

# Neuroscience and the Application to Arts Learning

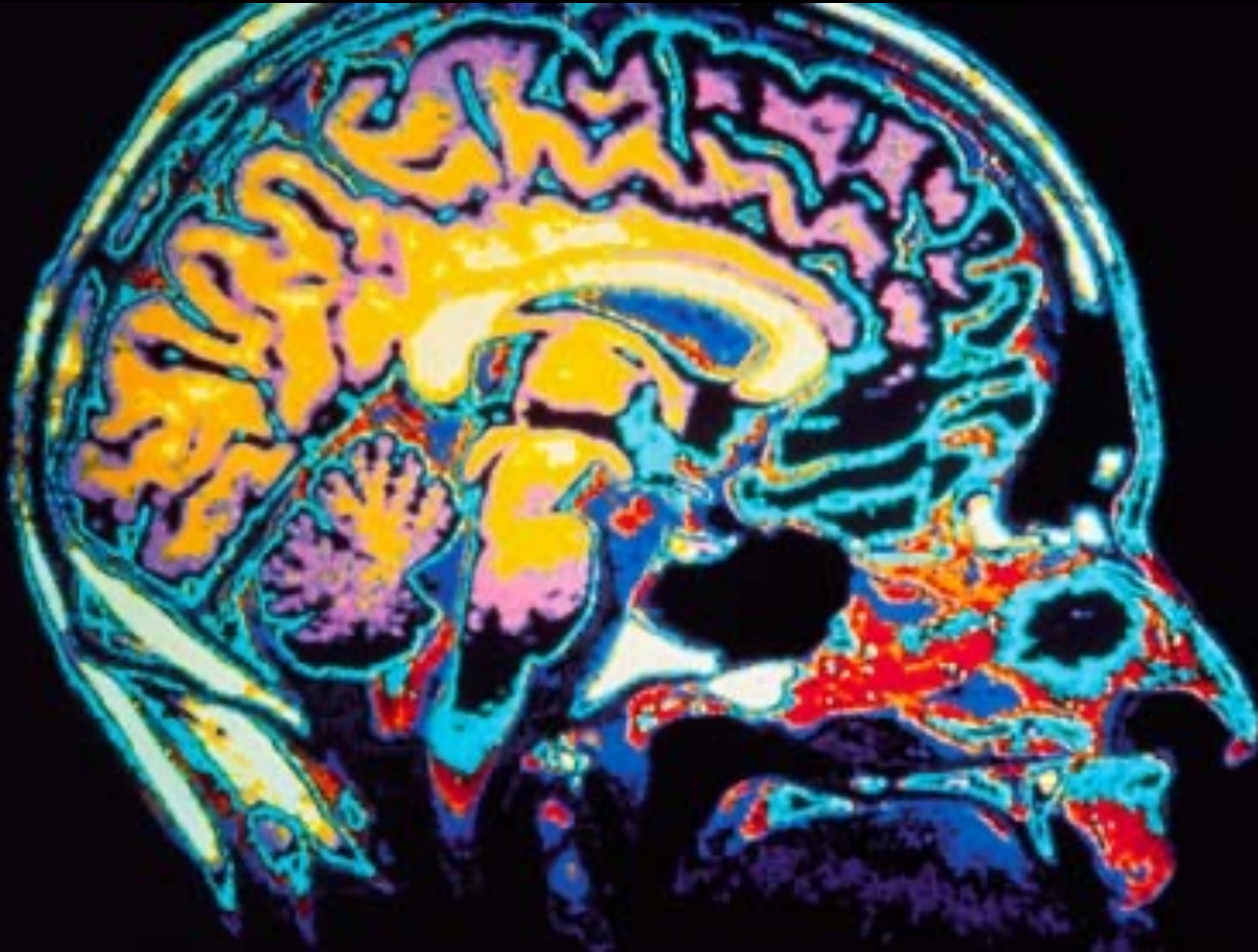
Catherine Richmond-Cullen, Ed.D © ccullen 2015



# You are a Community



Neuroimaging: Offers new insights  
into how the brain learns



# Statement of Learning

Participants will discover current information on neuroscience research and ascertain the connections between what researchers are learning about the brain and how the arts may apply to that information.

