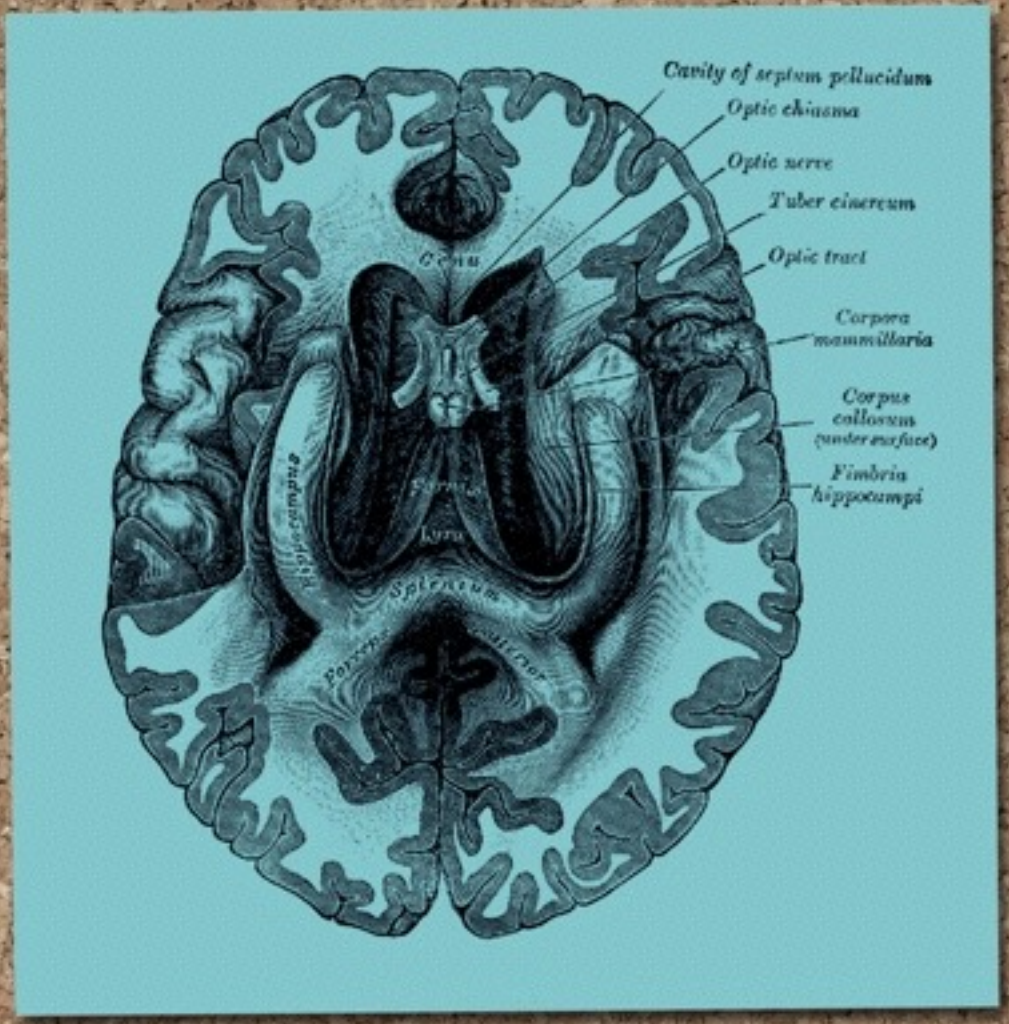
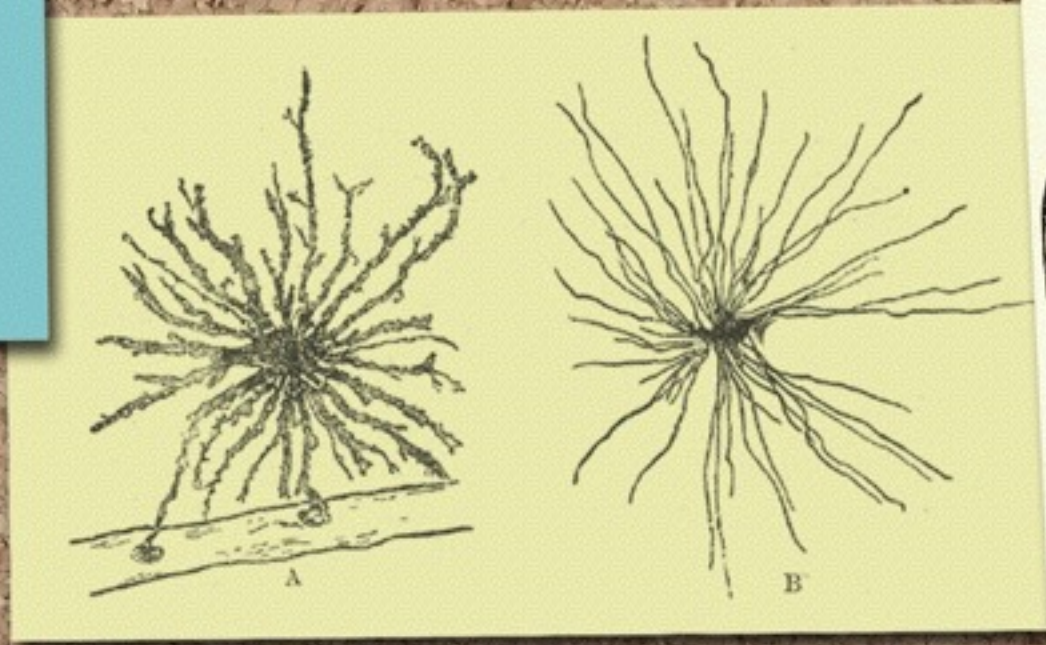


Neuroplasticity

Neuroplasticity

Neuro - for “neuron,” the nerve cells in the brain and nervous system



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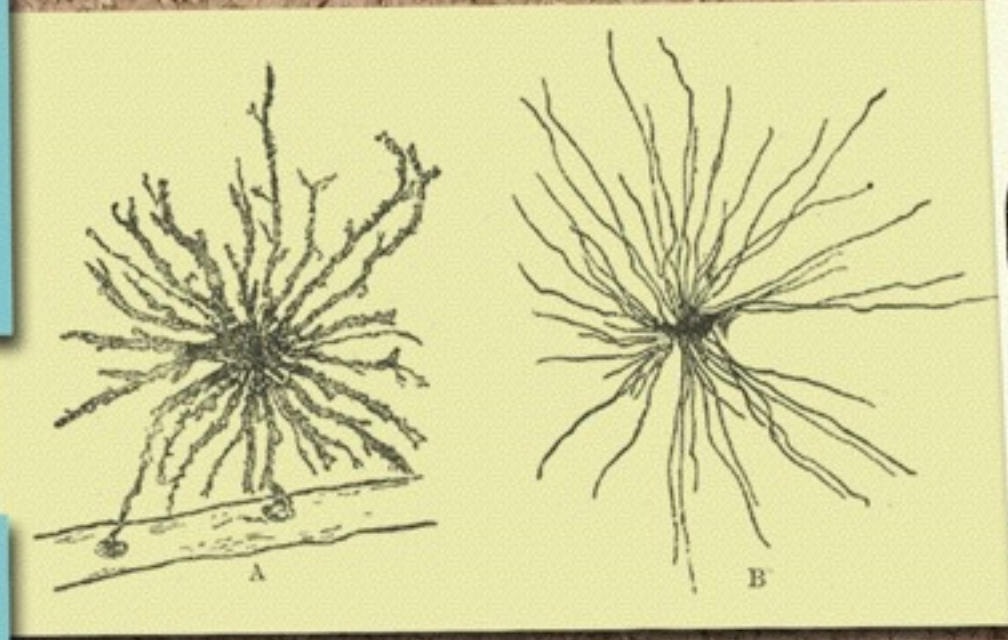


Plastic - for “changeable, malleable, modifiable”

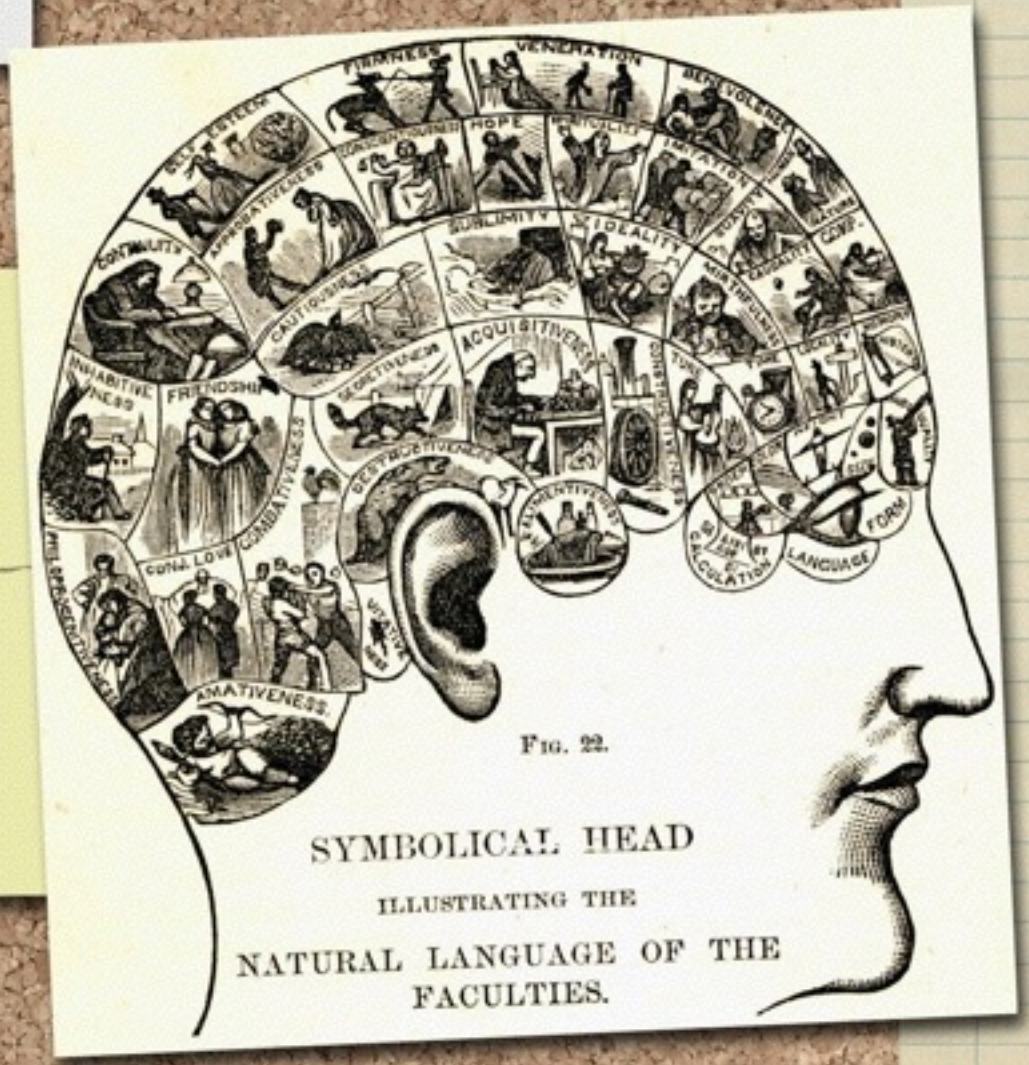


Fig. 22.

