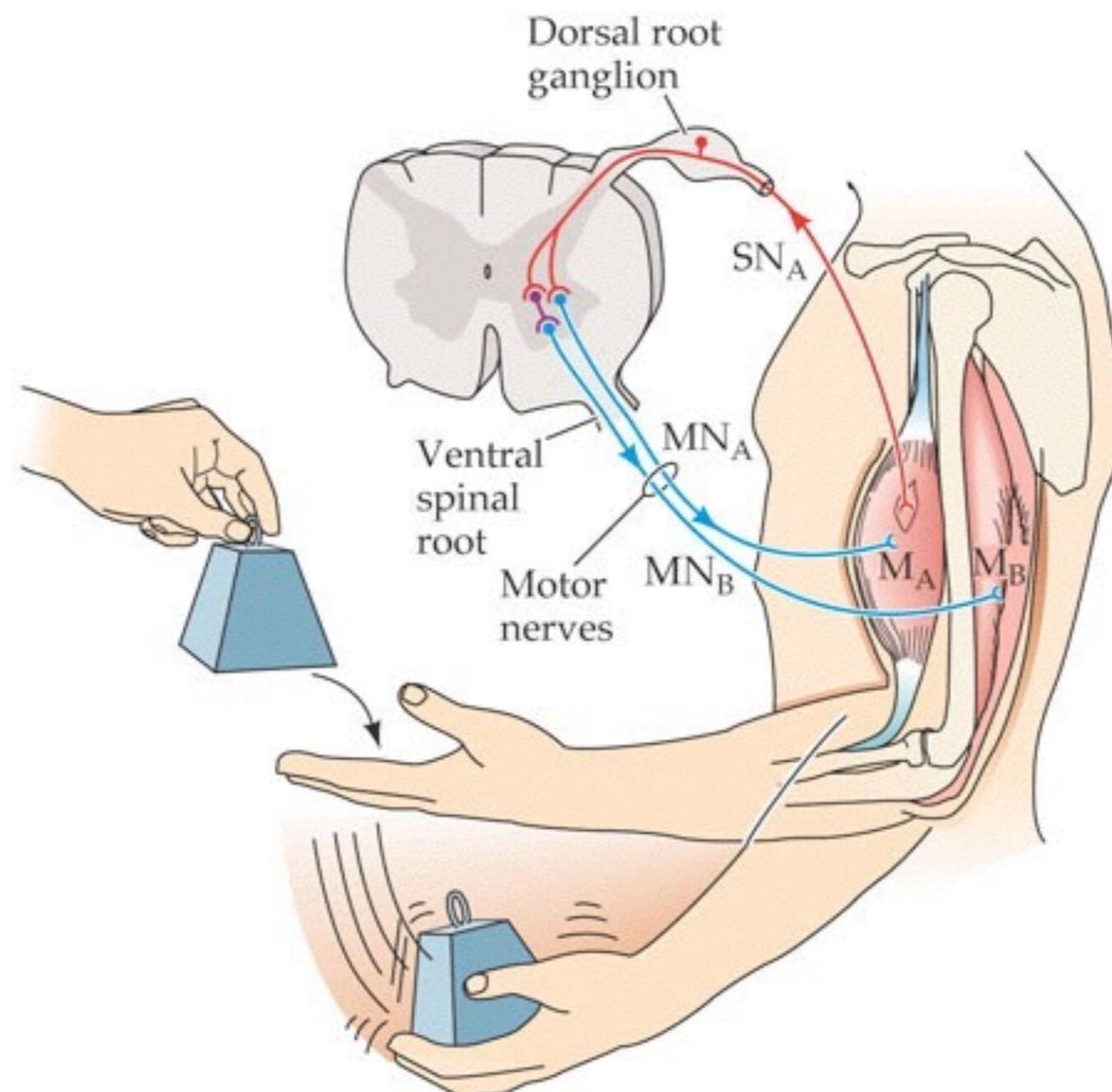


(b) Innervation of a  
Golgi tendon organ