# Cerebral Cortex

**Frontal Lobe**- associated with reasoning, planning, parts of **speech**, movement, emotions, and **problem solving**

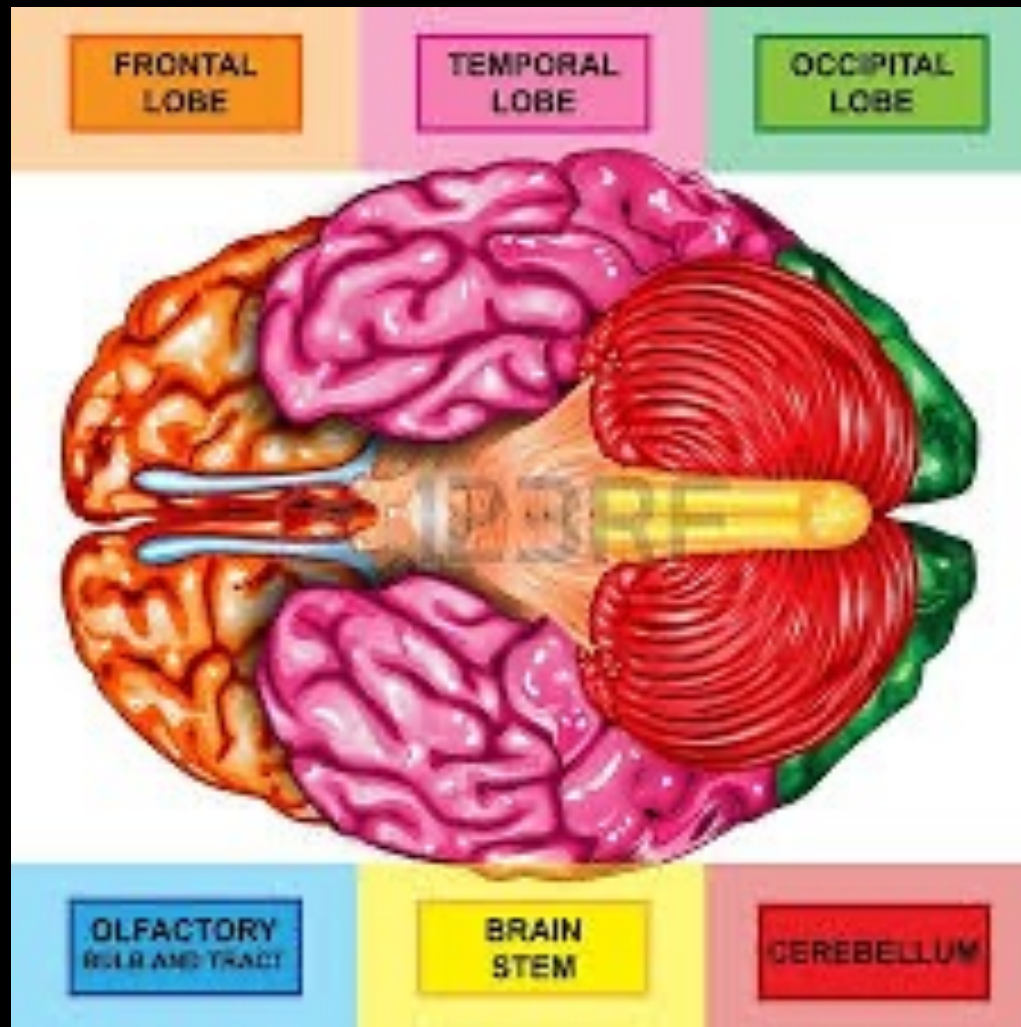
**Parietal Lobe**- associated with **movement**, orientation, recognition, perception of stimuli

