Self-Directed Neuroplasticity

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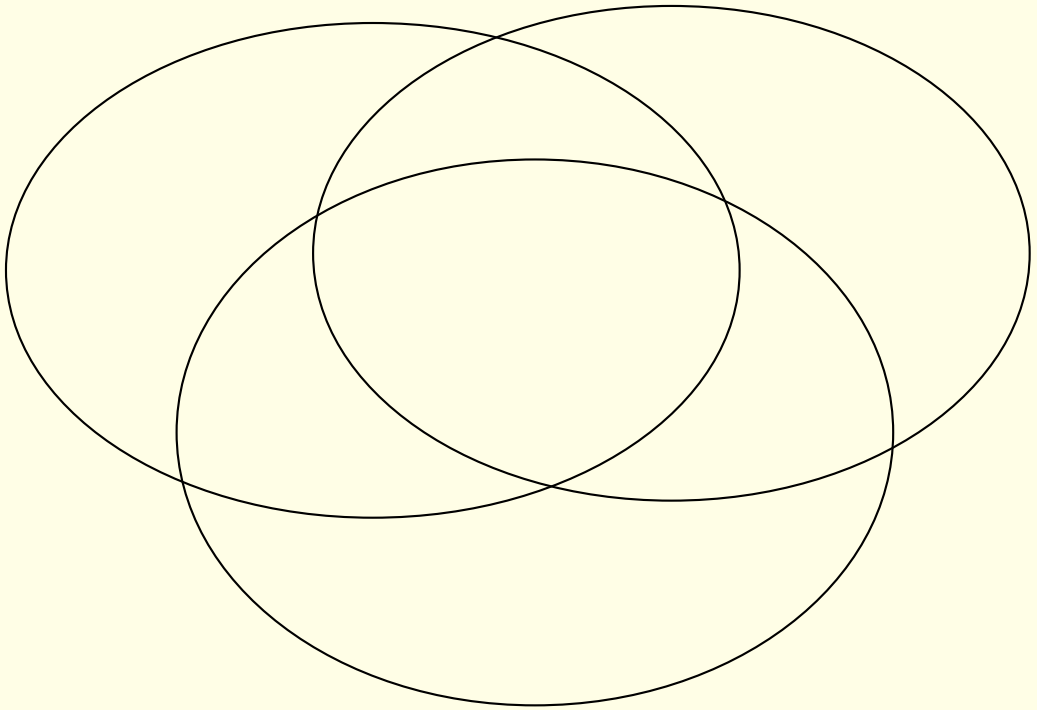
Topics

- Fertile intersections
- Your brain: technical specs
- Self-directed neuroplasticity
- The brain: so what?
- Cultivating inner resources
- Natural happiness

Fertile Intersections

Common - and Fertile - Ground



The history of science is rich in the example of the fruitfulness of bringing two sets of techniques, two sets of ideas, developed in separate contexts for the pursuit of new truth, into touch with one another.

J. Robert Oppenheimer

Do not go by oral tradition, by lineage of teaching, by hearsay, by a collection of texts, by logic, by inferential reasoning,

by reasoned cognition, by the acceptance of a view after pondering it, by the seeming competence of a speaker,

or because you think, "this . . . is our teacher."

But when you know for yourselves, "these things are wholesome, these things are blameless; these things are praised

by the wise; these things, if undertaken and practiced,

lead to welfare and happiness,"

then you should engage in them.

The Buddha

Great questioning, great enlightenment;
little questioning, little enlightenment;
no questioning, no enlightenment.

Dogen

We ask, "What is a thought?"

We don't know,

yet we are thinking continually.

Venerable Tenzin Palmo

When the facts change,
I change my mind, sir.

What do you do?

John Maynard Keynes

Domains of Intervention

- We can intervene in three domains:
  - World (including relationships)
  - Body
  - Mind
- All three are important. And they work together.
- We have limited influence over world and body.
- In the mind:
  - Much more influence
  - Changes are with us wherever we go