SYMBOLICAL HEAD

ILLUSTRATING THE

NATURAL LANGUAGE OF THE FACULTIES.

Localization - longstanding idea that the brain is like a complex machine, made up of parts, each of which performs a specific mental function and exists in a genetically predetermined or hardwired location.

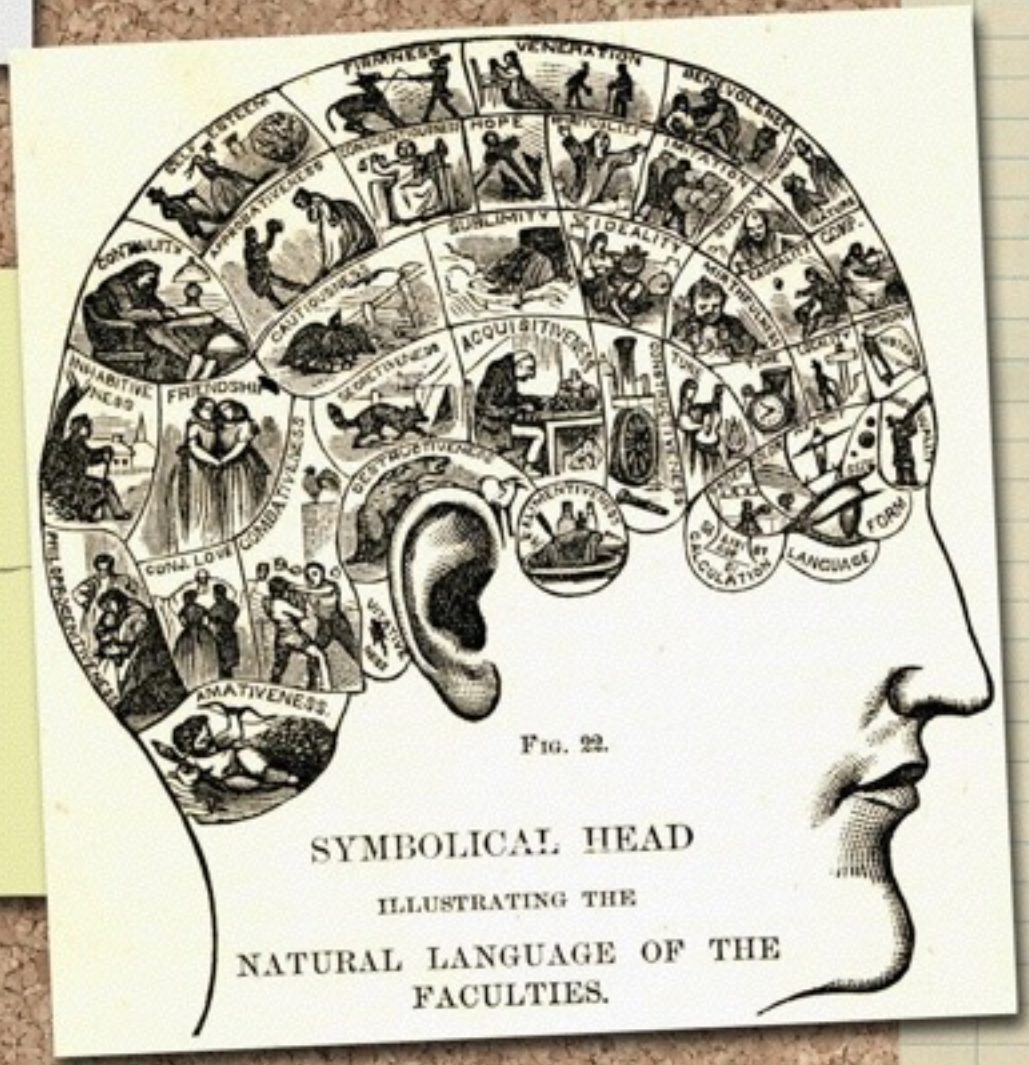


Fig. 22.

SYMBOLICAL HEAD

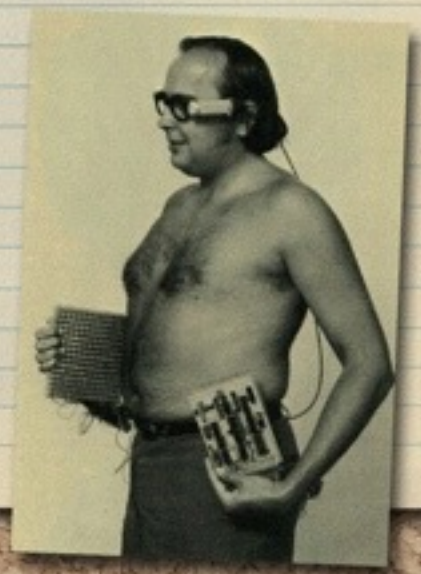
ILLUSTRATING THE

NATURAL LANGUAGE OF THE FACULTIES.

In the late 1960s, a group of scientists began to reject localizationist claims.

Led by Paul Bach-y-Rita, an expert in:

- Medicine
- Psychopharmacology
- Ocular Neurophysiology
- Visual Neurophysiology
- Biomedical Engineering



Bach-y-Rita's father, Pedro (professor at CCNY), had a disabling stroke at age 65.

Had four weeks of rehab and was pronounced helpless for life.

Paul's brother George (an MD in Mexico) broke all rules and, learning from babies, taught his father to:

Crawl, walk on knees, stand, and walk.

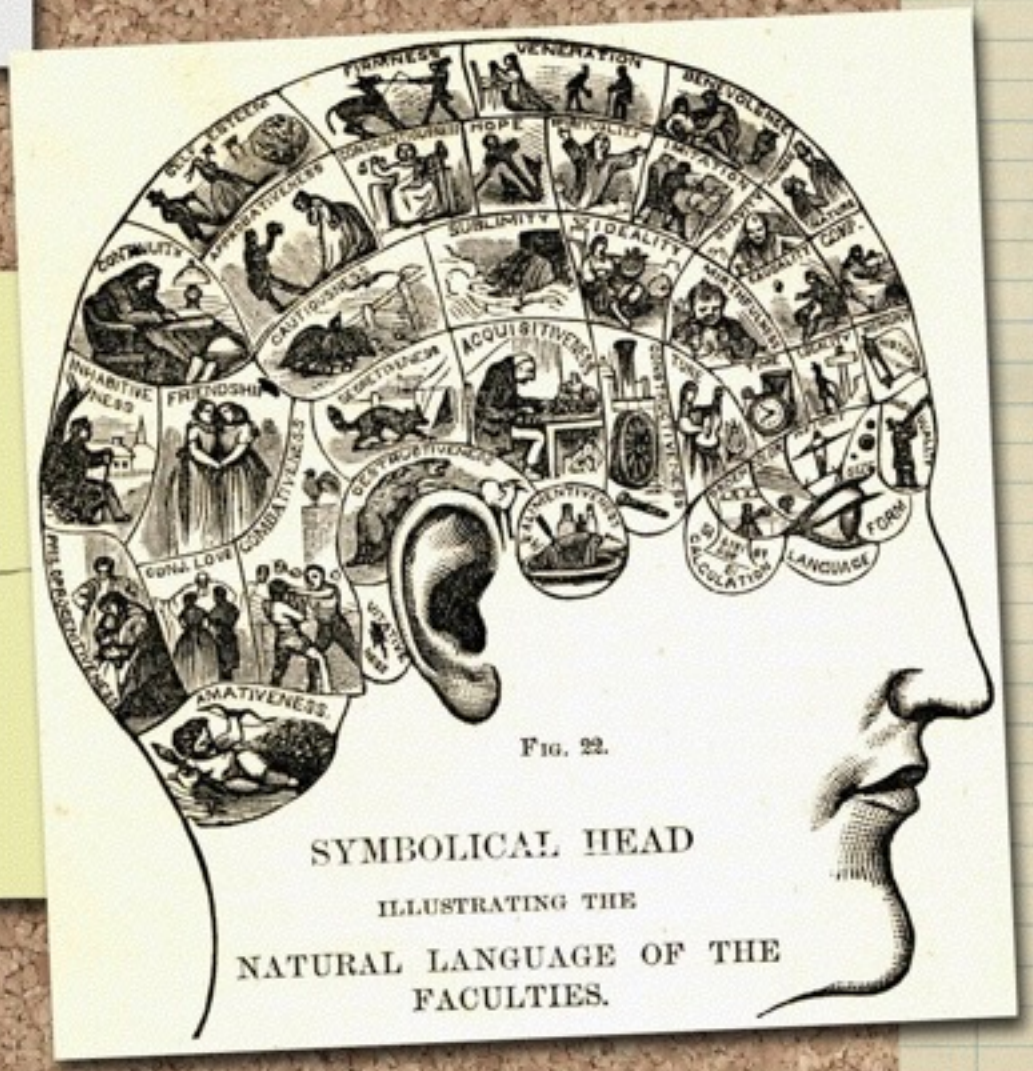


Fig. 22.

SYMBOLICAL HEAD

ILLUSTRATING THE

NATURAL LANGUAGE OF THE FACULTIES.

- Slowly recovered speech
-Re-learned to type using whole arm, wrist, ,head and fingers
- At the end of a year, returned to full time teaching at CCNY

According to prevailing localization theory, he should never have been able to recover!

The brain can

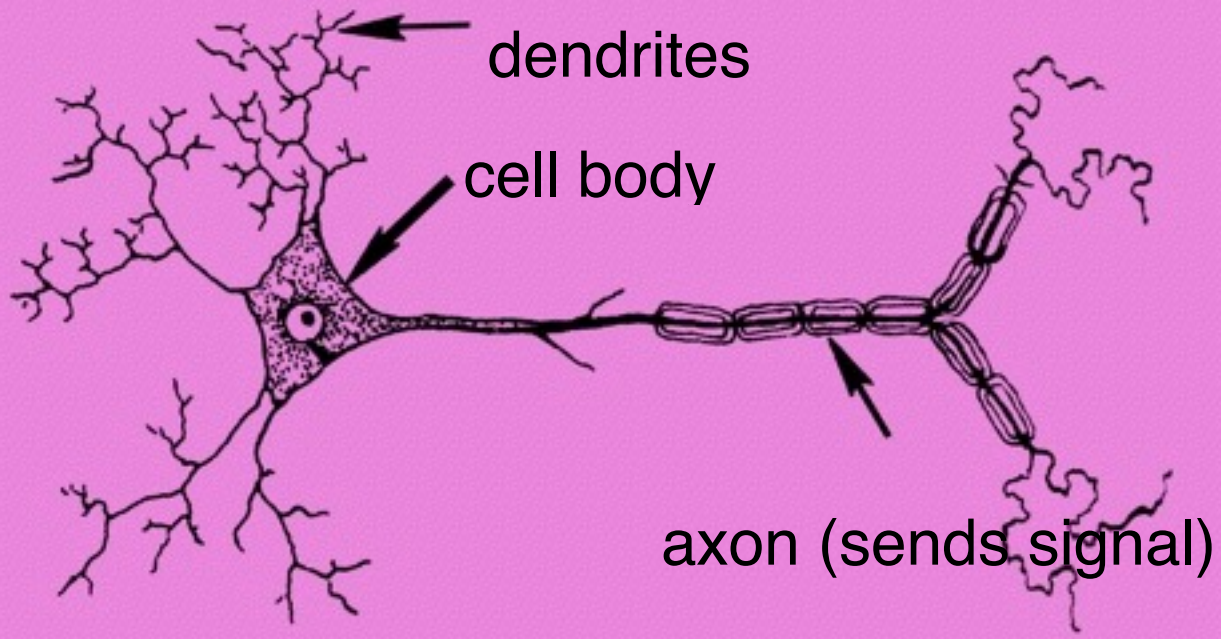
r e o r g a n i z e

itself to acquire new functions through brain stimulating exercises.