**Occipital Lobe**- associated with **visual** processing

**Temporal Lobe**- associated with perception and recognition of **auditory** stimuli, memory, and speech



# The Cerebrum or Cerebral Cortex



# Functions of the Brain

**Linguistic:** Theatre, Music, Dance and Visual Art

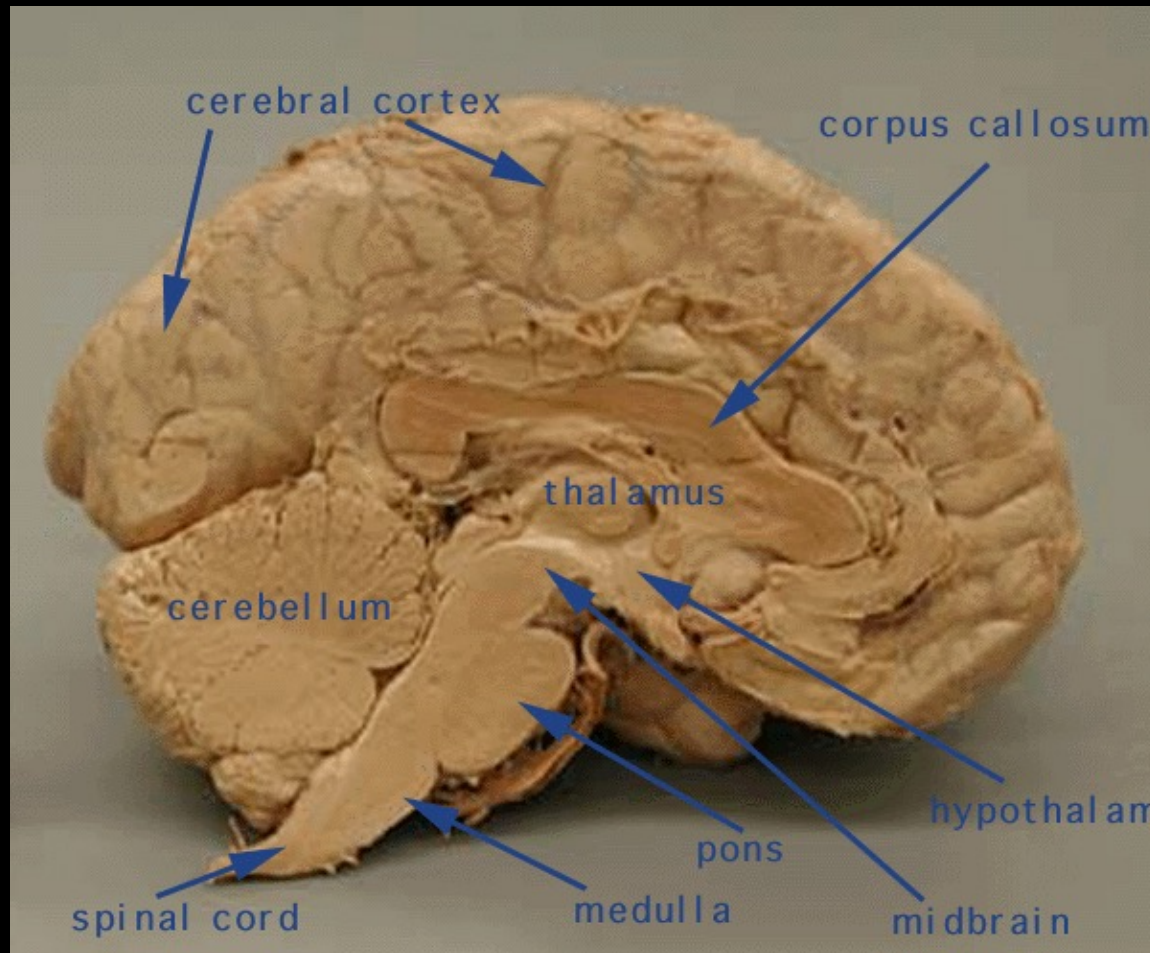
**Visual / Spatial:** Theatre, Music, Dance and Visual Art

**Motor:** Theatre, Music, Dance and Visual Art

**Executive Functions / Attentional:** Problem Solving and Establishing Patterns for Memory

**Memory:** Enhanced through convergence zones

# Limbic System





# Memory Facts

- Working memory is limited as per chronological age
- We are wired to learn 7 items
- Memory stores in patterns
- Teaching with chunking and engagement
- Convergence zones
- Plasticity

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# **A FEW FACTS ABOUT NEUROSCIENCE AND THE ARTS**

# Performing Arts and Cognition

1. motivation

2. sustained attention necessary to improve performance

3. training of attention that leads to improvement in other domains of cognition





## Genetics

studies have begun to yield candidate genes that may help explain individual differences in interest in the arts



# Music and Memory



1. Increases the ability to manipulate information in both working and long term memory
2. These links extend beyond the domain of music training

# Music and Literacy

Correlations exist between music training and both reading acquisition and sequence learning.

Phonological awareness, is correlated with both music training and the development of a specific brain pathway.



# Dance and Cognition



Learning to dance by effective observation affects the neural substrates that support the organization of complex actions.

Effective observations learning may transfer to the other cognitive skills.

# Acting

Acting appears to lead to memory improvement through the learning of general skills for manipulating semantic information.





# Music and Geometry

There appear to be specific links between the practice of music and skills in geometrical representation.