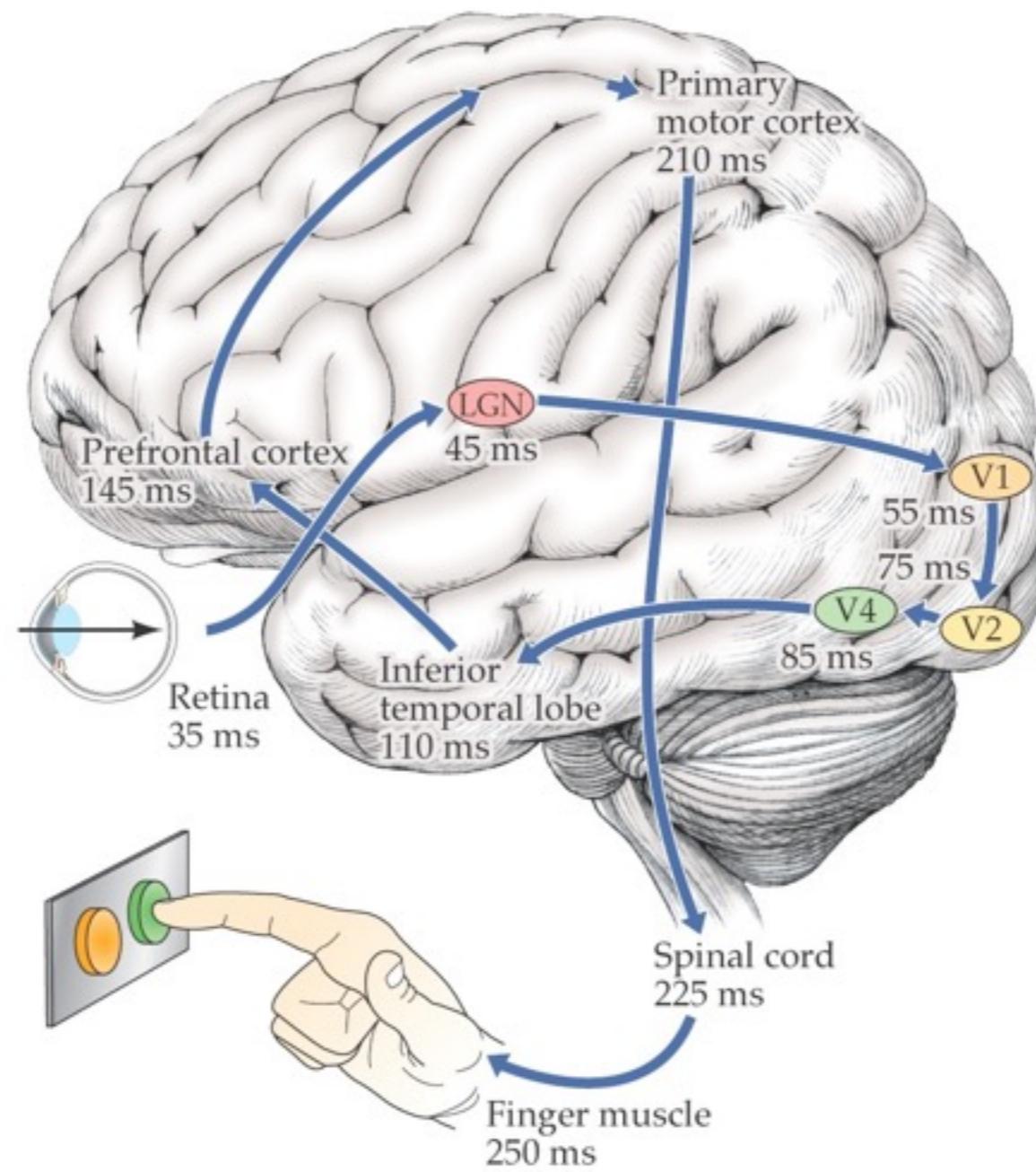








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