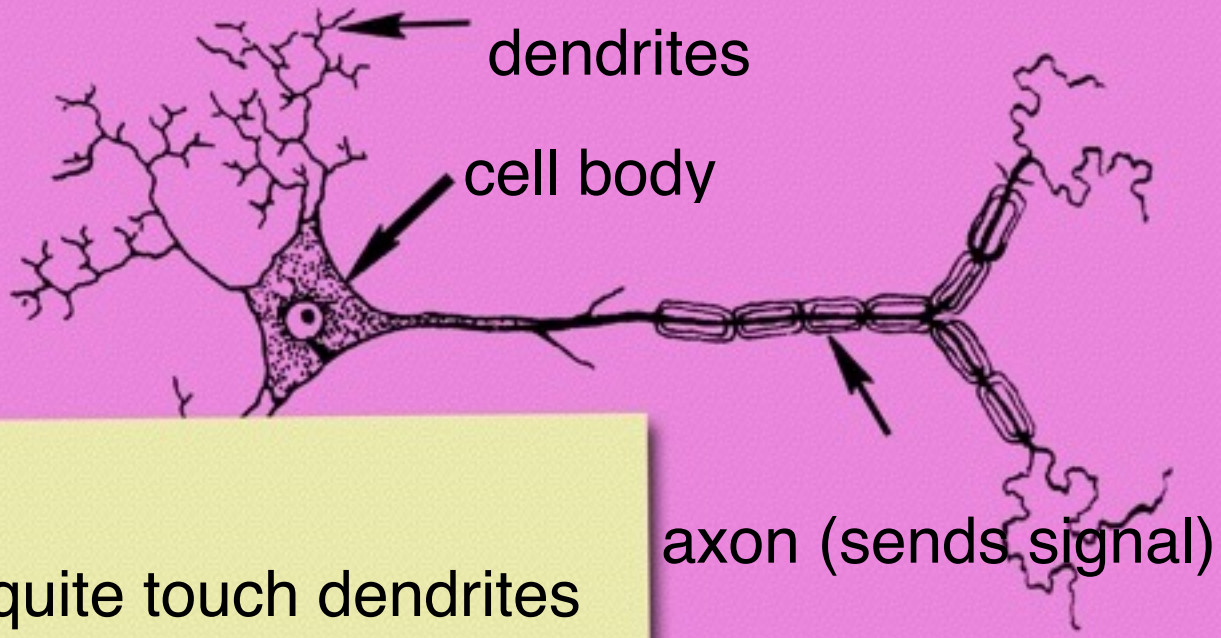
The *visual cortex* in a blind person can be taken over to accept input from *hearing and some touch*.

The *auditory cortex* in a deaf person can be taken over to accept input from your eyes and create superior *peripheral vision.*

Neurons have Three Parts

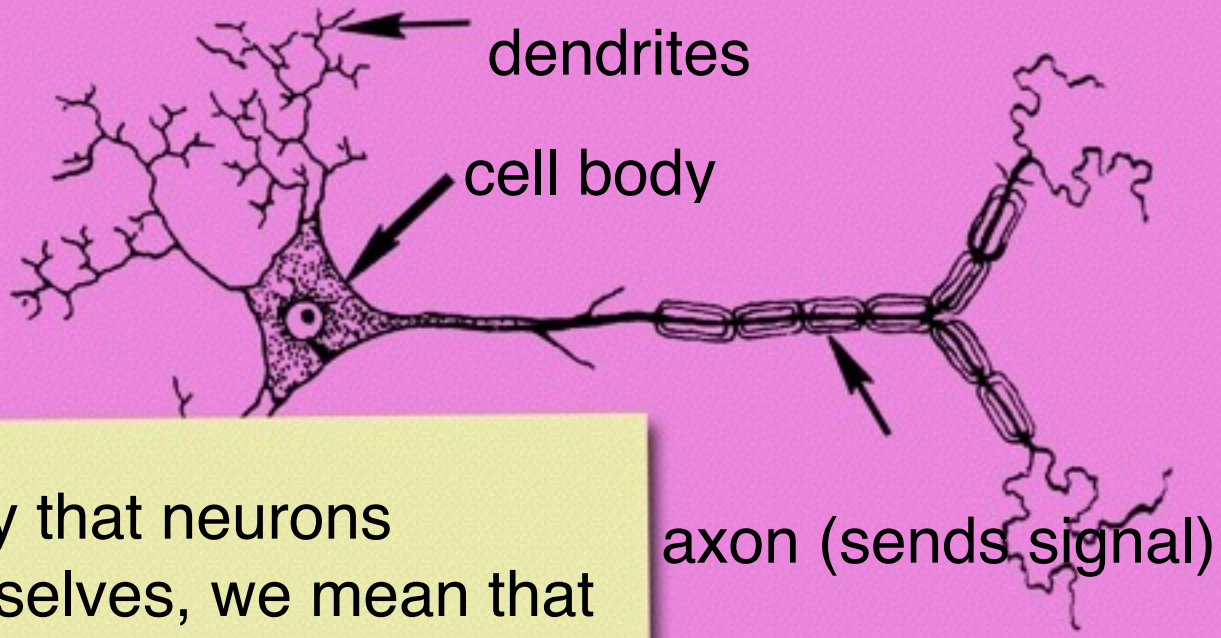


Neurons have Three Parts

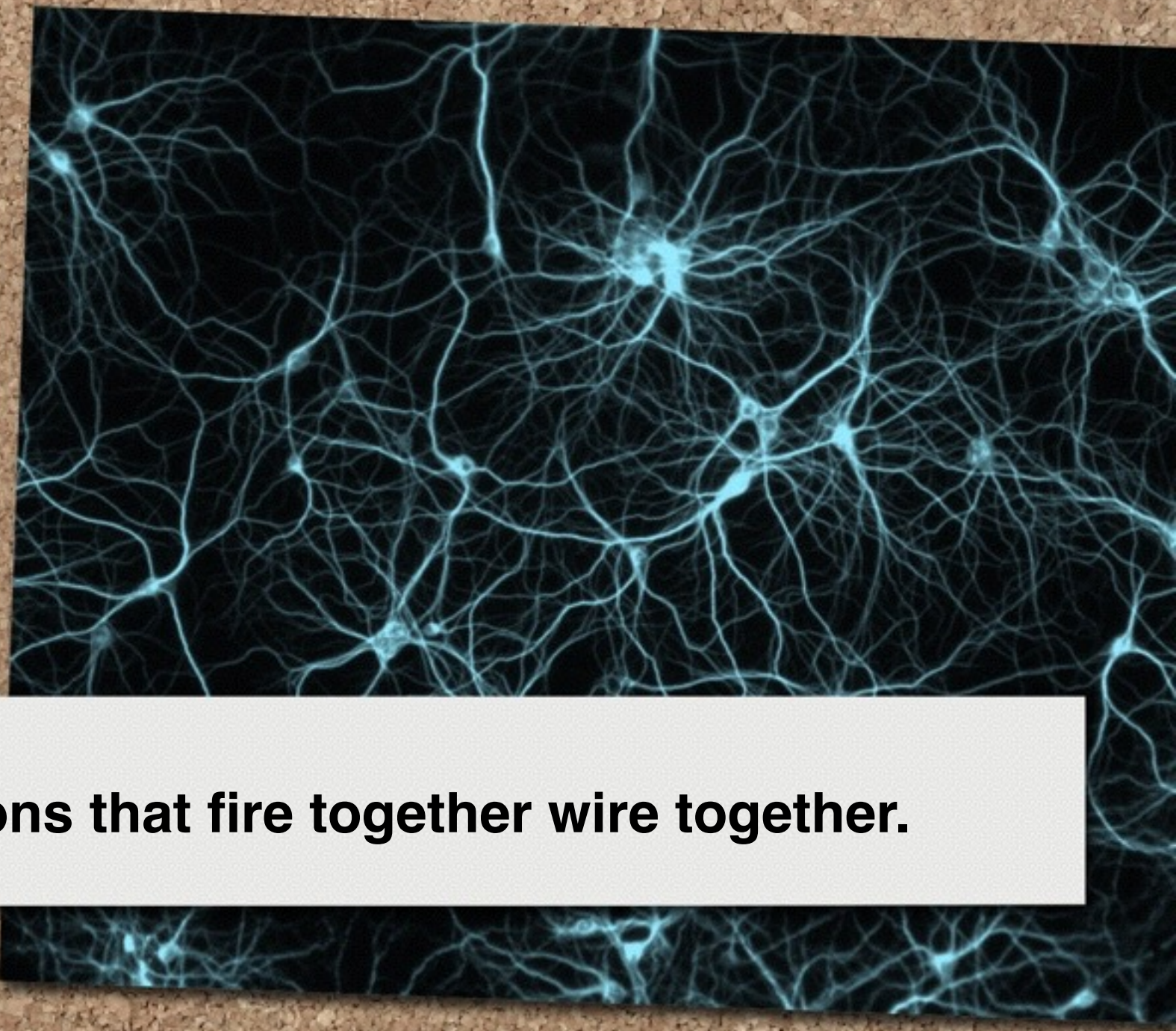


Axons don't quite touch dendrites - synapse is space in between. Chemical messengers called neurotransmitters create the links

