

Aalborg University PhD course April-May, 2011

## MUSIC AND NEUROSCIENCE

An introduction to Antonio Damasio:  
Self Comes to Mind (2010)  
and the embodiment of music

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Damasio's central idea

The BODY is a foundation of  
THE CONSCIOUS MIND

# Relationships with phenomenology: Embodiment and the unity of senses

Sound permeates and penetrates my bodily being (...)  
Its bodily involvement comprises  
the range from soothing pleasure to the point of insanity  
in the continuum of possible sound in music and noise.  
Listening begins by being bodily global in its effects.

Don Ihde: *Listening and Voice* (1976/2007:45)

The theory of the body is already a theory of perception.  
Our own body is in the world as the heart is in the organism:  
it keeps the visible spectacle constantly alive,  
it breathes life into it and sustains it inwardly,  
and with it forms a system.

Merleau-Ponty: *Phenomenology of Perception* (1945/2002:235)

The body is a foundation of the mind

What is mind?

MIND is

a mental stream of organized images  
which may be unconscious or conscious

# Images in the mind

may have any kind of sense origin:

visual  
tactile  
smell

auditory  
visceral  
taste

Images are created by mapping

The brain maps  
the world  
the body  
and its own doings

Maps are momentary patterns  
which can be experienced as  
images in the mind

CONSCIOUS MIND = MIND + SELF

Conscious minds begin when self comes to mind,  
when brains add a self process to the mind mix,  
modestly at first but quite robustly later

(Damasio 2010:22)

✓

The MIND is a process: a flowing mix of images

The SELF is also a process

The self is the process of knowing, which is  
present whenever we are conscious

Self adds subjectivity to the mind



Central idea:

**FEELING**

pervades the images we perceive subjectively

The self is always felt

Three stages of SELF:

PROTOSELF

CORE SELF

AUTOBIOGRAPHICAL SELF

PROTOSELF is

The feeling of knowing that my body exists

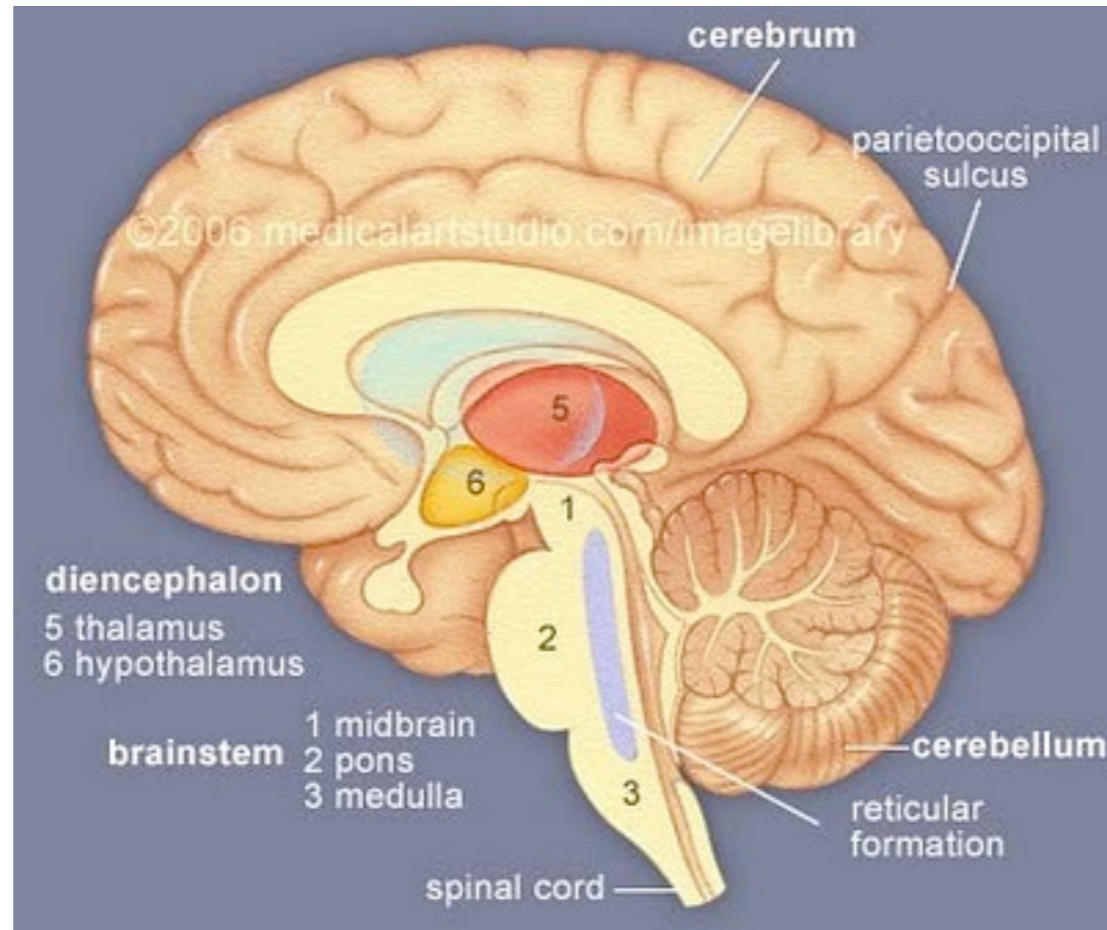
This is a PRIMORDIAL FEELING  
generated in the BRAIN STEM.

It has a valence:

a degree of

pain ←————→ pleasure

# Brain stem - Thalamus - Cortex



## Three stages of self:

First stage: THE PROTOSELF is the primordial feeling of knowing that my body exists

Second stage: THE CORE SELF is the feeling of knowing what happens: my organism has relationships to objects and events and I can act upon them

Third stage:

**THE AUTOBIOGRAPHICAL SELF** is  
the feeling of knowing  
that I am me and I have a memory

I know that I have a past and a future  
and social and cultural relations

What is the difference between feelings and emotions?