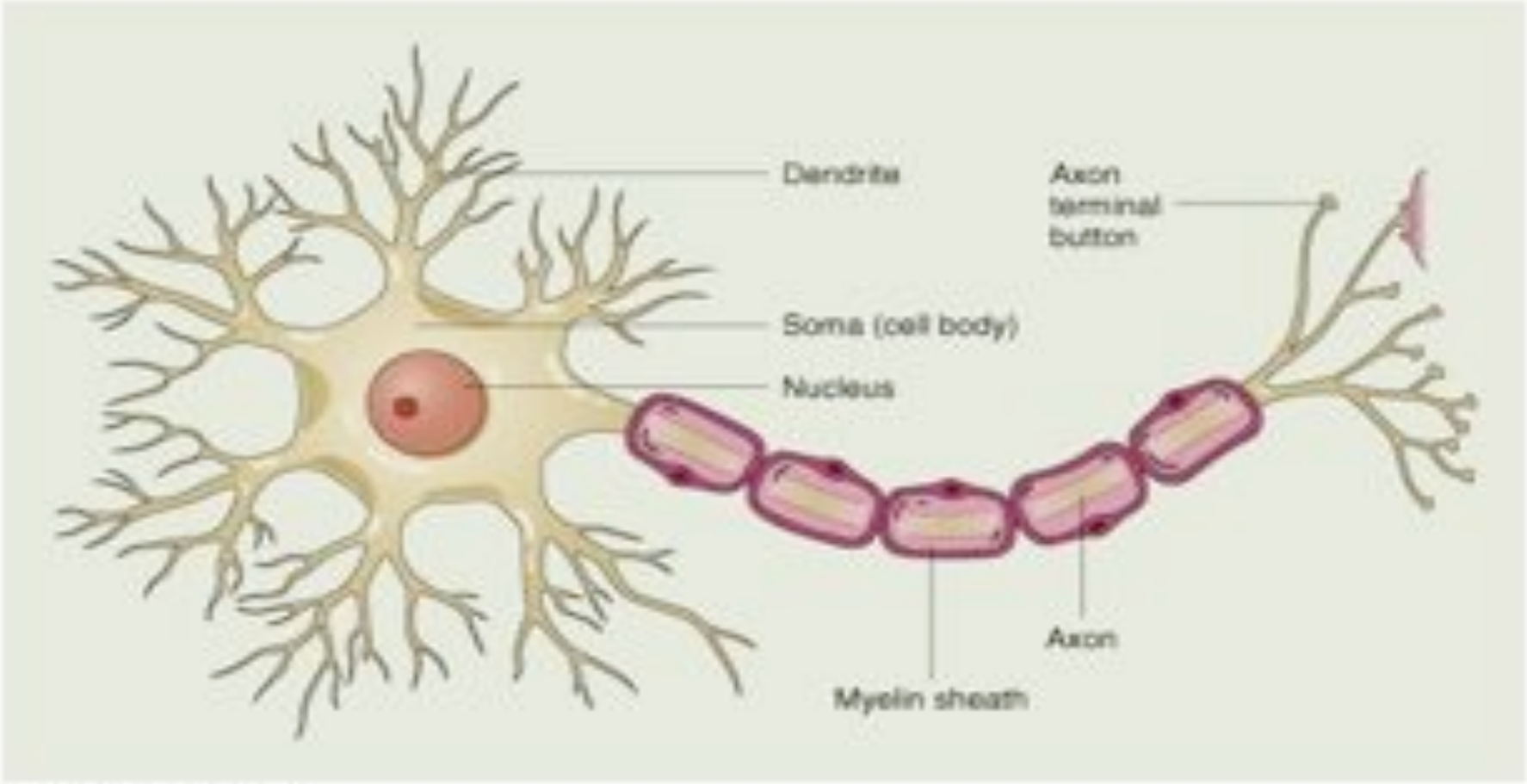
Your Brain: Technical Specs

Your Brain: The Technical Specs

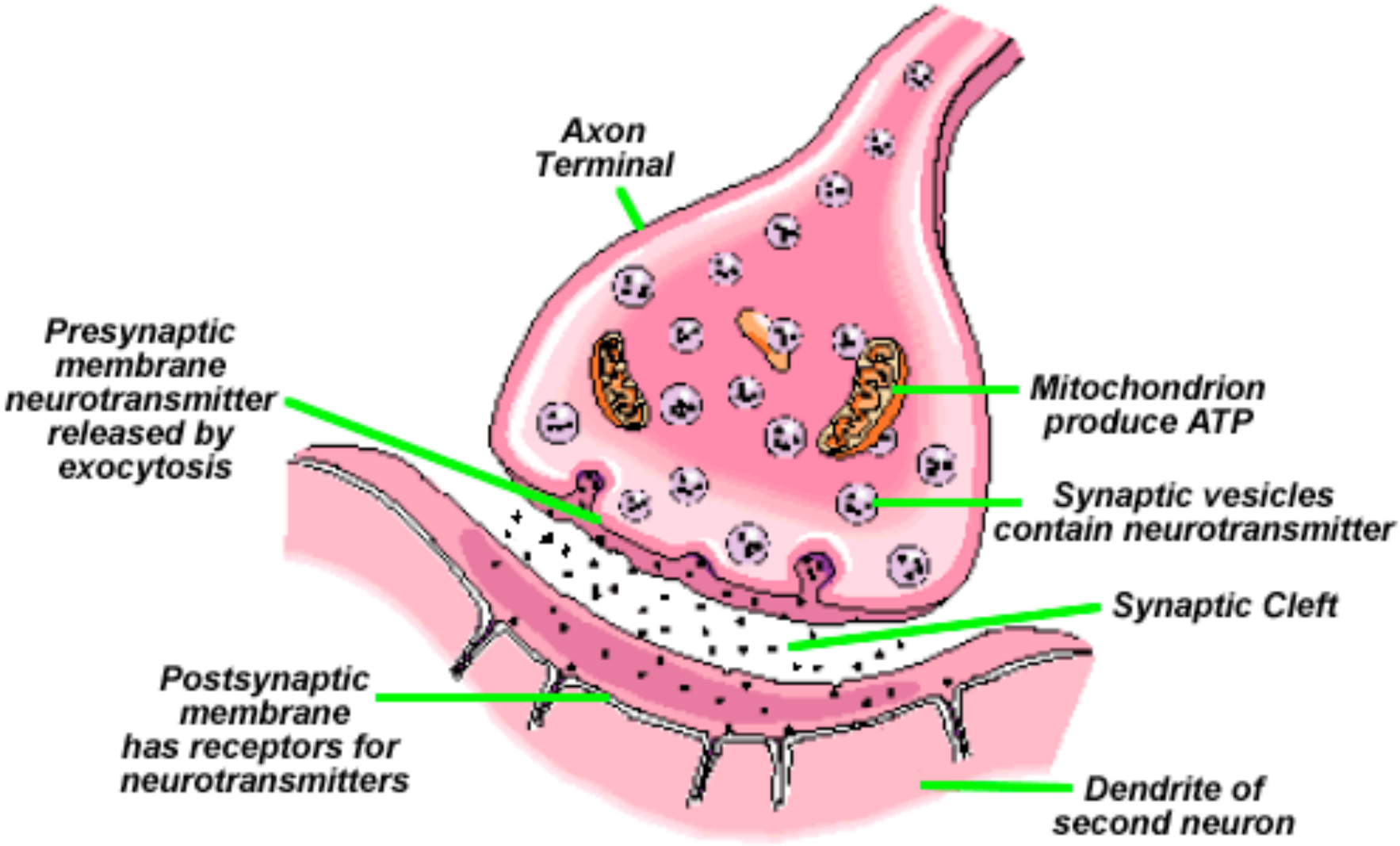
- **Size:**
  - 3 pounds of tofu-like tissue
  - 1.1 trillion brain cells
  - 100 billion “gray matter" neurons
- **Activity:**
  - Always on 24/7/365 - Instant access to information on demand
  - 20-25% of blood flow, oxygen, and glucose
- **Speed:**
  - Neurons firing around 5 to 50 times a second (or faster)
  - Signals crossing your brain in a tenth of a second
- **Connectivity:**
  - Typical neuron makes ~ 5000 connections with other neurons:

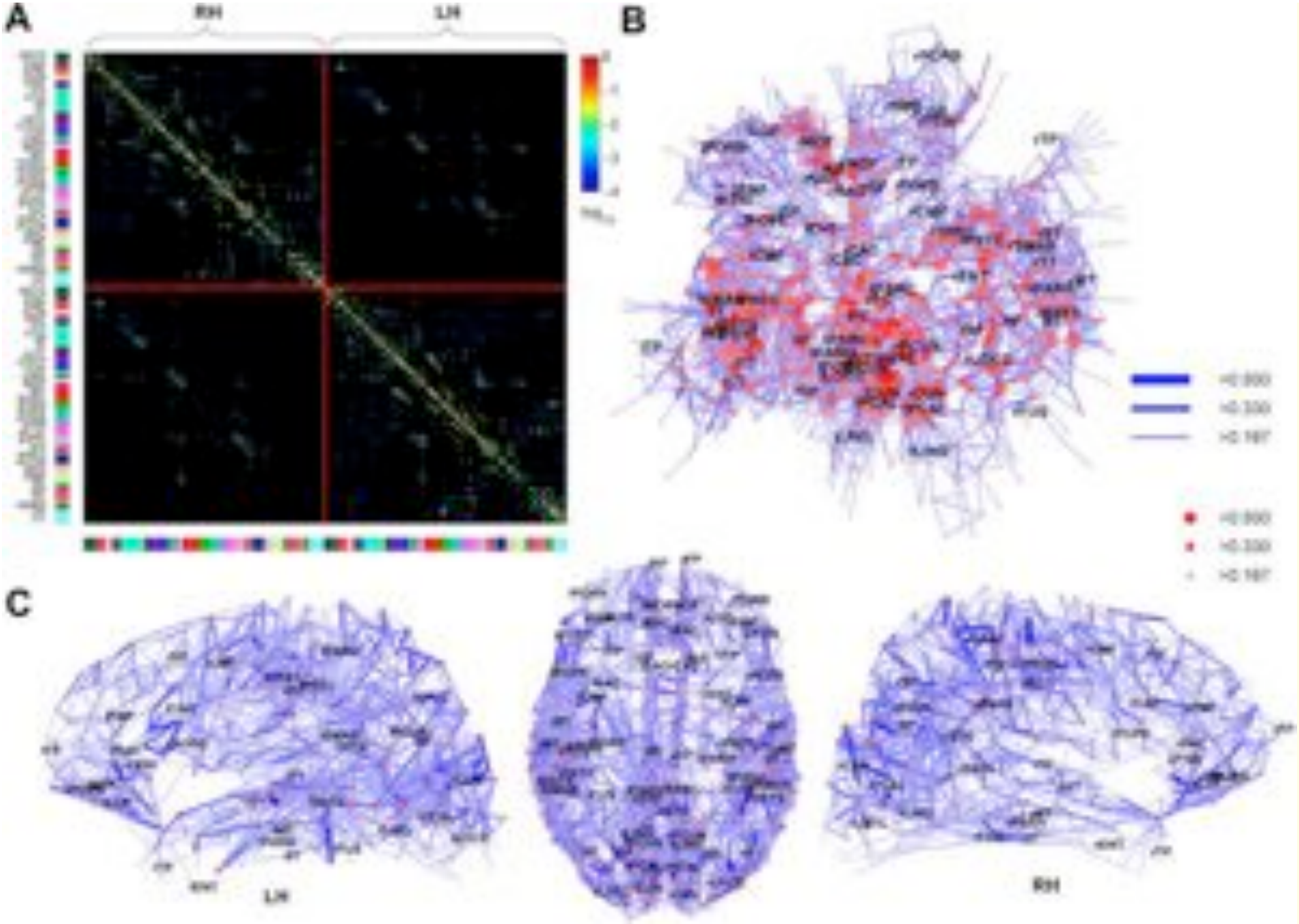
  ~ 500 trillion synapses

A Neuron



A SYNAPSE


Axon Terminal
Presynaptic membrane neurotransmitter released by exocytosis
Mitochondrion produce ATP
Synaptic vesicles contain neurotransmitter
Synaptic Cleft
Postsynaptic membrane has receptors for neurotransmitters
Dendrite of second neuron


A
RH
LH
B
C
LH
RH

Specialization and Teamwork

- Specialized functions
  - Speech production differs from comprehension.
  - Face recognition
- Working in harmony as a network
  - Network “noise” facilitates individual signals.
  - *“Specialization is for insects.”* - Robert Heinlein
  - Distributed information - “Holographic”
  - One part can compensate for damage to another.
- No localized self -

  “Self” is in the system, not the cells.

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. . . A Profoundly Complex System

Your brain is the most complex object known in the universe.

Sources of Individuality

- **Genetic Variation**, such as**:**
  - Receptors for neurotransmitters
  - The numbers of neurons and their connections
- **Gender:**
  - Similarities outweigh the subtle differences
- **Variation in synaptic connections** for exactly the same reflex . . . or concept
- **History:**
  - Fetal
  - Lifespan

Implications of Individuality

- Respect for individual differences
- Compassion for oneself and others
- The Buddha said there are four kinds of practitioners:
  - Those for whom practice is easy and quick
  - Those for whom practice is easy and long
  - Those for whom practice is hard and quick
  - Those for whom practice is hard and long
- All you can do is tend to the causes leading to good results, like the care and feeding of your own brain.

Self-Directed Neuroplasticity

The Mind/Brain System

- "Mind" = flow of information within the nervous system
  - Information is represented by the nervous system.
  - Most mind is unconscious; awareness is part of mind.
  - The headquarters of the nervous system is the brain.

- In essence then, apart from hypothetical transcendental factors, your mind *is* what your brain *does*.

- Brain = necessary, *proximally* sufficient condition for mind.
  - The brain depends on the nervous system, which intertwines with and depends on other bodily systems.
  - These systems in turn intertwine with and depend upon nature and culture, both presently and over time.
  - And as we'll see, the brain also depends on the mind.

Within the Frame of Western Science

Our focus is on how to use the mind to change the brain to benefit the mind.

There could be Transcendental factors at work in the brain and the mind.

Since this cannot be proven either way, a truly scientific attitude is to accept it as a possibility.

Bowing to the possibility of the Transcendental, I'll stay within the frame of Western science.