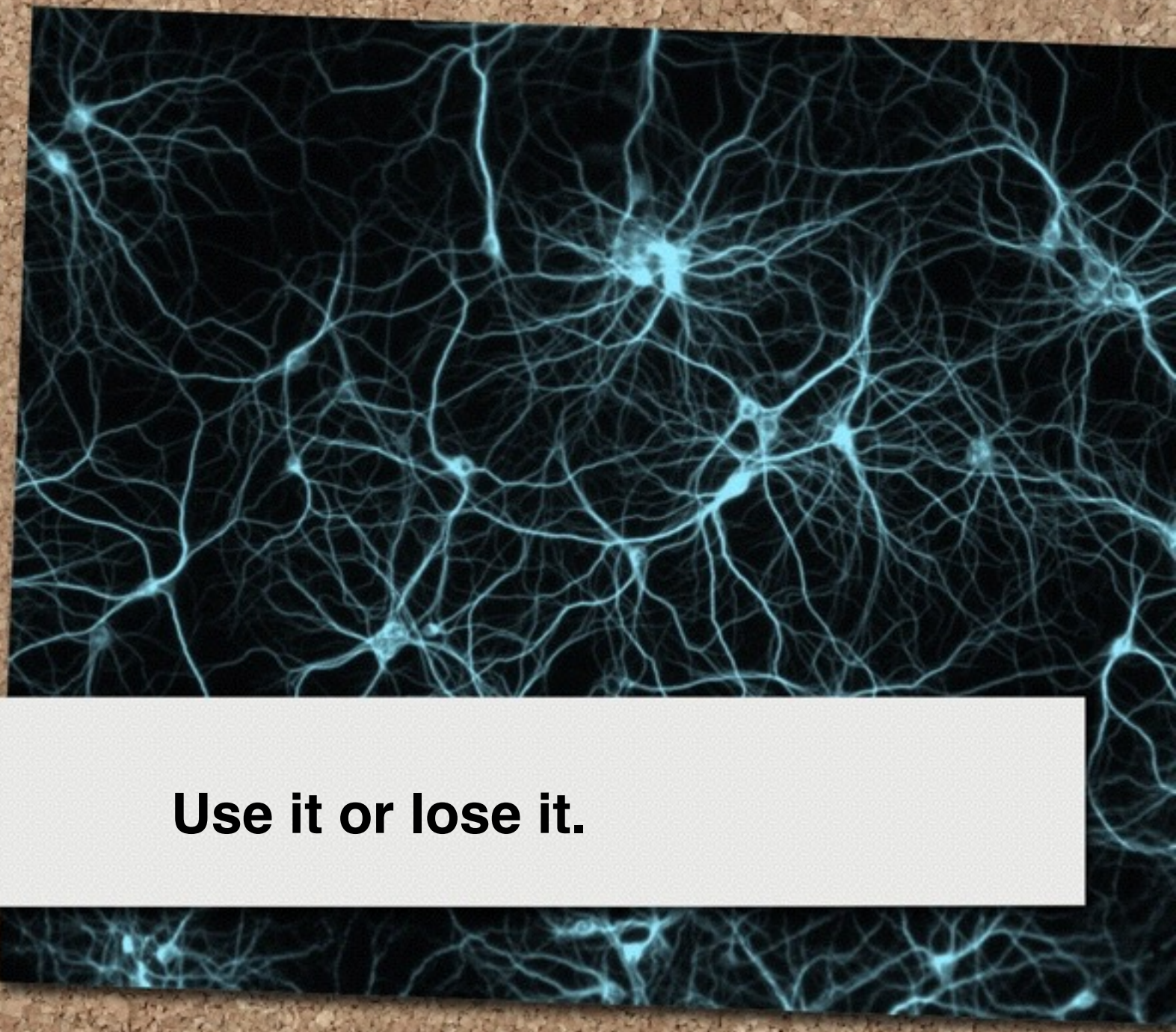
Neurons have Three Parts



When we say that neurons "rewire"themselves, we mean that alterations occur in the synapse, increasing or decreasing the number of connections between neurons.



Neurons that fire together wire together.



Use it or lose it.

Plasticity is greatest in “critical period” in infancy and early childhood.

Plasticity is greatest in “critical period” in infancy and early childhood.

But the brain remains plastic throughout life (as evidenced by Paul Bach-y-Rita’s 65 year-old father.)

After critical period when tasks are performed automatically, they change the brain map but the changes do not last.

Only when one works to pay attention does lasting change occur.

Learning a language in Critical Period is easy because “the learning machinery is constantly on.”

Learning a language later requires intense focus but is good for us because it “**turns on the control system for plasticity** and keeps it in good shape for laying down sharp memories of all kinds.

Plasticity Is Enhanced By 3 Things.

Plasticity Is Enhanced By 3 Things.

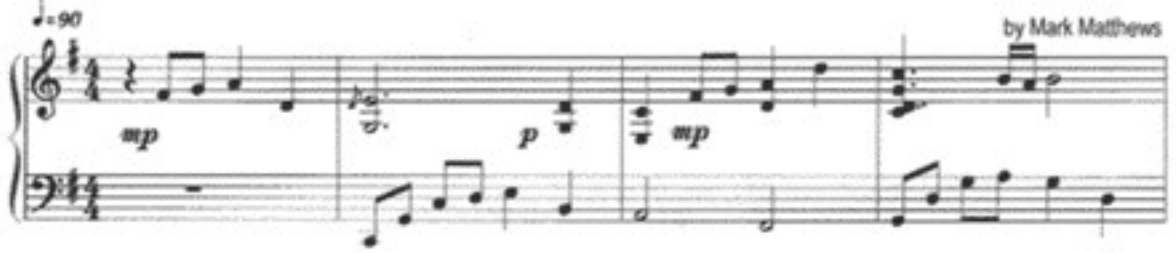
1

Intense, sustained mental focus.

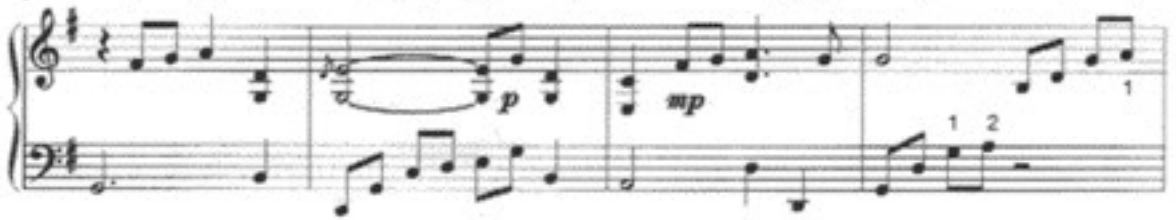
-Activites performed without paying attention do not create new structure.

Fast pattern if learning (like cramming for a test) can strengthen existing synaptic connections, but do not create new ones.

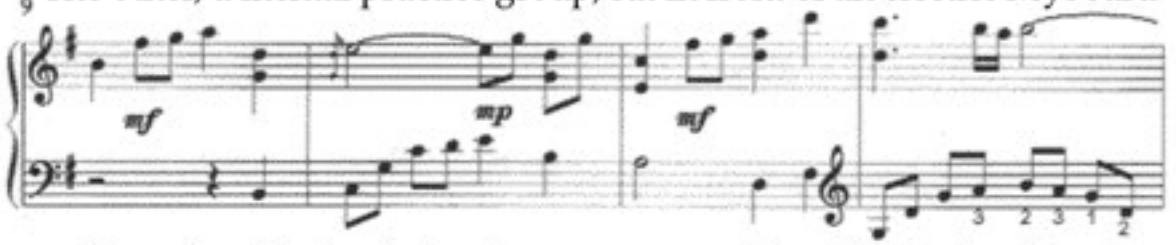
by Mark Matthews



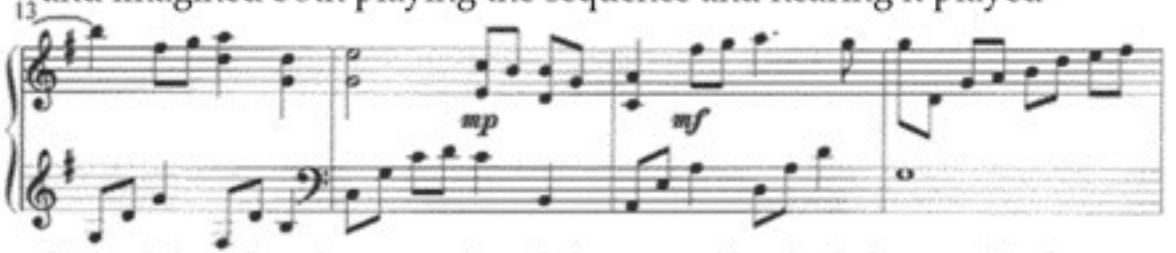
Two groups learning to play the piano: one, a physical practice group.



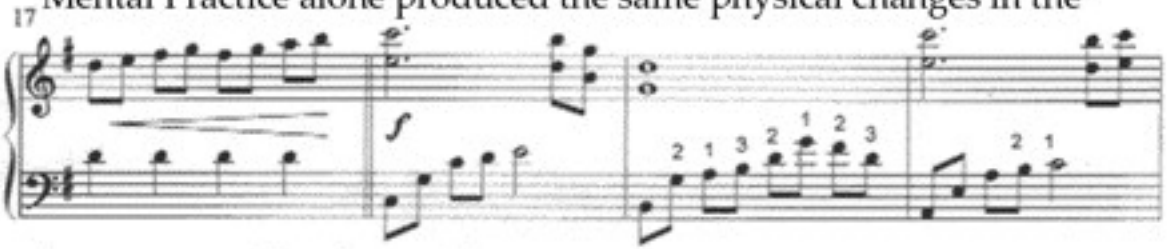
The other, a mental practice group, sat in front of an electric keyboard



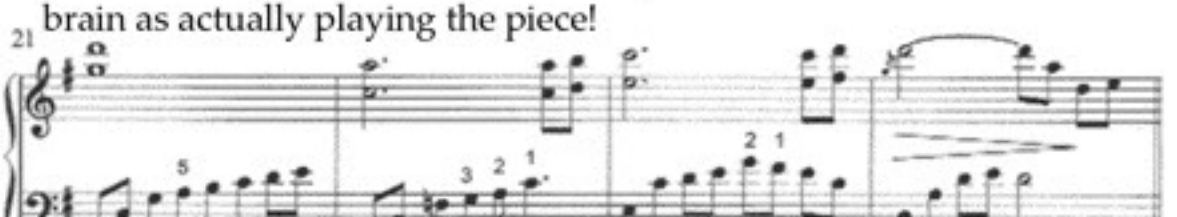
and imagined both playing the sequence and hearing it played

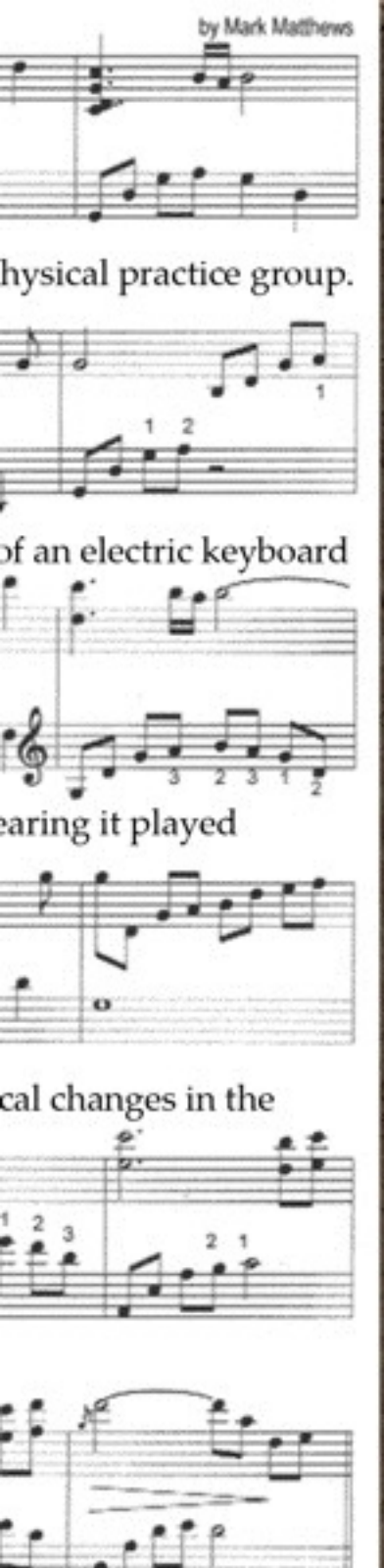


Mental Practice alone produced the same physical changes in the



brain as actually playing the piece!