Feelings and emotions are distinguishable processes:

### EMOTIONS

are complex, largely automated programs  
of **ACTIONS** carried out in the body

### FEELINGS

are images of **EMOTIONS**:  
**PERCEPTIONS** executed in brain maps

## Central idea

All feelings of emotions  
are complex variations on  
**PRIMORDIAL FEELINGS**

generated in the  
**BRAIN STEM**



# Certain brain stem nuclei produce NEUROTRANSMITTERS

which are essential for

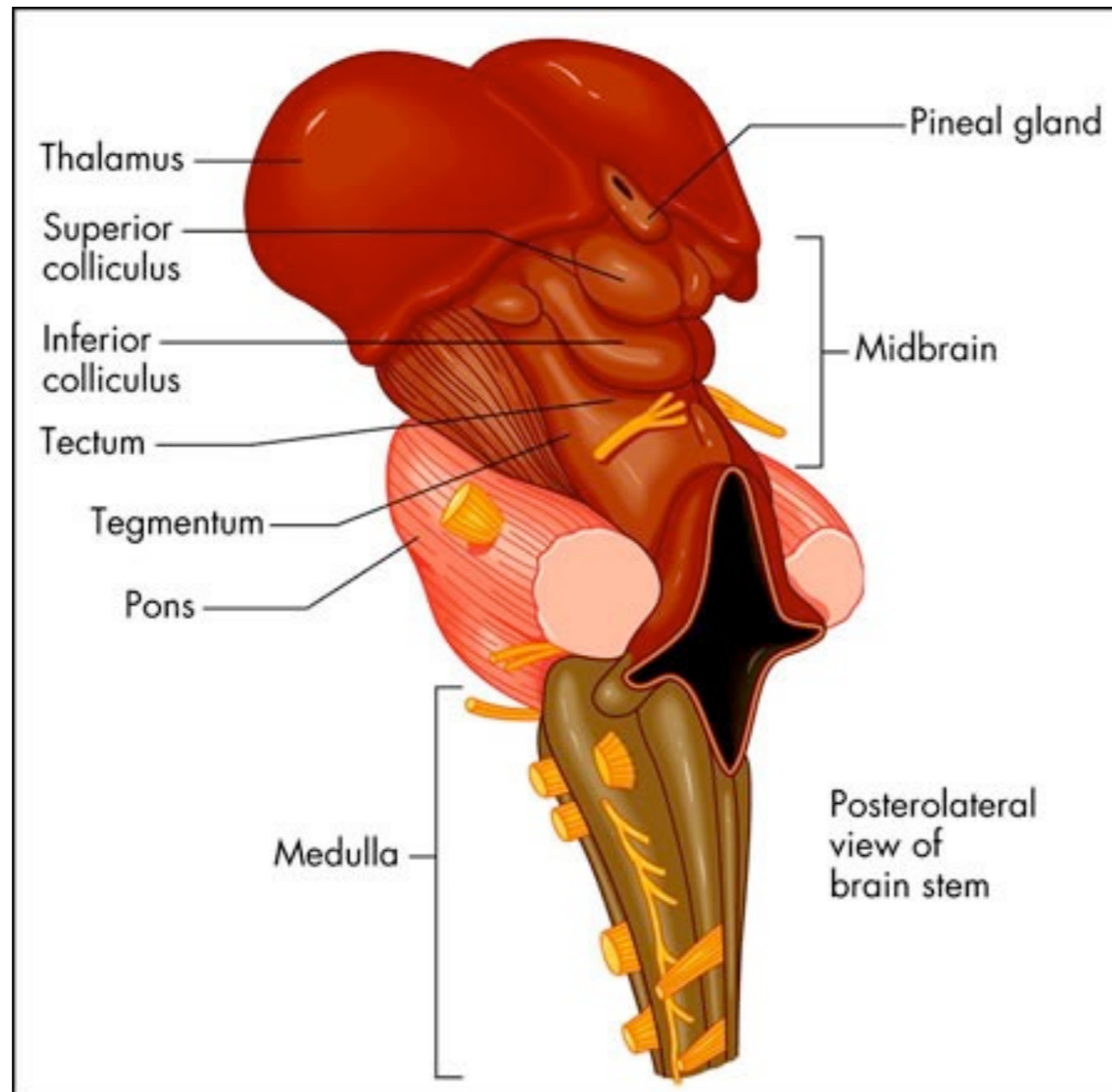
Arousal systems: Panksepp (1998, 2009)

Value systems: Edelman & Tononi (2000)

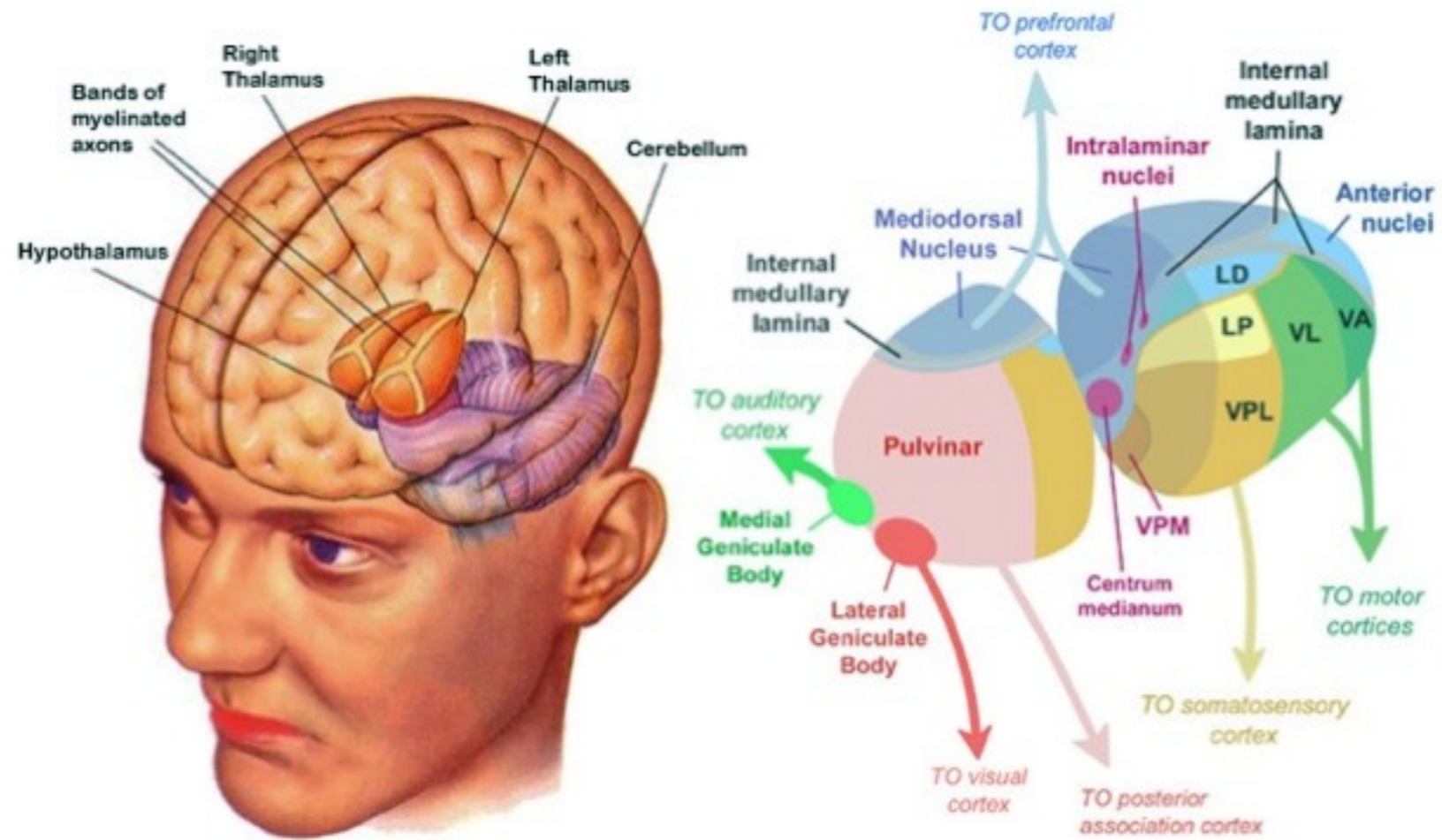
Vitality affects, Forms of vitality: Stern (2004, 2010)