# Neocortex: 76% of the brain

Top layer of the cerebral hemispheres, 2-4 mm thick, and made up of six layers, labelled I to VI (with VI being the innermost and I being the outermost).

- The neocortex is part of the cerebral cortex. It is involved in higher functions such as sensory perception, generation of motor commands, spatial reasoning, conscious thought, and in humans, language.
- The neocortex consists of grey matter surrounding the deeper white matter of the cerebrum.
- It is found only in mammals

# Thalamus

The structure has sensory and motor functions. Almost all sensory information enters this structure where neurons send that information to the overlying cortex. Axons from every sensory system (except olfaction) synapse here as the last relay site before the information reaches the cerebral cortex.

# Hypothalamus

The structure is involved in functions including homeostasis, emotion, thirst, hunger, circadian rhythms, and control of the autonomic nervous system. In addition, it controls the pituitary.

# Amygdala

Involved in memory, emotion, and fear.



# Hippocampus

This part of the brain is important for learning and memory . . . for converting short term memory to more permanent memory, and for recalling spatial relationships in the world about us

# Cerebellum

The cerebellum, or "little brain", is similar to the cerebrum in that it has two hemispheres and has a highly folded surface or cortex. This structure is associated with regulation and coordination of movement, posture, and balance.

# Brain Stem

Underneath the limbic system is the brain stem. This structure is responsible for basic vital life functions such as breathing, heartbeat, and blood pressure. Scientists say that this is the "simplest" part of human brains because animals' entire brains, such as reptiles (who appear early on the evolutionary scale) resemble our brain stem.

- Midbrain
- Pons
- Medulla

# Midbrain/Mesencephalon

Part of the brain stem, which includes the tectum and tegmentum. It is involved in functions such as vision, hearing, eye movement, and body movement. The anterior part has the cerebral peduncle, which is a huge bundle of axons traveling from the cerebral cortex through the brain stem and these fibers (along with other structures) are important for voluntary motor function.