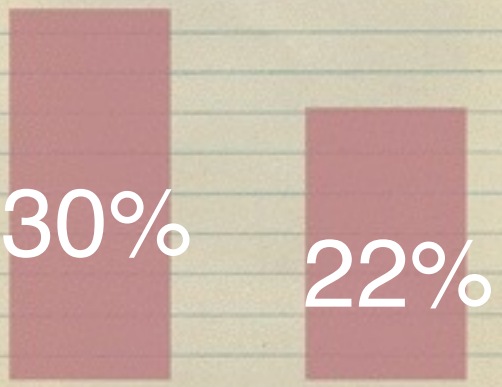
Two groups aiming to strengthen muscles:

-Physical Group

-Mental Group - imagined doing muscle contraction while also imagining a voice shouting “Harder! Harder!”

Physical group increased muscle strength by 30%

Mental group increased muscle strength by 22%!



Plasticity Is Enhanced By 3 Things.

2

New demands rather than repeating learned skills

-novel environments trigger neurogenesis

-must learn something new rather than replaying already mastered skills to improve plasticity.

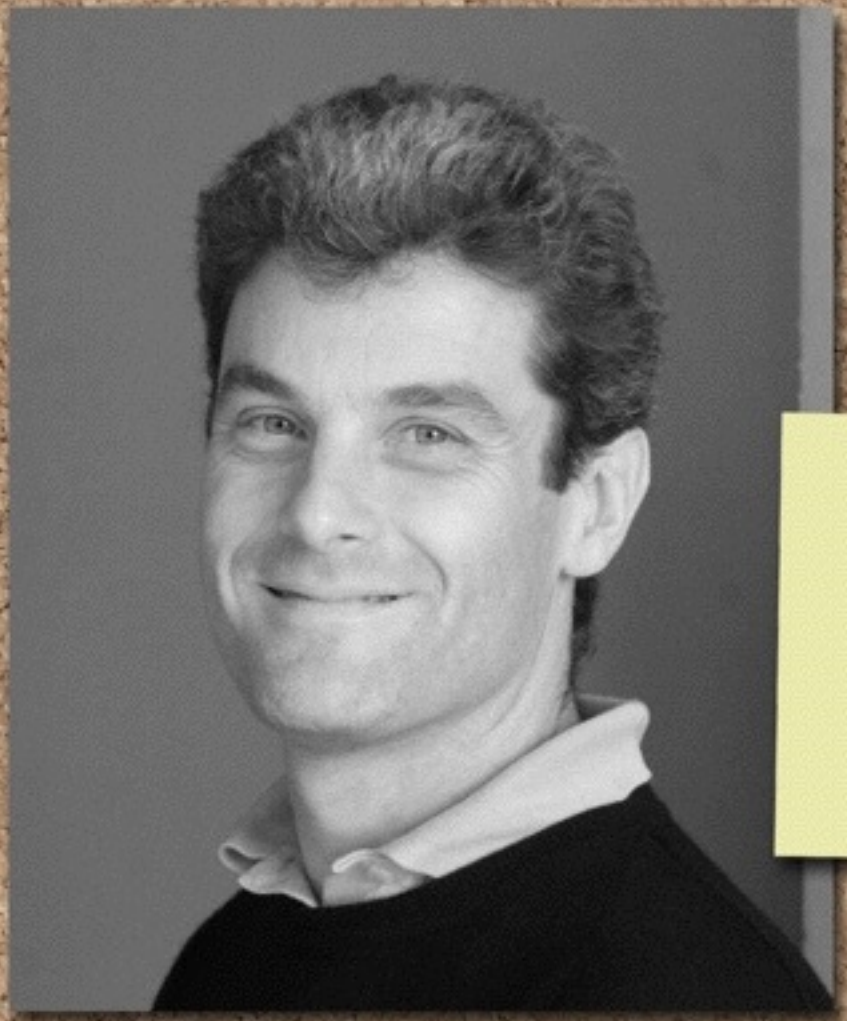
Plasticity Is Enhanced By 3 Things.

3

Physical Activity

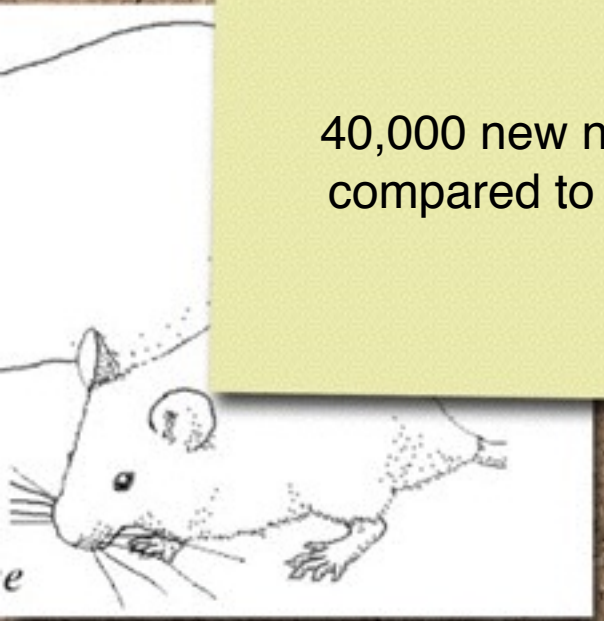
- -increases production of neurons
- -stimulates release of dopamine and seratonin (which are neurotransmitters)

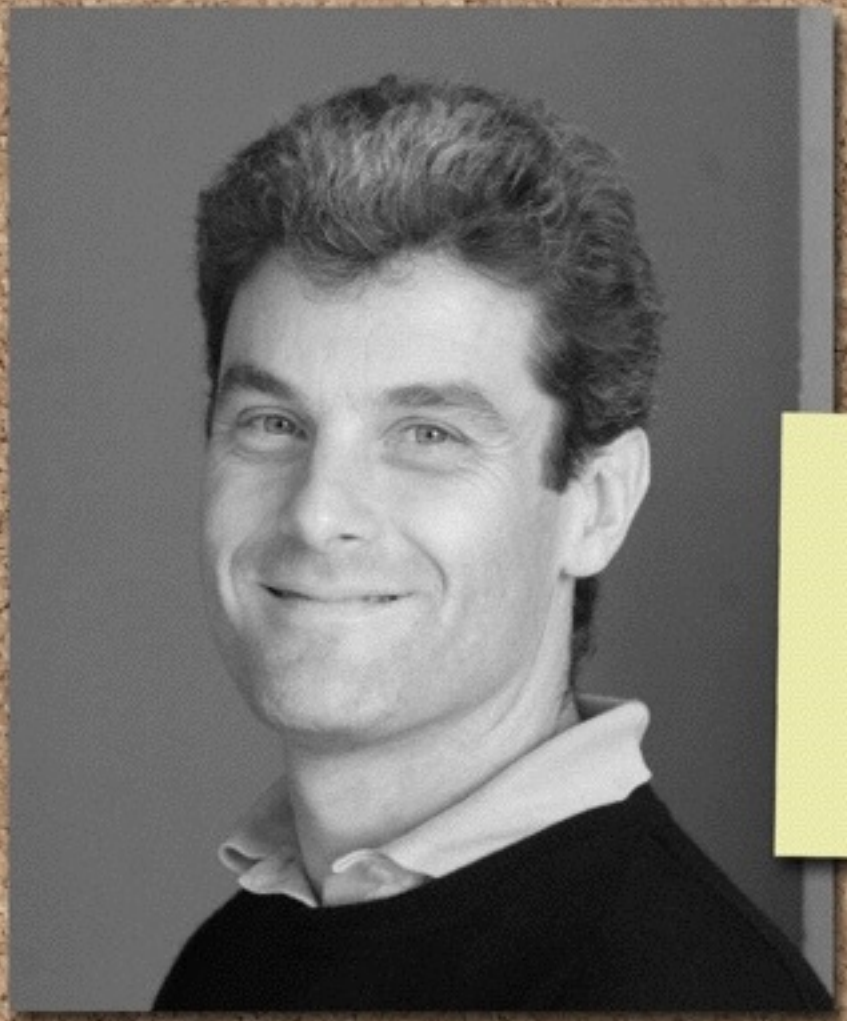
Gerd Kemperman at Salk Laboratories put aging mice in a cage with mice toys such as balls, tubes and running wheels for 45 days.

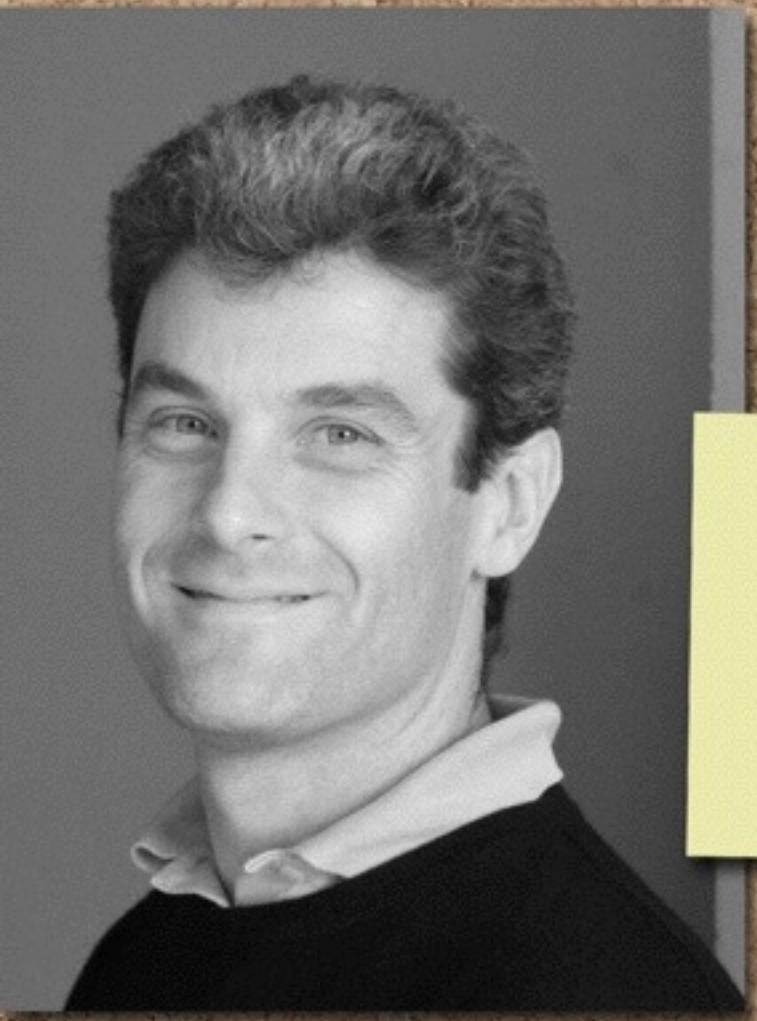


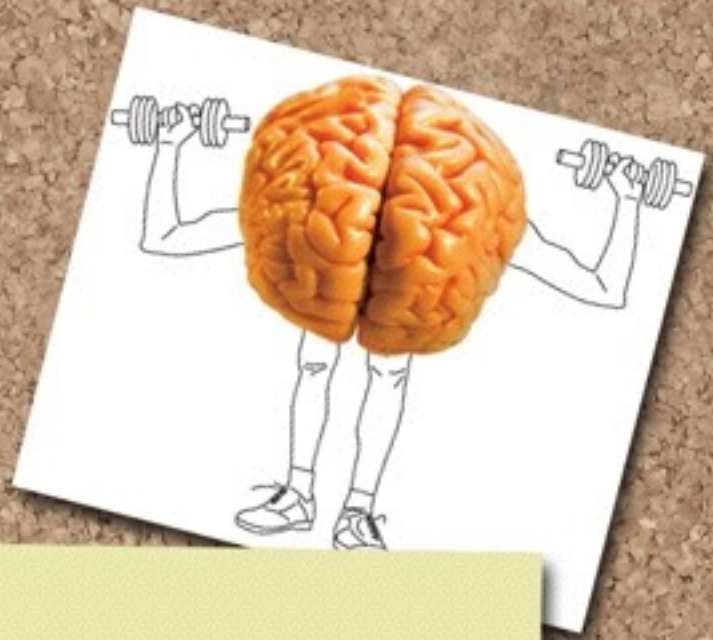
Gerd Kemperman at Salk Laboratories put aging mice in a cage with mice toys such as balls, tubes and running wheels for 45 days.