Background feelings, Primordial feelings: Damasio (1999, 2010)

# The Brain stem and Thalamus



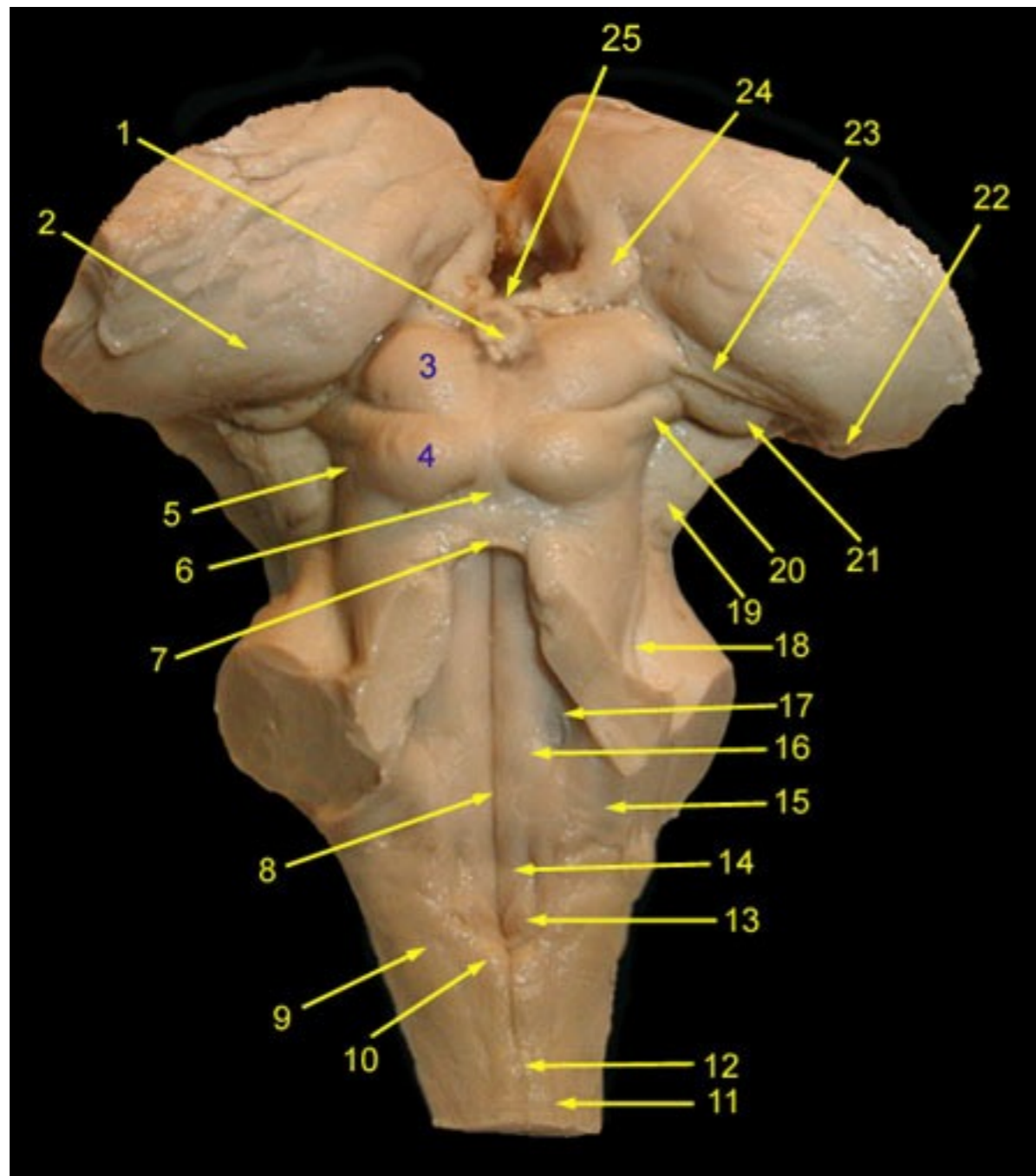
# Thalamus connections



**The BRAIN STEM**  
processes information needed to  
represent the body and control its life

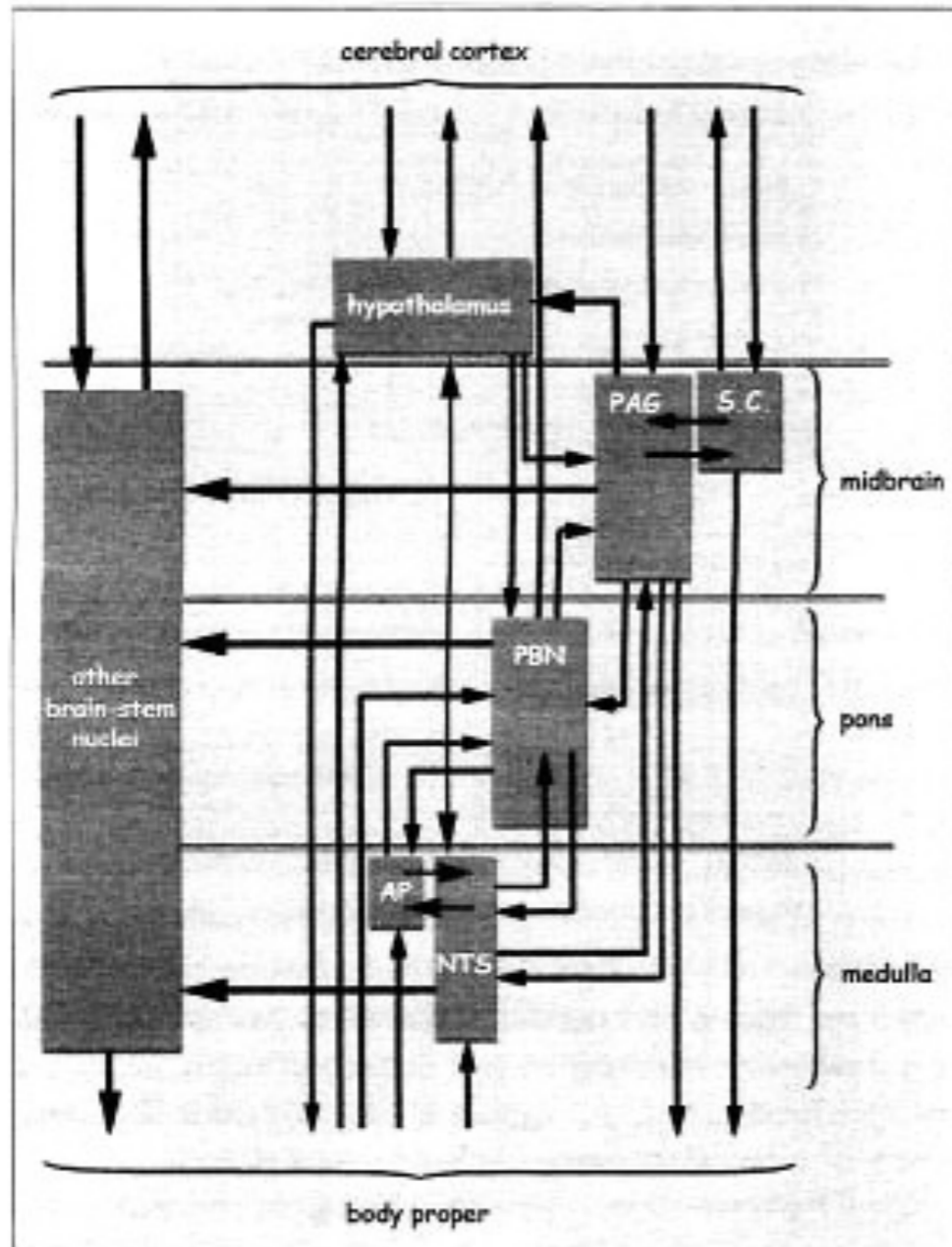
**The THALAMUS**  
disseminates signals from the BRAIN STEM  
to a widespread territory of the CORTEX

# The Brain Stem and Thalamus



1. Pineal gland
2. Thalamus ( Pulvinar )
3. Superior colliculus
4. Inferior colliculus
5. Lemniscal trigone
6. Frenulum veli
7. Superior medullary velum
8. Median sulcus
9. Gracile tubercle
10. Cuneate tubercle
11. Posterior intermediate sulcus
12. Posteromedian sulcus
13. Vagal trigone
14. Hypoglossal trigone
15. Striae medullares
16. Facial colliculus
17. Locus coeruleus
18. Parabrachial recess
19. Crus cerebri
20. Inferior collicular brachium
21. Medial geniculate body
22. Lateral geniculate body
23. Superior collicular brachium
24. Habenula
25. Habenular commissure

# Damasio's schematic illustration of brain stem nuclei and connections



(Thalamus is not shown)

Hypothalamus

SC: Superior colliculus

PAG: Periaqueductal Grey

PBN: Parabrachial Nucleus

NTS: Nucleus Tractus Solitarius

AP: Area Postrema

Other brain stem nuclei  
(regulate wakefulness and release neurotransmitters to cortex)