Fact #1

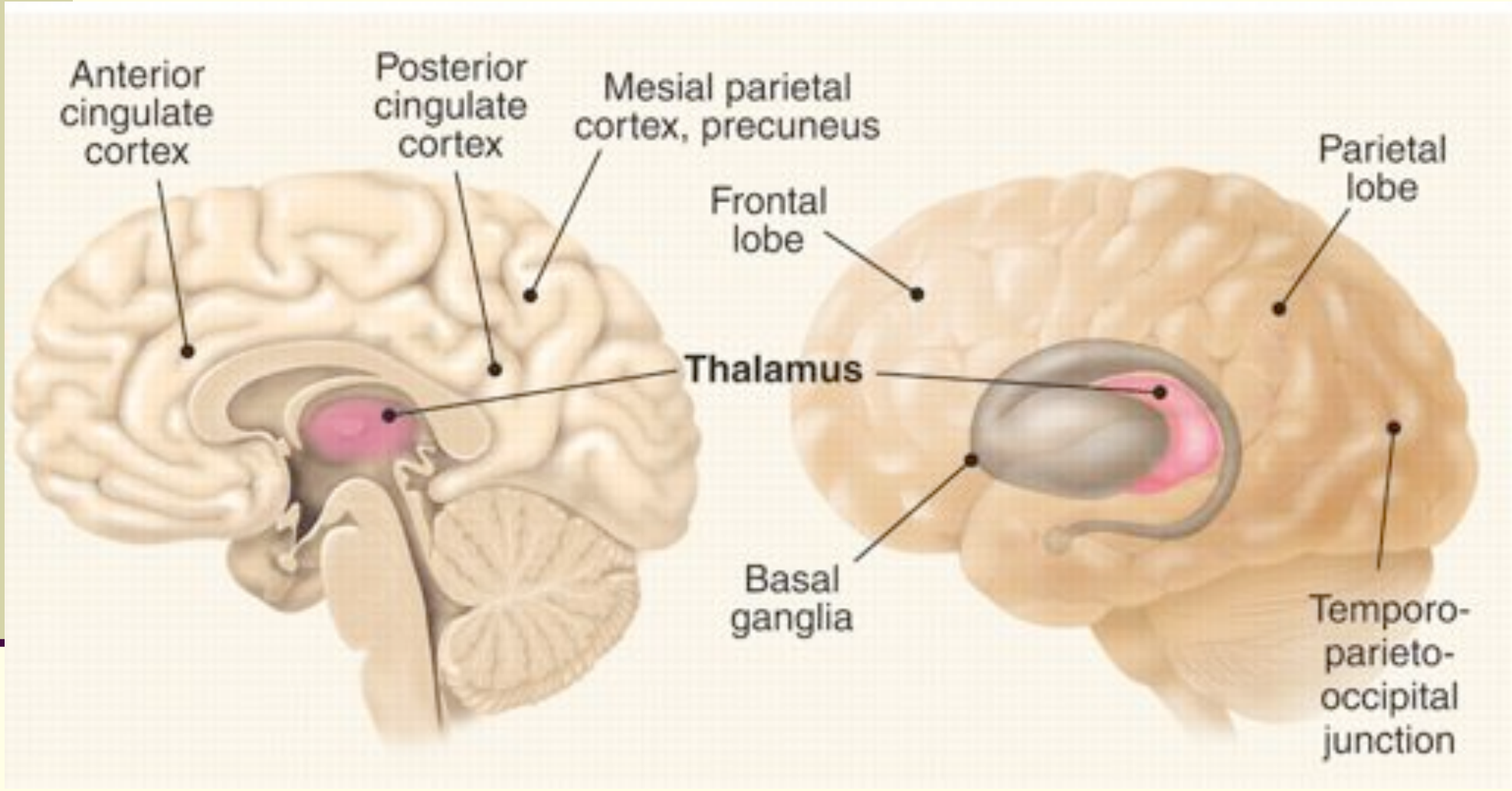
<u>As your brain changes, your mind changes</u>.

Ways That Brain Can Change Mind

- For better:
  - A little caffeine: more alertness
  - Thicker insula: more self-awareness, empathy
  - More left prefrontal activation: more happiness

- For worse:
  - Intoxication; imbalances in neurotransmitters
  - Concussion, stroke, tumor, Alzheimer's
  - Cortisol-based shrinkage of hippocampus: less capacity for contextual memory

Key Brain Areas for Consciousness



(adapted from) M. T. Alkire et al., Science 322, 876-880 (2008)

Fact #2

As your mind changes, your brain changes.

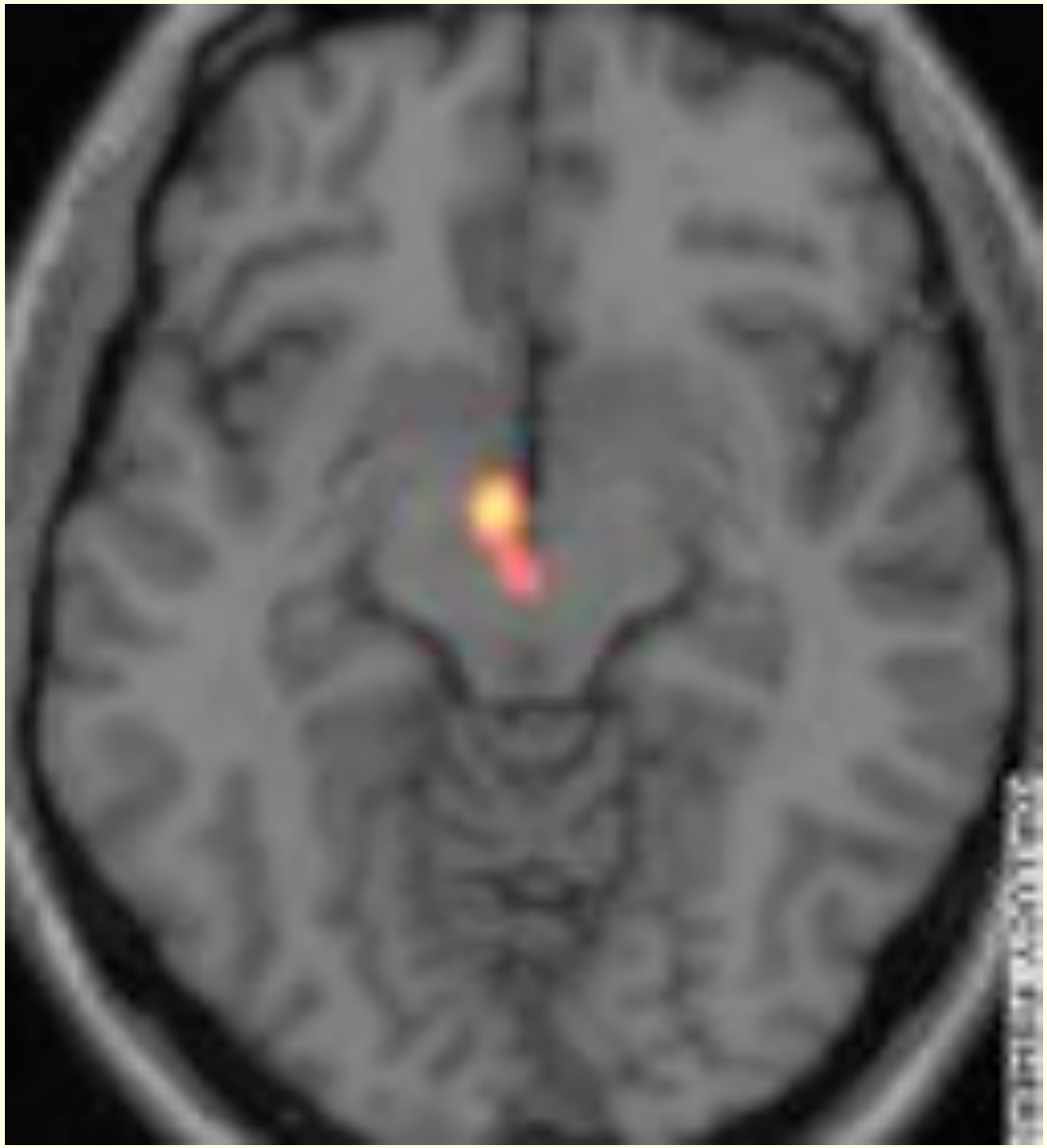
Immaterial mental activity maps to material neural activity.