40,000 new neurons (15% increase) compared to mice living in standard cages!



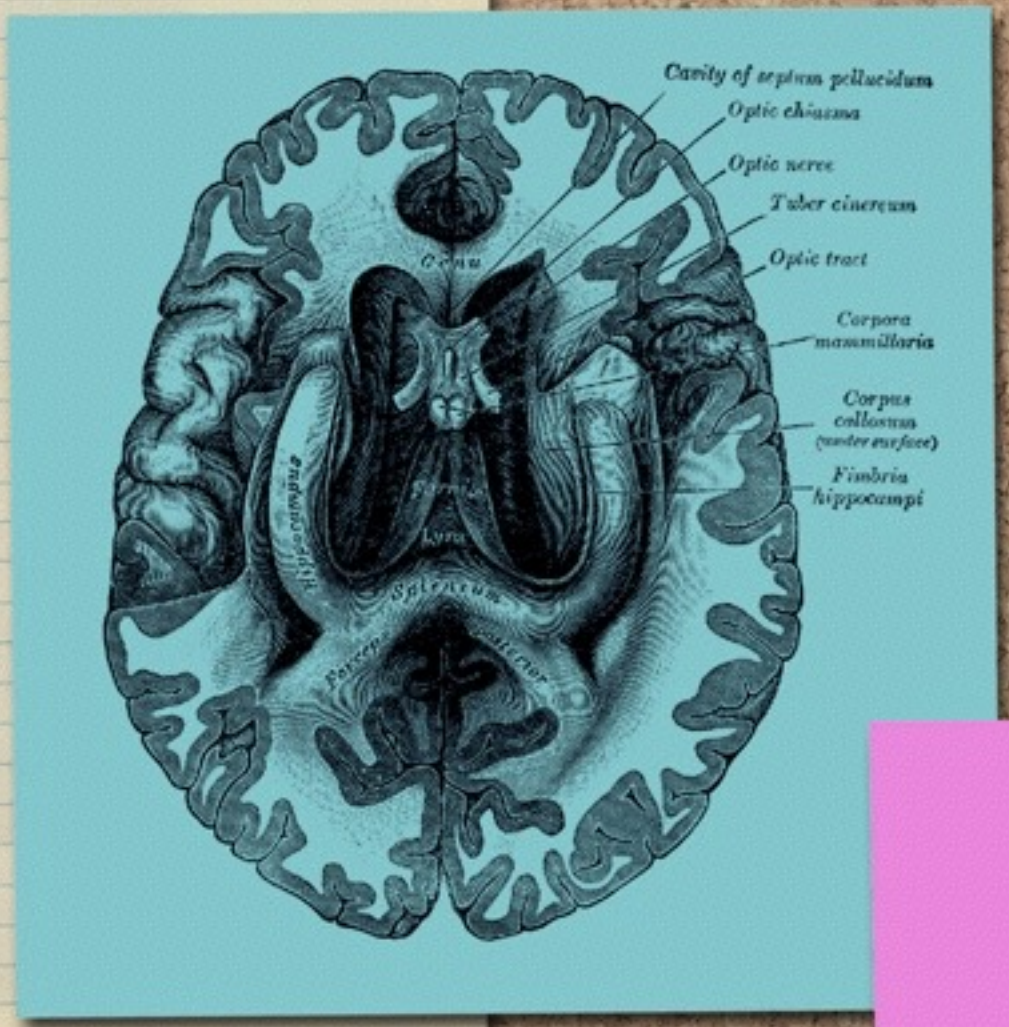






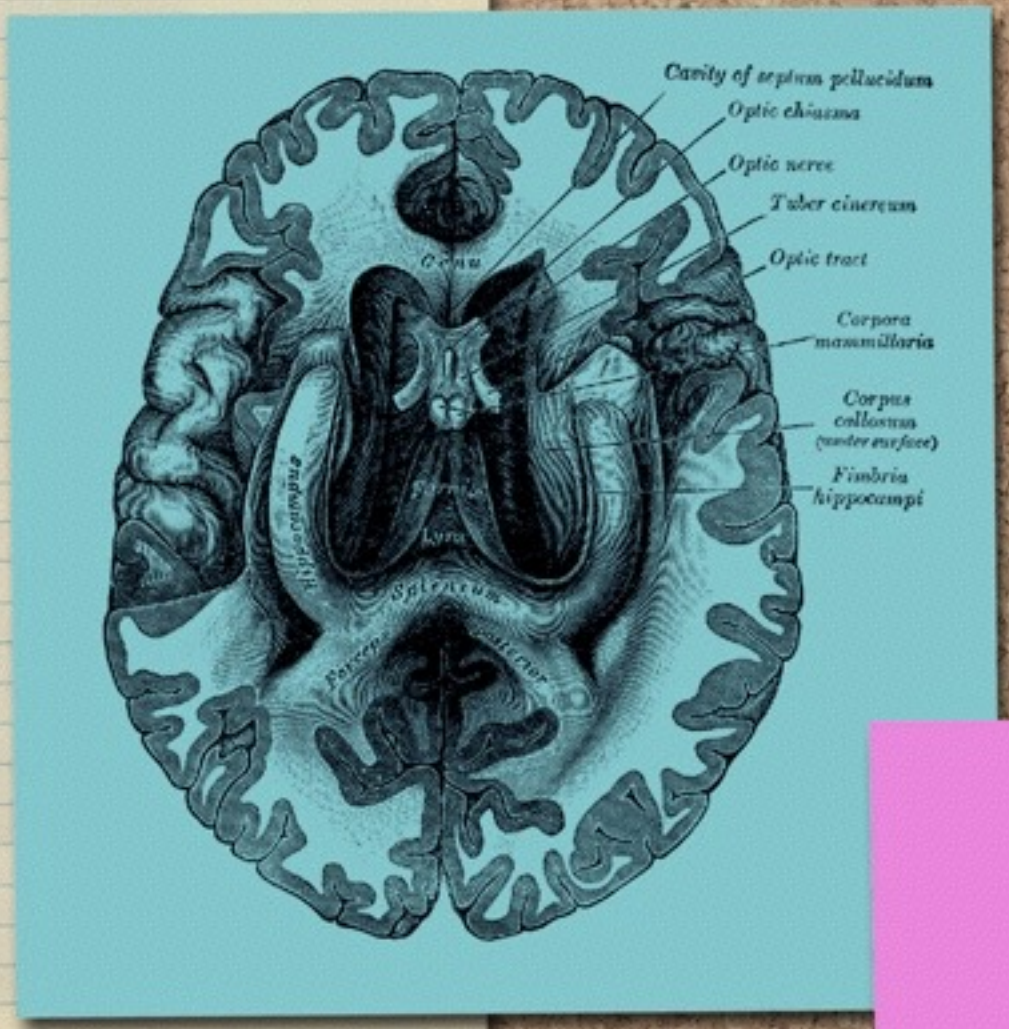
Exercise stimulates the production of the neurological growth factor, BDNF, which plays a crucial role in affecting plastic change.

Neuroplasticity applies to many functions of the brain.



Neuroplasticity applies to many functions of the brain.

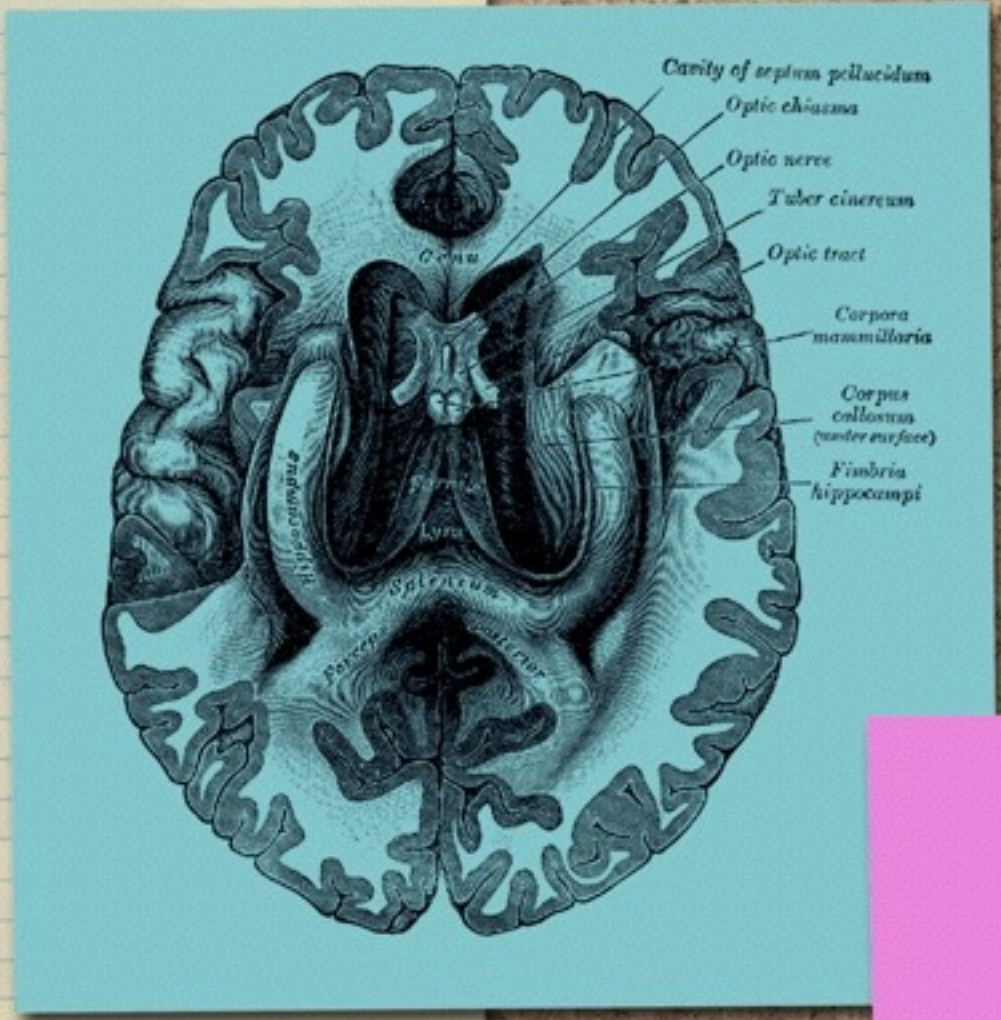
fine motor control



Neuroplasticity applies to many functions of the brain.