# NEUROTRANSMITTERS produced in the brain stem:

Acetylcholine: mediates attention and arousal

Norepinephrine: sustains sensory processing

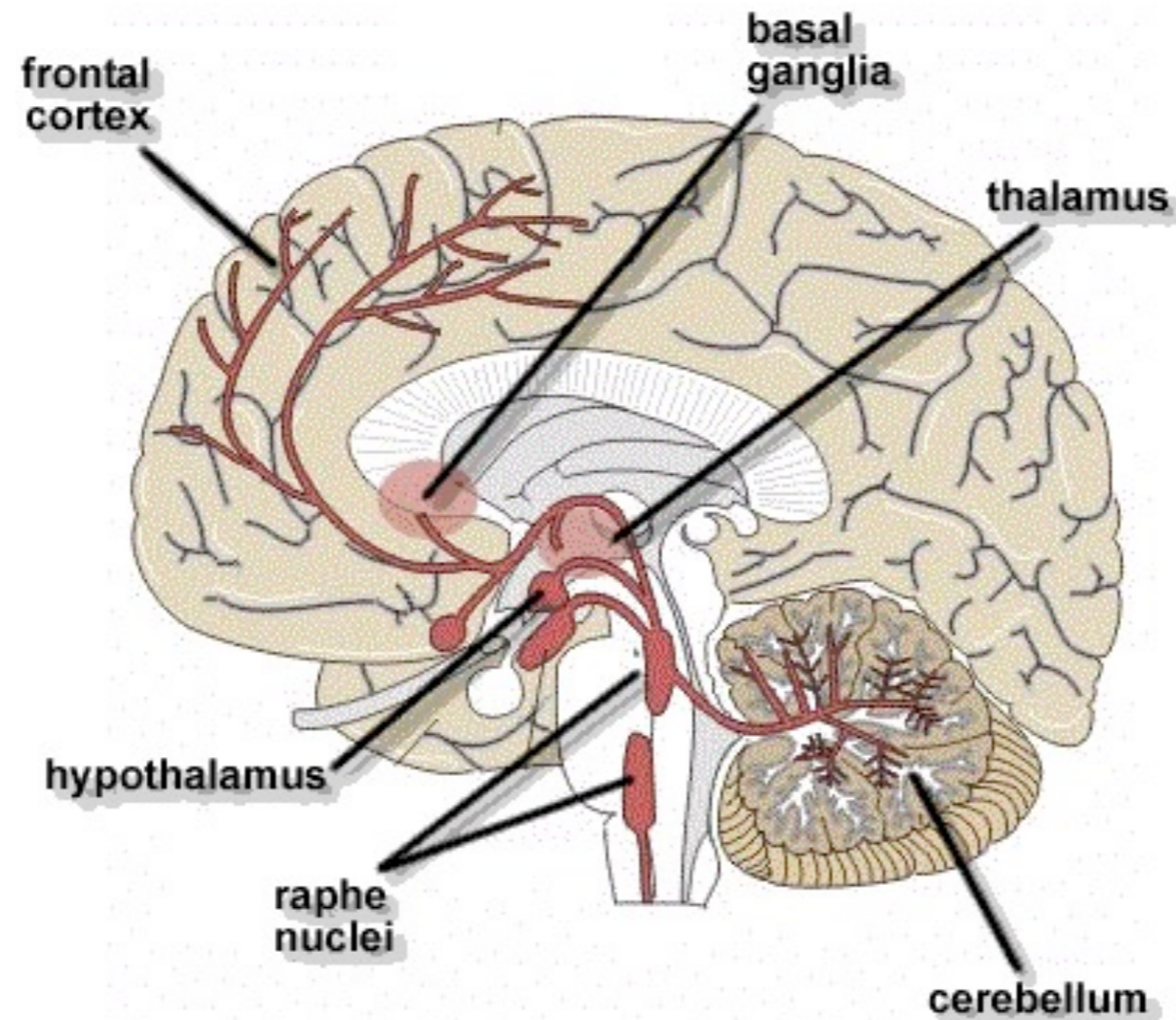
Serotonin: reduces impact of incoming information

Dopamine: maintains psychomotor and motivational focus and arousal

Panksepp: *Affective Neuroscience* (1998:107)

# An example: Serotonin distribution in the brain

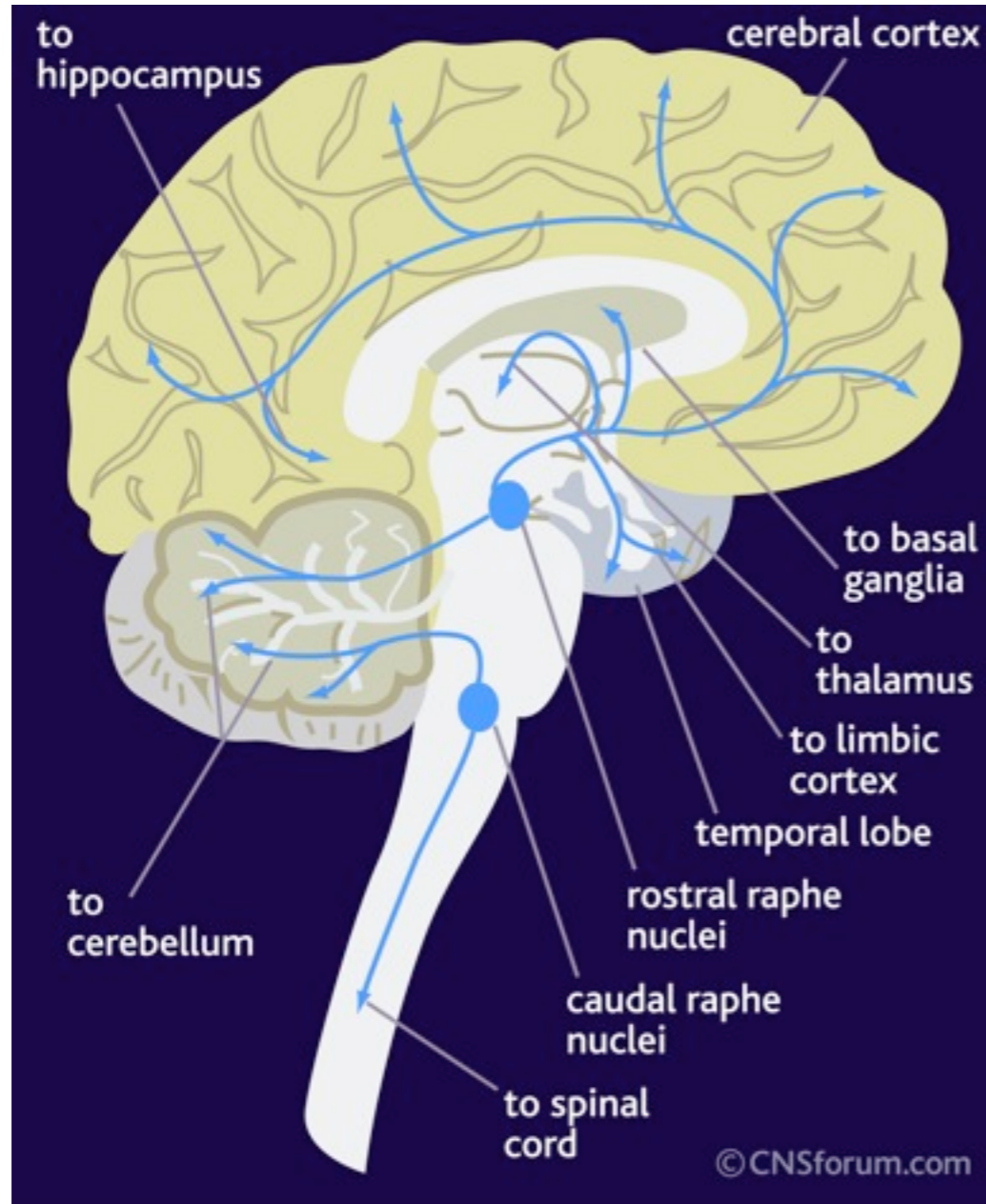
The serotonergic system consists of ascending axons from cell bodies in the raphe nuclei