This produces temporary changes in your brain and lasting ones.

Temporary changes include:

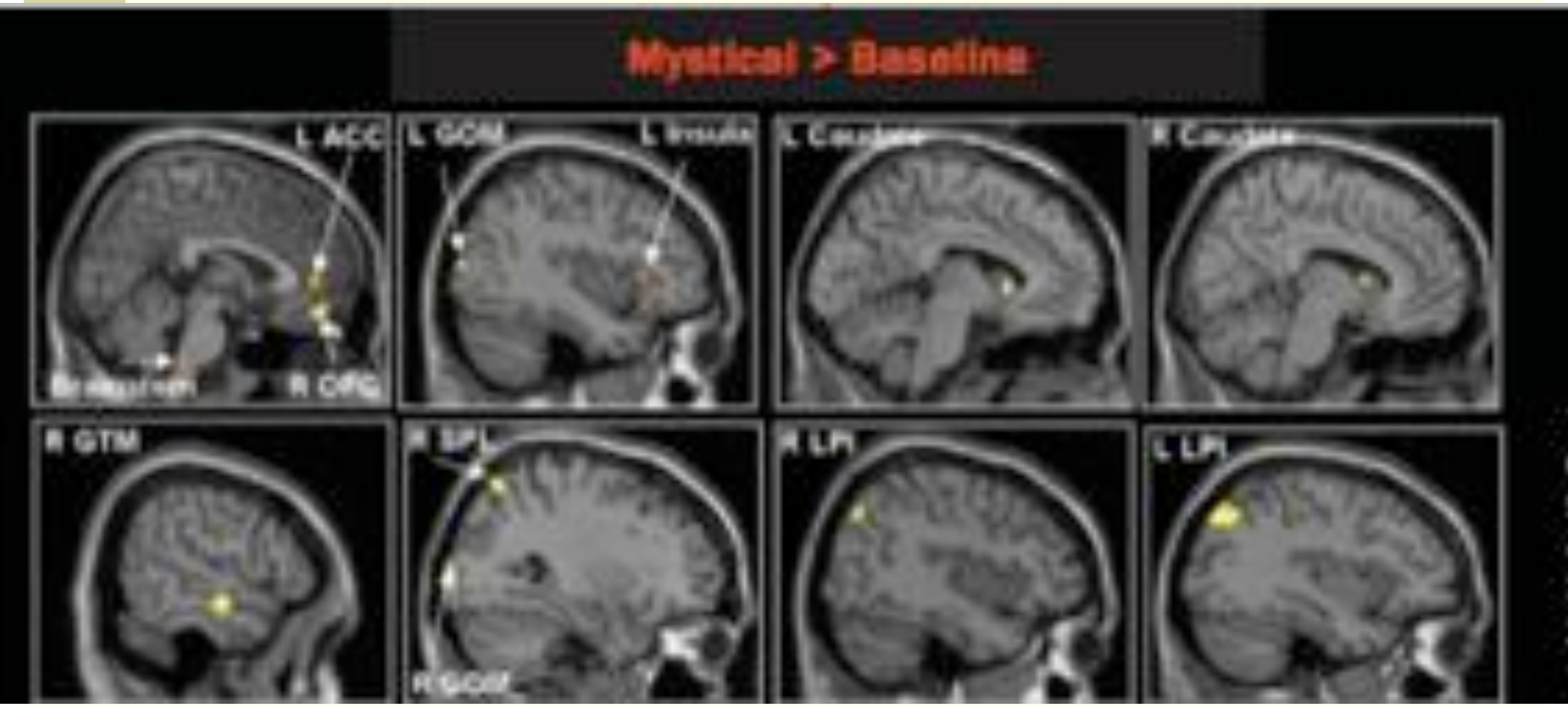
- Alterations in brainwaves (= changes in the firing patterns of synchronized neurons)
- Increased or decreased use of oxygen and glucose
- Ebbs and flows of neurochemicals