fine motor control

gross motor control

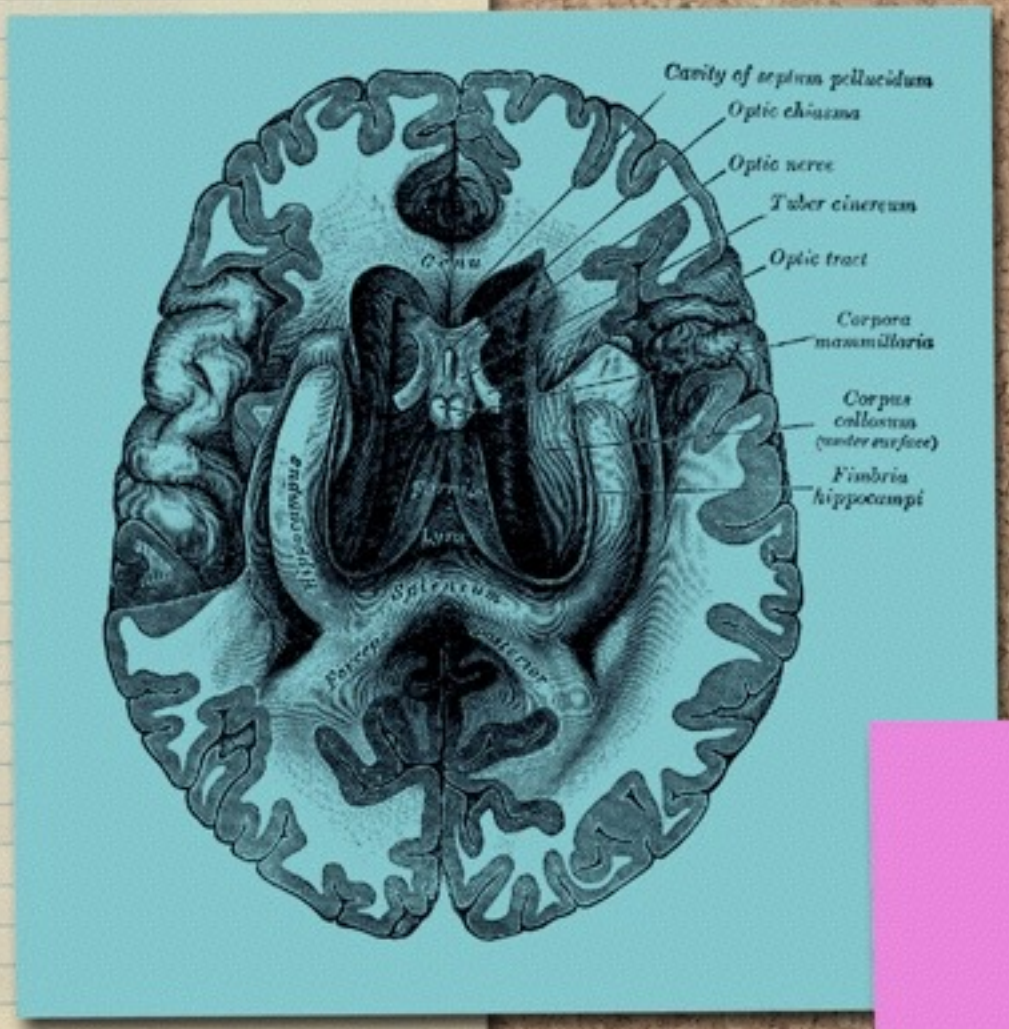


Neuroplasticity applies to many functions of the brain.

fine motor control

gross motor control

emotional bonds



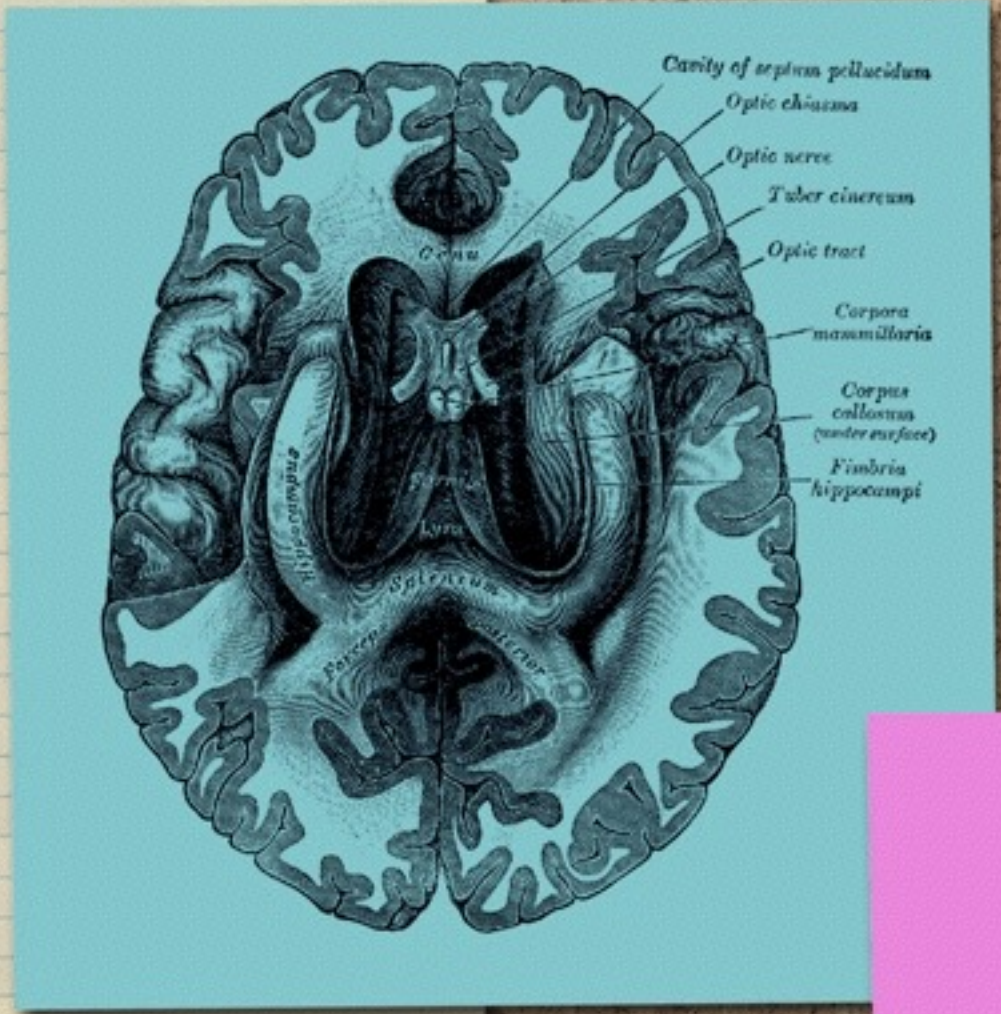
Neuroplasticity applies to many functions of the brain.

fine motor control

gross motor control

emotional bonds

sense of balance



Neuroplasticity applies to many functions of the brain.