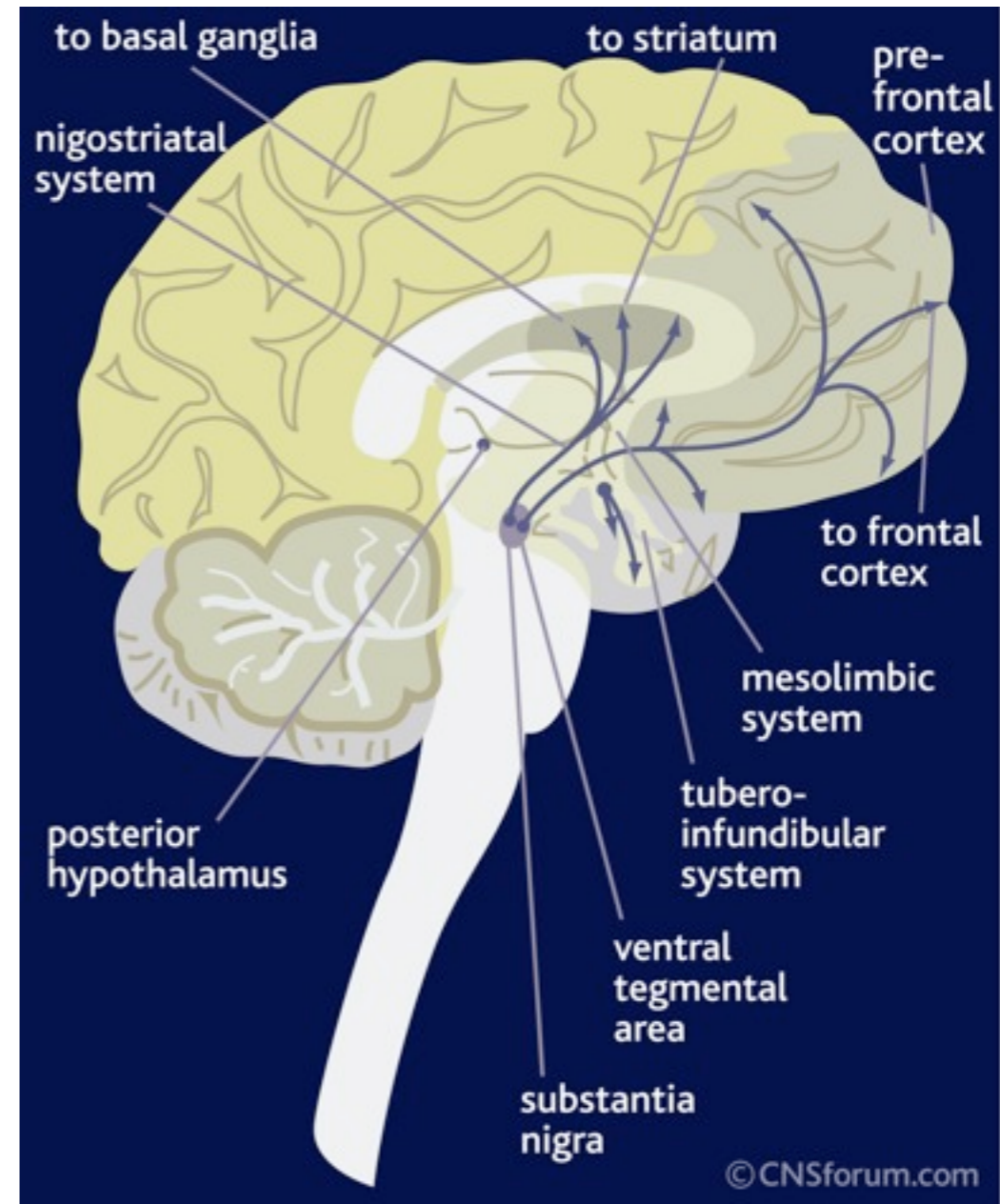


# A comparison:

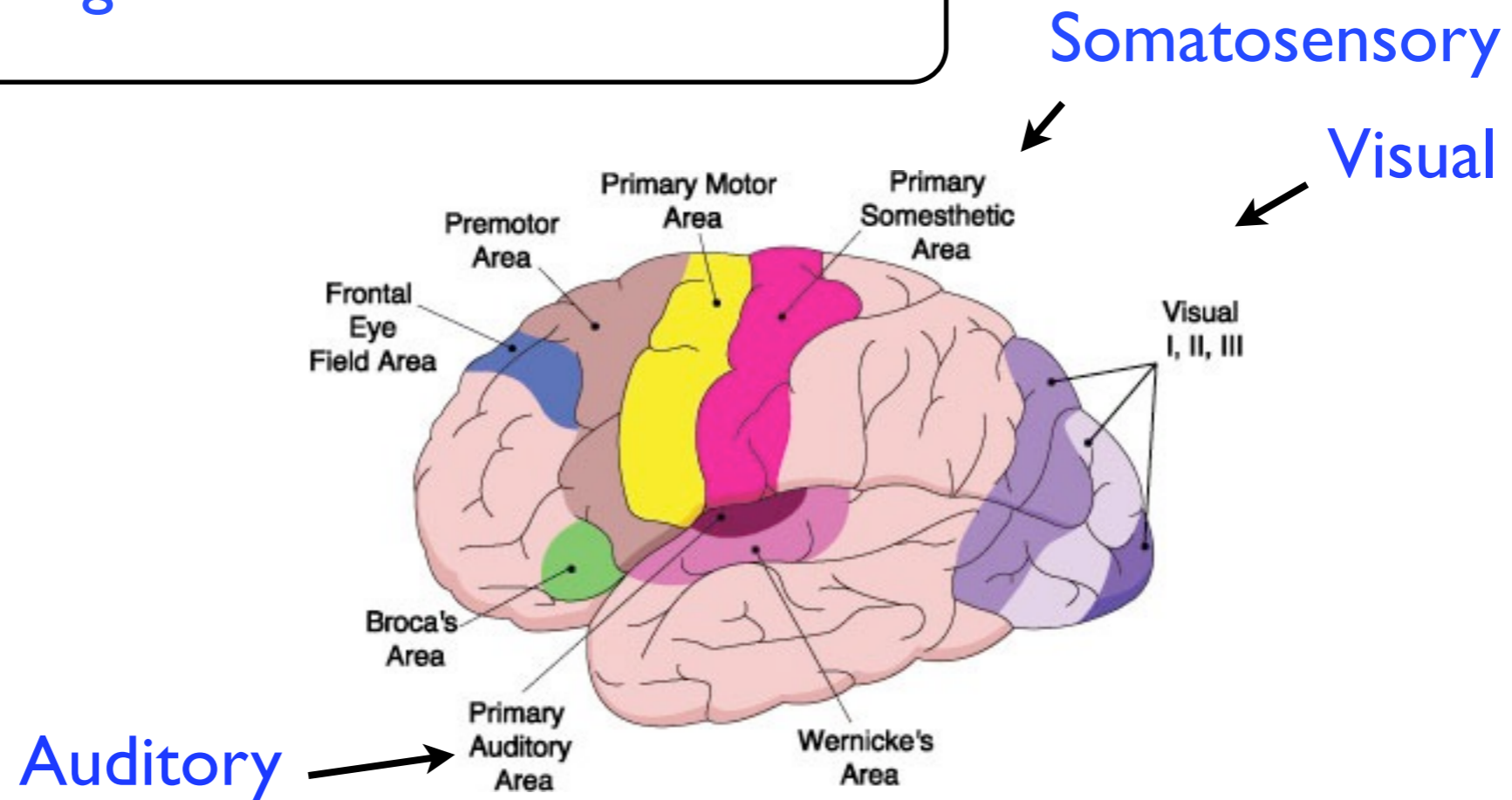
## Serotonin