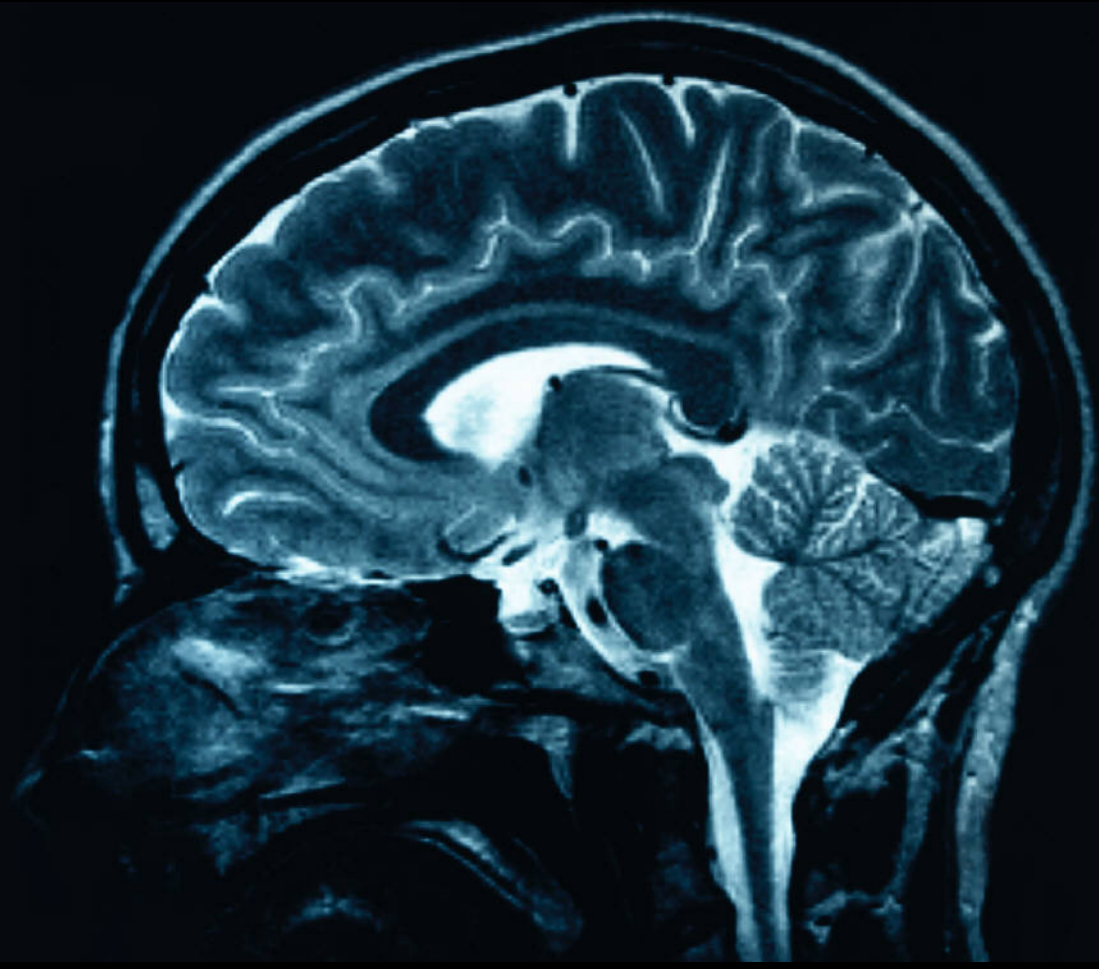
# Pons

- It is involved in motor control and sensory analysis... for example, information from the ear first enters the brain in the pons. It has parts that are important for the level of consciousness and for sleep. Some structures within the pons are linked to the cerebellum, thus are involved in movement and posture.



# Medulla Oblongata

This structure is part of the brain stem, between the pons and spinal cord. It is responsible for maintaining vital body functions, such as breathing and heartrate



# Long Term Storage

- Occurs during deep sleep
- If a learner cannot recall new learning after 24 hours it is not stored and will never be recalled

# Convergence Zones

More storage in different areas of the brain,  
better retention

- Where is the information stored?

# Cerebral Functions

- Interactions between human and the environment include the arts
- The arts have assisted humans to translate information in the environment.

# Cognitive Growth

- The neural functions of the brain grow rapidly during childhood.
- The arts can strengthen neural functioning
- The concept of the changing brain “plasticity” is directly related to arts learning.