The Rewards of Love



Tibetan Monk, Boundless Compassion

Christian Nuns, Recalling Profound Spiritual Experiences

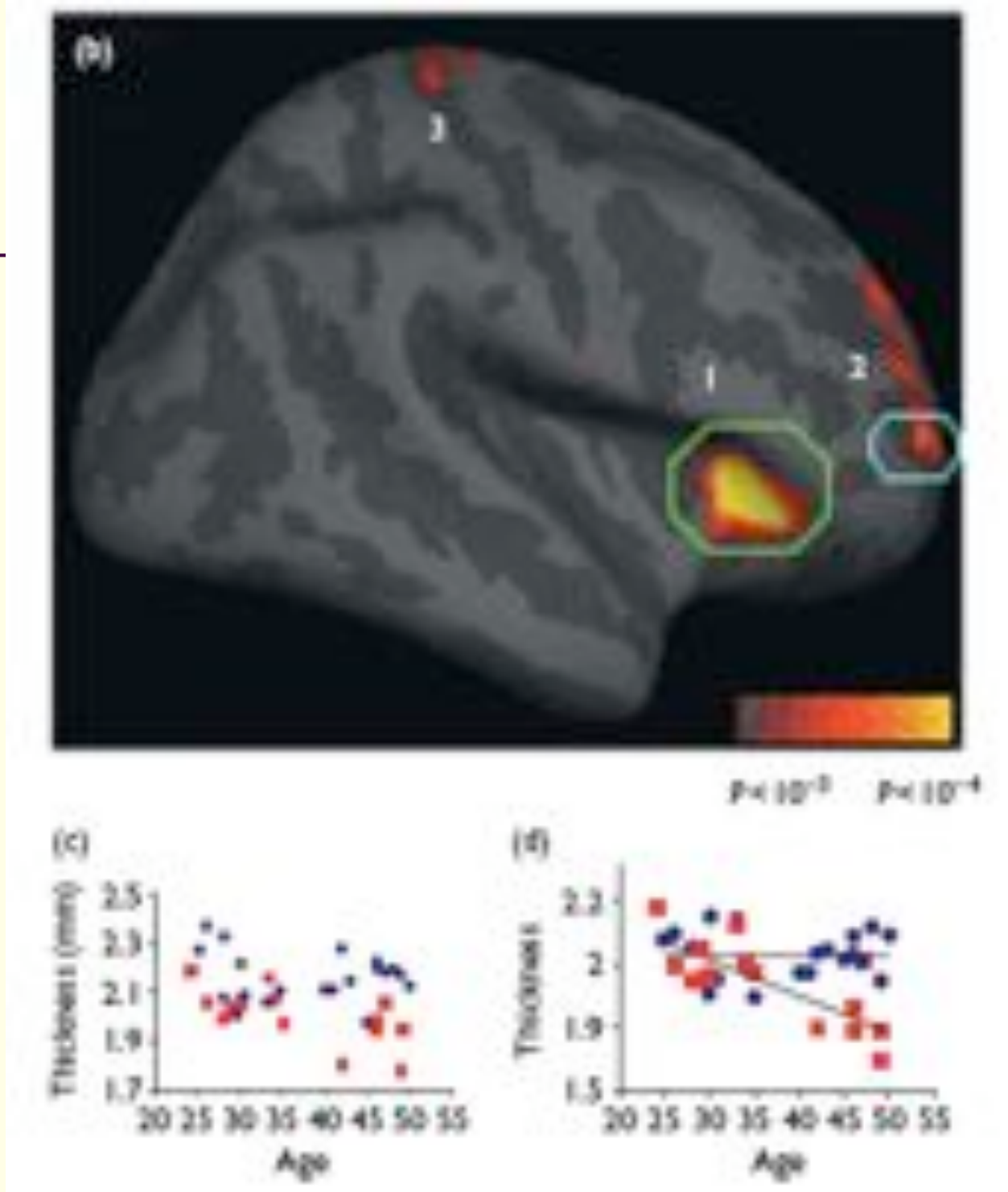


Beauregard, et al., *Neuroscience Letters,* 9/25/06

Mind Changes Brain in Lasting Ways

- What flows through the mind sculpts your brain. Immaterial experience leaves material traces behind.
- Increased blood/nutrient flow to active regions
- Altered epigenetics (gene expression)
- “Neurons that fire together wire together.”
  - Increasing excitability of active neurons
  - Strengthening existing synapses
  - Building new synapses; thickening cortex
  - Neuronal “pruning” - “use it or lose it”

Lazar, et al. 2005. Meditation experience is associated with increased cortical thickness. *Neuroreport*, 16, 1893-1897.



Physical Effects of Meditation

- Thickens and strengthens anterior (frontal) cingulate cortex and insula. Results include improved attention, empathy, and compassion.
- Less cortical thinning with aging
- Increases activation of left frontal regions, which lifts mood
- Increases power and reach of gamma-range brainwaves
- Decreases stress-related cortisol
- Stronger immune system

The principal activities of brains are making changes in themselves.

Marvin L. Minsky

Honoring Experience

One's experience *matters*.

Both for how it feels in the moment and for the lasting residues it leaves behind, woven into the fabric of a person's brain and being.

Fact #3

You can use your mind
to change your brain
to change your mind for the better.

This is self-directed neuroplasticity.

How to do this, in skillful ways?

Self-Goodwill

- All the great teachers have told us to be compassionate and kind toward all beings. And that whatever we do to the world affects us, and whatever we do to ourselves affects the world.

- You are one of the “all beings!” And kindness to yourself benefits the world, while hurting yourself harms the world.

- It’s a general moral principle that the more power you have over someone, the greater your duty is to use that power wisely. Well, who is the one person in the world you have the greatest power over? It’s your future self. You hold that life in your hands, and what it will be depends on how you care for it.

- Consider yourself as an innocent child, as deserving of care and happiness as any other.

“Anthem”

Ring the bells that still can ring
Forget your perfect offering
There is a crack in everything
That’s how the light gets in
That’s how the light gets in

Leonard Cohen

The Brain: So What?

Neuroplasticity in Context

- Neuroplasticity is not breaking news. It's been long presumed that mental activity changed neural structure: what else is learning?
- The news is in how the mind changes the brain.
- Most neuroplasticity is incremental, not dramatic.
- Neuroplasticity is ethically neutral.

Grounding in the Brain - Benefits

- Organizing framework
  - Evolutionary neuropsychology
  - Common ground across theories and methods
- Motivating to clients, clinicians, policy-makers
  - Concrete, in the body, *physical*
  - Status of medicine, hard science
- Highlighting key principles and practices
  - Implicit memory
  - Nonverbal processes
- Innovating with truly new methods
  - Neurofeedback
  - Fear extinction

Grounding in the Brain - Pitfalls

- Adding little new meaning
  - Replacing psych terms with neuro ("amygdala made me do it")
- Over-simplifying
  - Over-localizing function (e.g., empathy = mirror neurons)
  - Exaggerated terms ("God-gene," "female brain")
  - Materialistic reductionism, though brain and mind co-arise
- Claiming authority
  - Using neuro data to argue a political or cultural case
  - Using the secular religion of science to elevate status
- Underestimating the mind
  - Most big changes in psyche involve tiny changes in soma; mental plasticity holds more promise than neural plasticity.
  - Overlooking the insights and effectiveness of psychology
  - Ducking existential choices in values

Your Brain Makes You Suffer

The Evolution of Suffering

- Animals survive through three fundamental strategies. When these run into trouble, unpleasant alarm signals pulse through the nervous system.