distribution



## Dopamin distribution

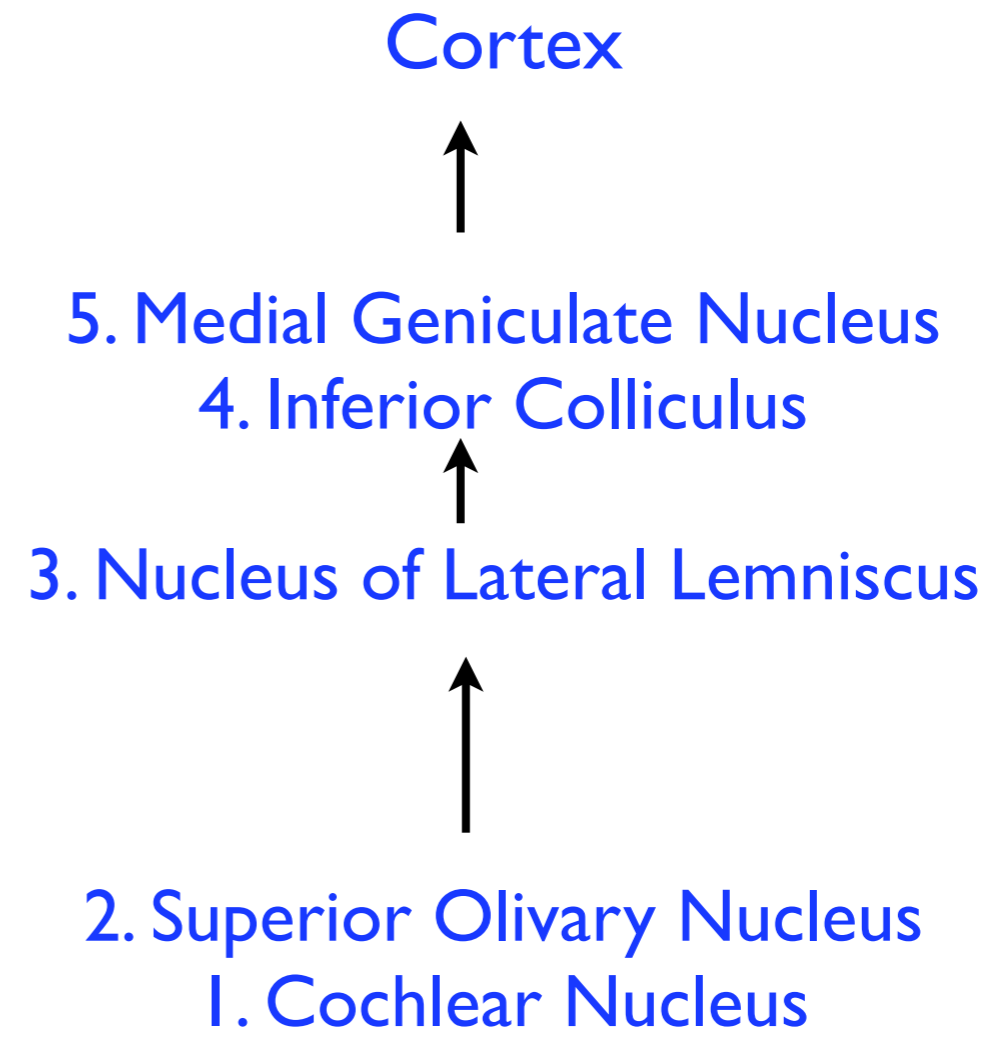
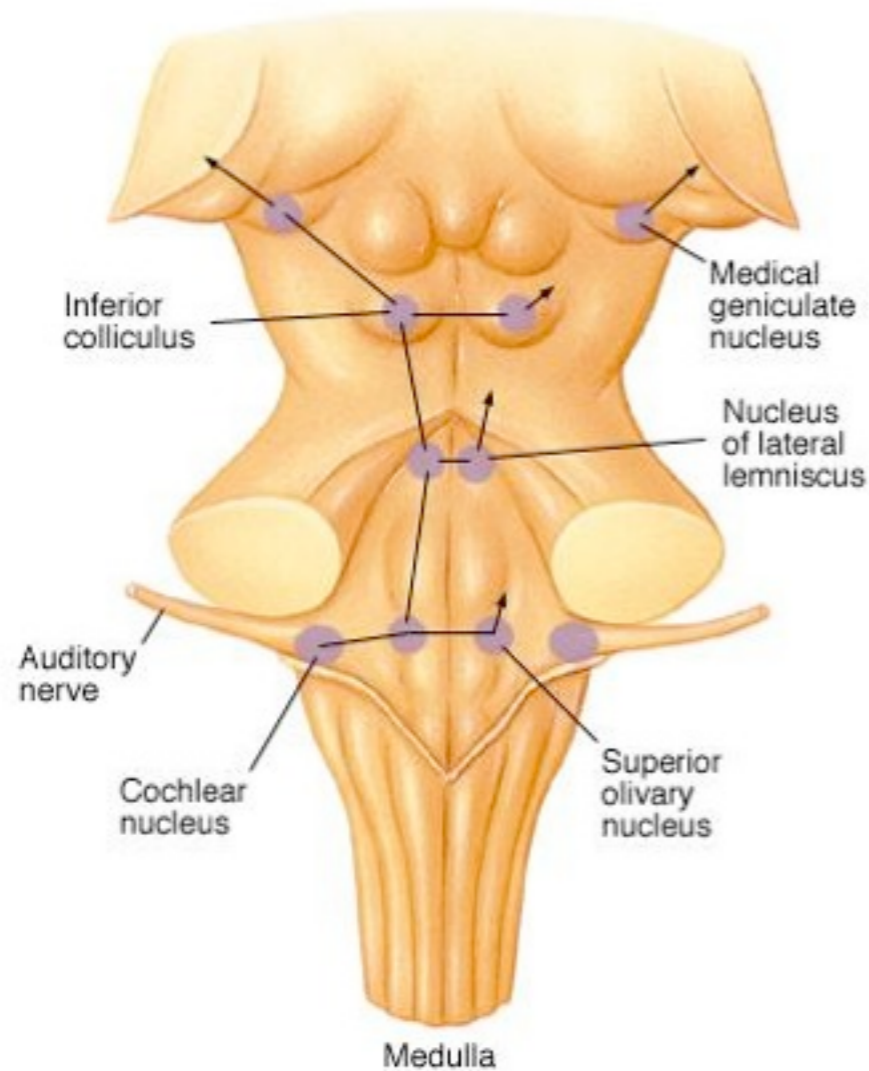