# Skills of Cognition: Arts

Pattern Recognition

Mental representations: real and imagined

Symbolic representations

Allegorical and metaphorical representations

Observational skills

Translation of abstraction from reality

Conveyance of meaning

Development of complex forms of thinking

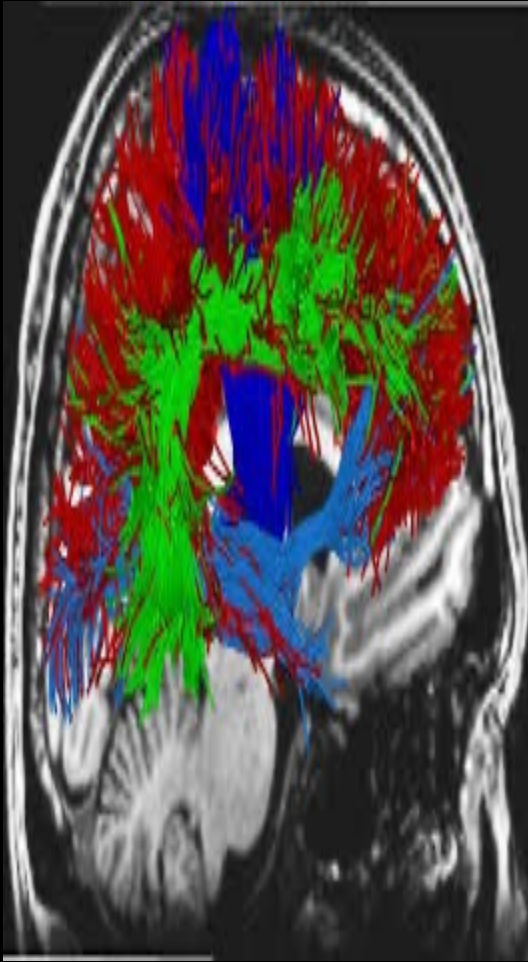
Emotional intelligence





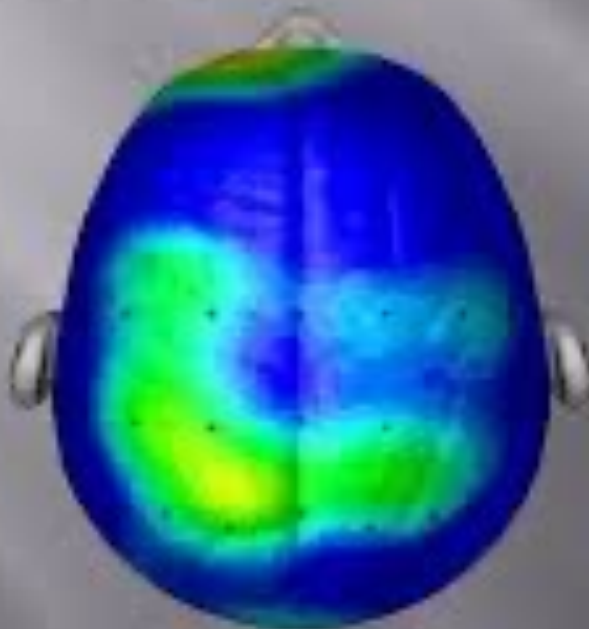


Each brain is uniquely organized.