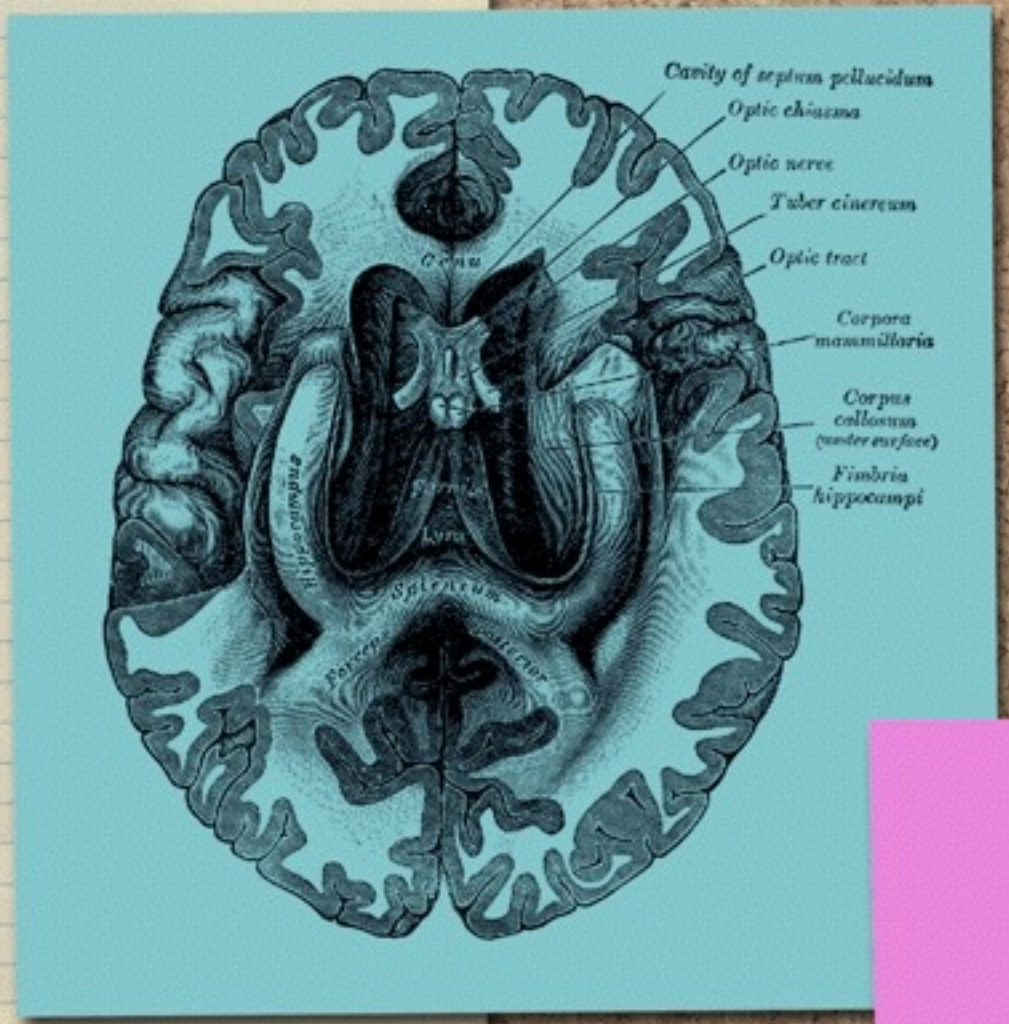
fine motor control

gross motor control

emotional bonds

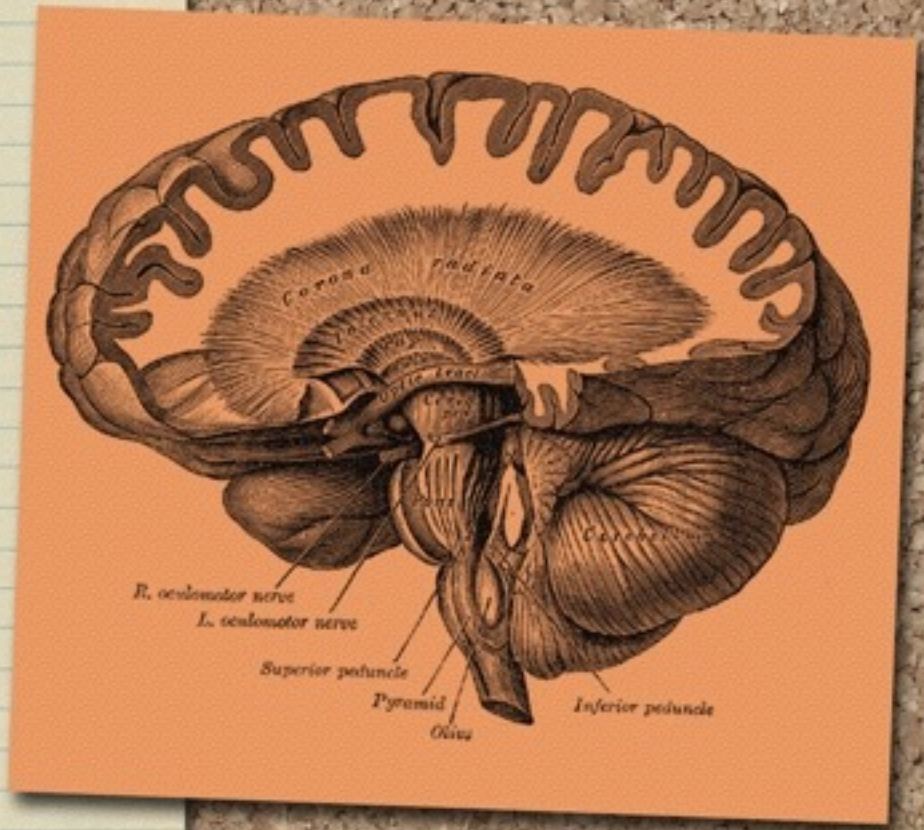
sense of balance

instinctive behavior (like sex)



Neuroplasticity applies equally to the frontal lobes that support creative thinking.

Neuroplasticity even allows one hemisphere of the brain to compensate for a weakness in the other by taking over some of its functions - called “mirror region takeover.”



Paul: 7-month-old whose right parietal lobe was destroyed in a car accident.

At 17, Paul was having problems with math (which should have been dealt with in left, not right hemisphere)

FMRI showed left lobe was now processing visual spatial information leaving no room to process math.

Accident occurred <u>before</u> stage of development where left lobe would have been needed for calculation.

Prior to 6-years-old (when math would begin to develop) visual-spatial activity found its home in the part of the brain most like the right parietal lobe - the left parietal lobe allowing Paul to learn to navigate the world.

Michelle - damaged left frontal lobe from birth.

-left frontal lobe: stores memories of individual events.

-right frontal lobe: extracts theme or main point from a series of events

Frontal lobes together are the part of the brain that is most uniquely human as they are most developed in humans relative to other animals.

Michelle has same mirror area adaption as paul, but in frontal lobes.

Ability to remember individual events was earlier developmental need so it found its home in the functional right frontal lobe crowding out normal activities that would occur there.

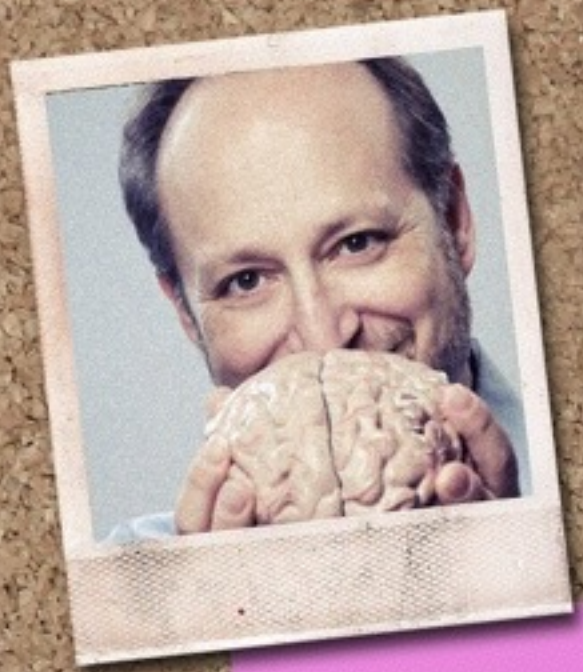
Michelle has difficulty with...

- -getting the main point
- -understanding metaphors and concepts
- -abstract thought
- -planning
- -envisioning the future

But Michelle has a savant's ability to...

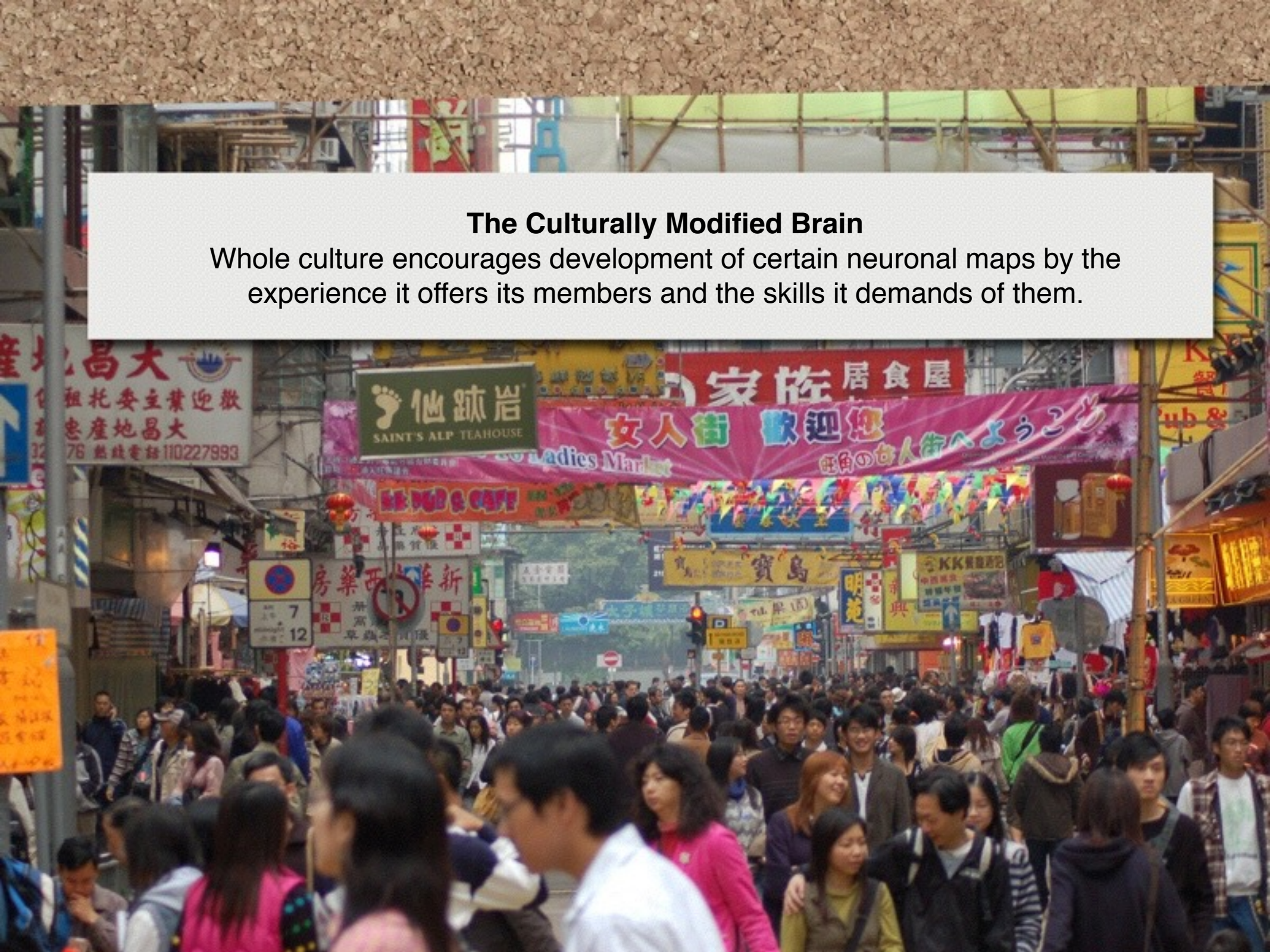
- -remember individual events
- -know exact dates and times
- -memorize cards (whiz @ solitaire)

But Why?



“People without disabilities can benefit from liberating one hemisphere from another”

Norman Doidge, The Brain That Can Change Itself



The Culturally Modified Brain

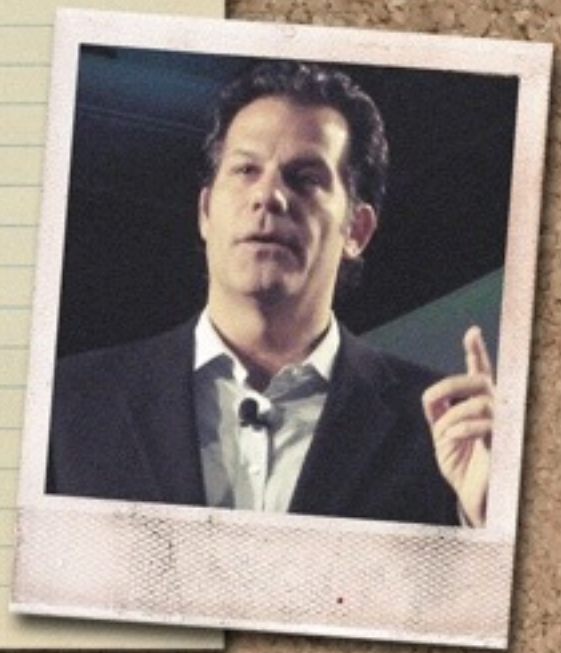
Whole culture encourages development of certain neuronal maps by the experience it offers its members and the skills it demands of them.

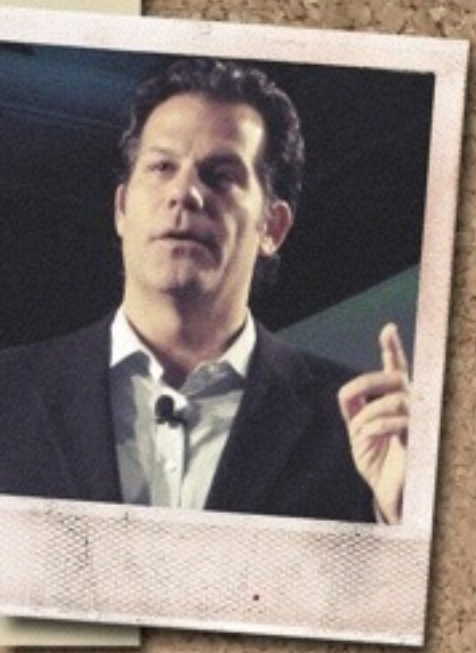
Historical Perspective:
Movement from Organizational Age
to Creative Age

How does our culture help to articulate our brain map in a creative age?

Florida Issues:

- -capacity for personal expression
- -freedom to shape your own job
- -flexible time
- -flat organization
- -personal motivation





How do we as individuals help to articulate our brain map to make ourselves better at creative problem solving?

-Experiential Life
-Csitzentmihali's 4-step recipe
-self-education

Twitter Card from fourth class period:
What is one small thing I can do in terms of lifestyle/daily activities to increase the action of my frontal lobe and make me better at creative problem solving?