- But trouble comes constantly: each strategy contains inherent contradictions, as the animal keeps trying:
  - To ***separate what is actually connected*** – in order to create a boundary between itself and the world
  - To ***stabilize what keeps changing*** – in order to maintain its internal systems within tight ranges
  - To ***hold onto fleeting pleasures and escape inevitable pains*** – in order to approach opportunities and avoid threats

The Three Marks of Existence

These survival strategies fly in the face of three observations the Buddha made about the nature of existence:

- Everything is connected to everything else, so nothing has an absolute, independent self-nature
- Everything is impermanent, constantly changing
- Suffering arises when we crave the lasting of pleasure and the ending of pain.

A Harvest of Suffering

- The unfortunate result of our highly evolved brain is that it's fertile ground for a harvest of suffering.

- Only humans worry about the future, regret the past, and blame themselves for the present. We get frustrated when we can't have what we want and disappointed when what we like ends. We suffer *that* we suffer. We get upset about being in pain, angry about dying, sad about waking up sad yet another day.

- This kind of suffering – which encompasses most of our unhappiness and dissatisfaction – is constructed by the brain. It is made up. Which is ironic, poignant, and supremely hopeful.

If the brain is the cause of your suffering, it can also be its cure.

Cultivating Inner Resources

The Importance of Inner Resources

- Examples:
  - Character virtues
  - Positive introjects
  - Corrective emotional experiences in psychotherapy
  - Learned optimism
  - Brahmaviharas; Paramittas; awakening factors

- Benefits
  - Increase positive emotions: physical and mental health
  - Improve self-soothing
  - Improve outlook on world, self, and future
  - Increase resilience, determination
  - Promote prosocial behaviors

The good life, as I conceive it, is a happy life.
I do not mean that if you are good you will be happy;
I mean that if you are happy you will be good.

Bertrand Russell

Factors of Neuroplasticity

- Physiological:
  - Norepinephrine (moderate)
  - Dopamine
  - Acetylcholine
  - Brain-derived neurotrophic factor (BDNF)
  - Natural opiods (?) (e.g., endorphins)
  - Neurogenesis (promoted by exercise)
- Mental:
  - Priming memory through intention
  - Target material:
    - Is within awareness
    - Receives focused attention
    - Is sustained, multimodal, and intense

The Power of Mindfulness

- Attention is like a spotlight, illuminating what it rests upon.
- Because neuroplasticity is heightened for what's in the field of focused awareness, attention is also like a vacuum cleaner, sucking its contents into the brain.
- Directing attention skillfully is therefore a fundamental way to shape the brain - and one's life over time.

The education of attention
would be an education par excellence.
William James

Mindfulness, Virtue, Wisdom

- **Mindfulness** (or “concentration”), **virtue**, and **wisdom** are identified in Buddhism and other contemplative traditions as the pillars of practice.
- In Western psychology, these are the foundations of mental health and well-being.
- These three pillars map to three core functions of the nervous system:
  - Receiving/learning
  - Regulating
  - Prioritizing/selecting

"Know the Mind, Shape the Mind, Free the Mind"

- **Mindfulness**, **virtue**, and **wisdom -** and their neural correlates **-** also map to three phases of practice:
  - Be aware of the garden, pull weeds, plant flowers.
  - Be mindful of, release, replace.
  - Let be, let go, let in.
- People vary in their inclinations and strengths with the phases.
- Sometimes we need to take in resources in the third phase in order to bear our own experience.
- Mindfulness is key to the second and third phase, sometimes curative on its own, and always beneficial in strengthening its neural substrates. But often it is not enough by itself.

Just having positive experiences is not enough.

They pass through the brain like water through a sieve, while negative experiences are caught.

We need to engage positive experiences actively to weave them into the brain.

That's where sustained mindfulness comes in - making the brain like Velcro for positive experiences, but Teflon for negative ones.

Compassion

The root of Buddhism is compassion,

and the root of compassion is compassion for oneself.

Pema Chodren

Self-Compassion

- Compassion is the wish that a being not suffer, combined with sympathetic concern. Self-compassion simply applies that to oneself. It is not self-pity, complaining, or wallowing in pain.

- Studies show that self-compassion buffers stress and increases resilience and self-worth.

- But self-compassion is hard for many people, due to feelings of unworthiness, self-criticism, or “internalized oppression.” To encourage the neural substrates of self-compassion:
  - Get the sense of being cared about by someone else.
  - Bring to mind someone you naturally feel compassion for
  - Sink into the experience of compassion in your body
  - Then shift the compassion to yourself, perhaps with phrases like: “May I not suffer. May the pain of this moment pass.”