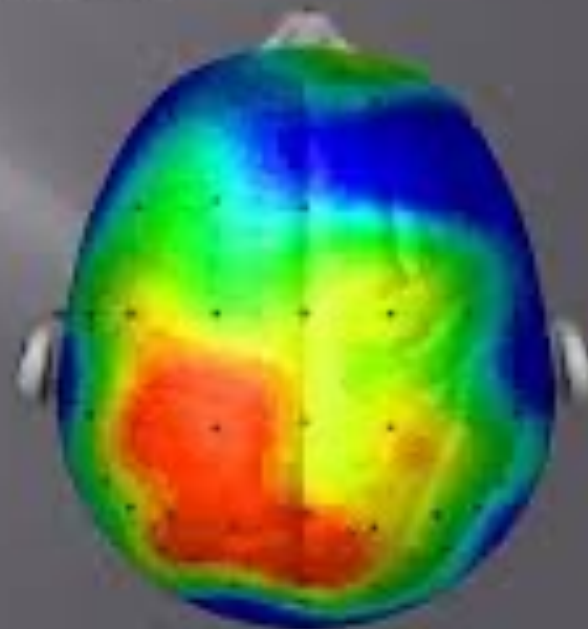


# All Learning is Physiological

BRAIN AFTER SITTING QUIETLY

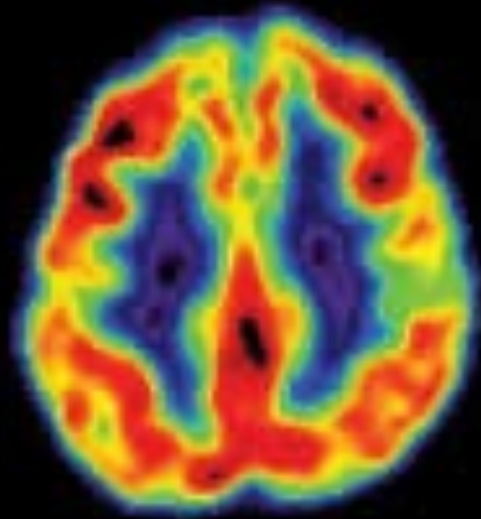


BRAIN AFTER 20 MINUTE WALK

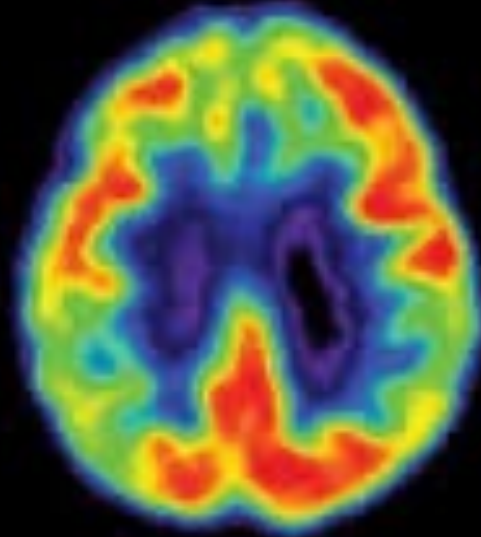


Research/scan compliments of Dr. Chuck Hillman University of Illinois

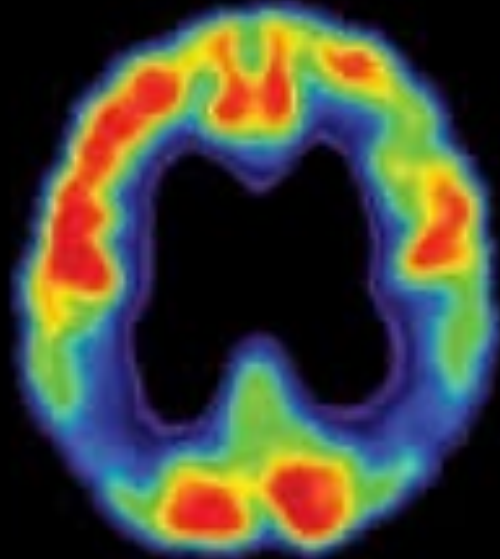
# Learning is Developmental



Normal



Mild cognitive  
impairment



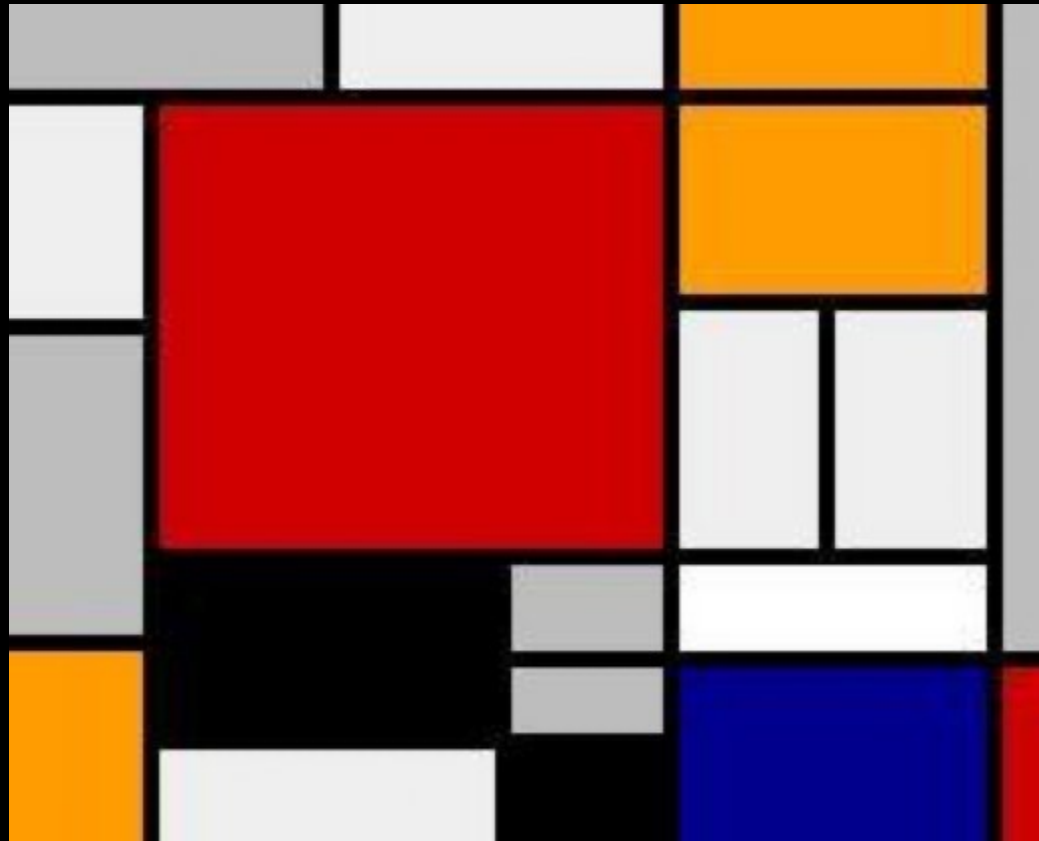
Alzheimer's  
disease



# The brain is social



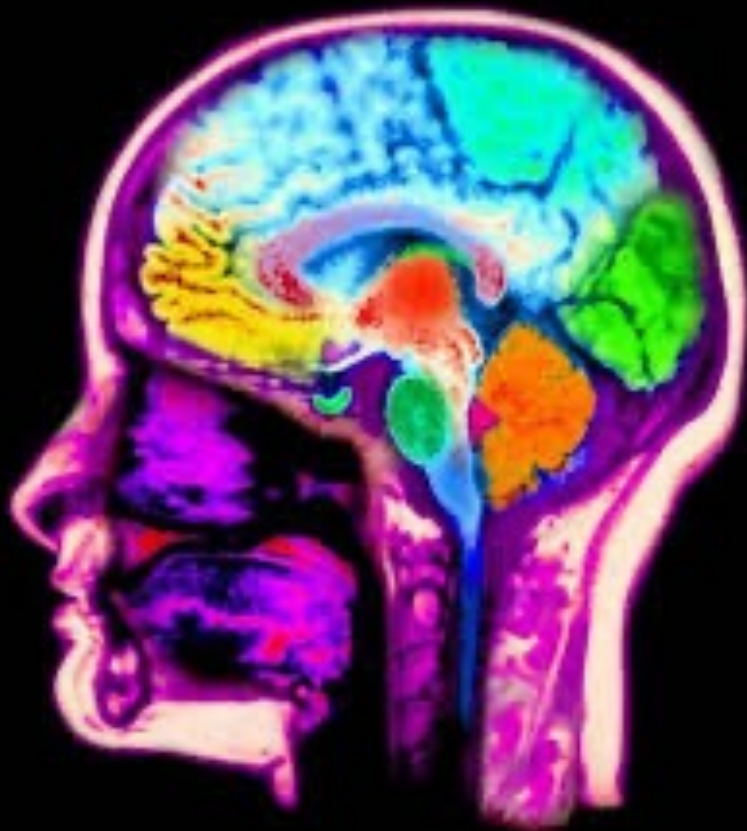