What about MUSIC? We are conscious of auditory images of music in the cortex



But before arriving in the cortex, auditory information is processed in five brain stem nuclei

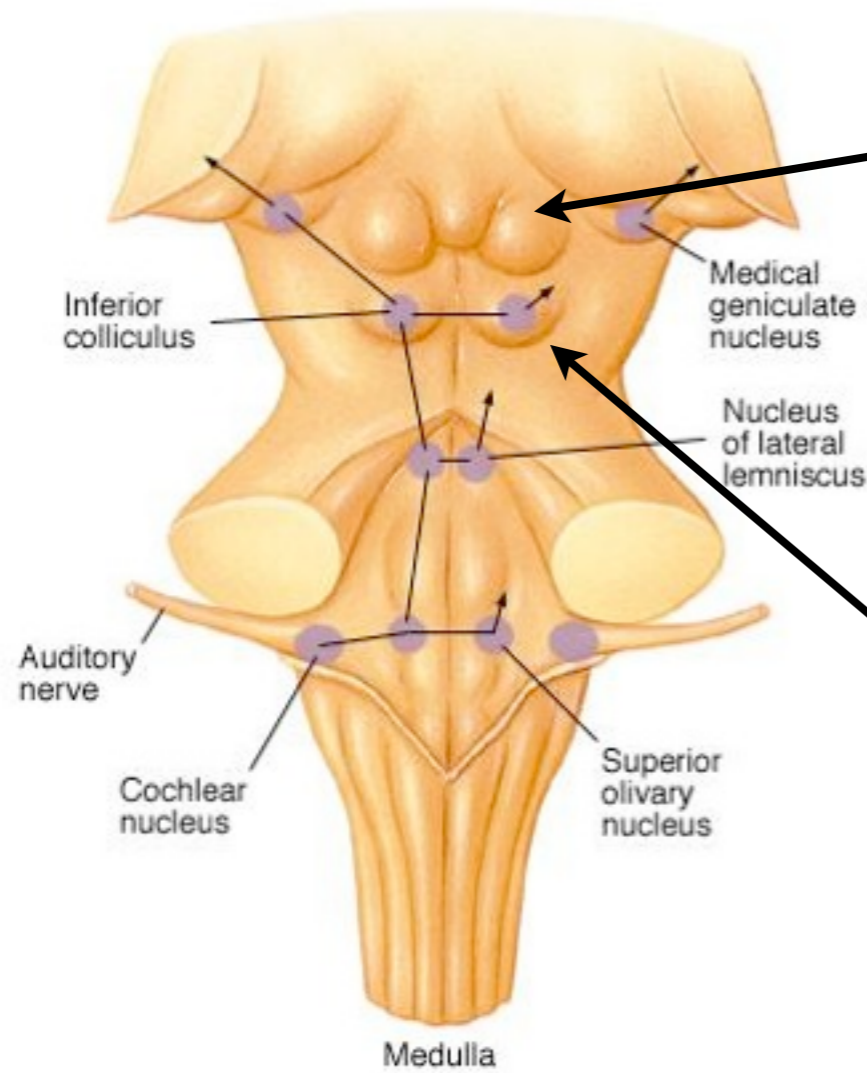
## Five brain stem nuclei in the auditory pathway



... plus one!

..plus one nucleus related to auditory processes:

## THE SUPERIOR COLLICULUS



The  
**SUPERIOR COLLICULUS**  
has seven layers.  
The deep layers contain  
**SUPERPOSED MAPS** of  
visual, auditory and somatic  
information

The  
**INFERIOR COLLICULUS**  
is an important way station  
for auditory signals on the way to  
the cortex

# The superior colliculus permits INTEGRATION

of visual, auditory and somatic information  
before this information is forwarded  
to the early sensory cortices  
which produce images in the mind



This leads to the final proposal of...

## Two working hypotheses:

MUSIC is immediately integrated with vision, body sensations and motor processes due to the connections in the superior colliculus

MUSIC has an immediate and direct impact on vital body functions due to the possible connections of nuclei in the brain stem

You are the music while the music lasts!



## References:

Damasio, A. *The Feeling of What Happens* (1999)

Damasio, A. *Self Comes to Mind* (2010)

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Ihde, D. *Listening and Voice* (1976/2007)

Merleau-Ponty, M. *Phenomenology of Perception* (1945/2002)

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in: Malloch, S. & Trevarthen, C. *Communicative Musicality* (2009:105-46)

Stern, D. *The Present Moment* (2004)

Stern, D. *Forms of Vitality* (2010)