The search for meaning is innate.



# Learning involves both conscious and unconscious processes

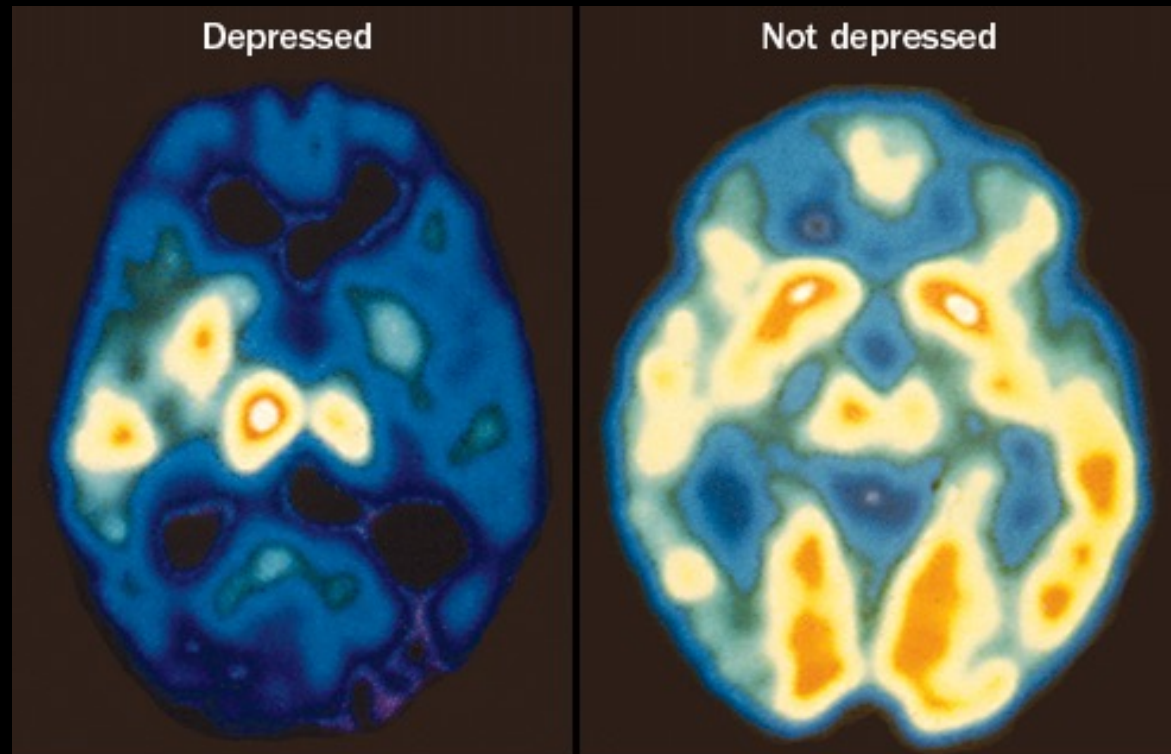


We learn through patterns.





# Emotions are critical to patterning and storage



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We need to make sense of experience  
and learn facts and skills



# The brain learns parts and wholes simultaneously



# Learning involves focused attention and peripheral perception





# Complex learning is enhanced by challenge and limited by threat