Natural Happiness

Reverse Engineering the Brain

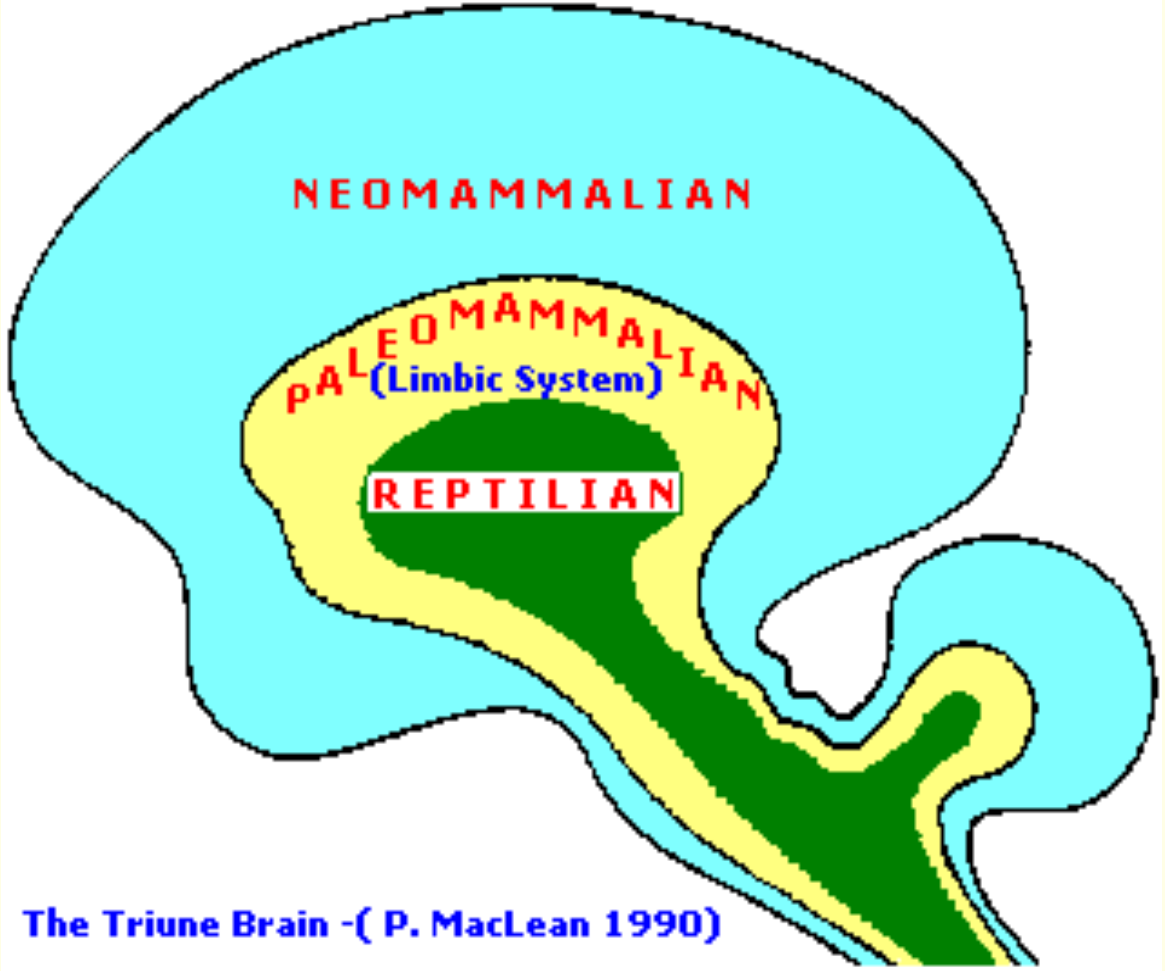
What's the nature of the brain when a person is:

- In peak states of productivity or "flow?"
- Experiencing inner peace?
- Self-actualizing?
- Enlightened (or close to it)?

Evolution

- ~ 4+ billion years of earth
- 3.5 billion years of life
- 650 million years of multi-celled organisms
- 600 million years of nervous system
- ~ 200 million years of mammals
- ~ 60 million years of primates
- ~ 6 million years ago: last common ancestor with chimpanzees, our closest relative among the “great apes” (gorillas, orangutans, chimpanzees, bonobos, humans)
- 2.5 million years of tool-making (starting with brains 1/3 our size)
- ~ 150,000 years of *homo sapiens*
- ~ 50,000 years of modern humans
- ~ 5000 years of blue, green, hazel eyes

Evolutionary History



The Triune Brain

Three Stages of Brain Evolution

- **Reptilian:**
  - Brainstem, cerebellum, hypothalamus
  - Reactive and reflexive
  - **Avoid** hazards
- **Mammalian:**
  - Limbic system, cingulate, early cortex
  - Memory, emotion, social behavior
  - **Approach** rewards
- **Human:**
  - Massive cerebral cortex
  - Abstract thought, language, cooperative planning, empathy
  - **Attach** to “us”

Three Motivational Systems

- **Avoid** “sticks,” threats, penalties, pain
- **Approach** “carrots,” opportunities, rewards, pleasure
- **Attach** to “us,” for proximity, bonds, feeling close
- Although the three branches of the vagus nerve loosely map to the three systems, the essence of each is its aim, not its neuropsychology.
- Each system can draw on the other two for its ends.

Home Base of the Human Brain

When not threatened, ill, in pain, hungry, upset, or chemically disturbed, most people settle into being:

- **Calm** (the Avoid system)
- **Contented** (the Approach system)
- **Caring** (the Attach system)
- **Creative -** synergy of all three systems

This is the brain in its natural, ***responsive*** mode.

The Responsive Mode

Behind the Obscurations

Sam sees *"peeping among the cloud-wrack . . . a white star twinkle for a while.*

The beauty of it smote his heart, as he looked up out of the forsaken land, and hope returned to him.

For like a shaft, clear and cold, the thought pierced him that in the end the Shadow was only a small and passing thing: there was light and high beauty forever beyond its reach."

Tolkein, *The Lord of the Rings*

Some Benefits of Responsive Mode

- Recovery from “mobilizations” for survival:
  - Refueling after depleting outpourings
  - Restoring equilibrium to perturbed systems
  - Reinterpreting negative events in a positive frame
  - Reconciling after separations and conflicts

- Promotes prosocial behaviors:
  - Experiencing safety decreases aggression.
  - Experiencing sufficiency decreases envy.
  - Experiencing connection decreases jealousy.
  - We’re more generous when our own cup runneth over.

But to Survive, We Leave Home . . .

- **Avoid**: When we feel threatened or harmed
- **Approach**: When we can't attain important goals
- **Attach**: When we feel isolated, disconnected, unseen, unappreciated, unloved

This is the brain in its ***reactive*** mode of functioning

- a kind of inner homelessness.

The Reactive Mode

Reactive Dysfunctions in Each System

- **Approach** - Addiction; over-drinking, -eating, -gambling; compulsion; hoarding; driving for goals at great cost; spiritual materialism
- **Avoid** - Anxiety disorders; PTSD; panic, terror; rage; violence
- **Attach** - Borderline, narcissistic, antisocial PD; symbiosis; *folie a deux*; “looking for love in all the wrong places”

Choices . . .

Reactive Mode

Or?

Responsive Mode

Coming Home . . .

Gladness

Love

Peace

Ways to "Take the Fruit as the Path"

General factors: See clearly. Have compassion for yourself. Take life less personally. Take in the good. Deepen equanimity.

Approach system

- Be glad.
- Appreciate your resources.
- Give over to your best purposes.

Attach system

- Sense the suffering in others.
- Be kind.
- Act with unilateral virtue.

Avoid system

- Cool the fires.
- Recognize paper tigers.
- Tolerate risking the dreaded experience.

Know the mind.

Shape the mind.

Free the mind.

Great Books

See www.RickHanson.net for other great books.

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Key Papers - 1

See www.RickHanson.net for other scientific papers.

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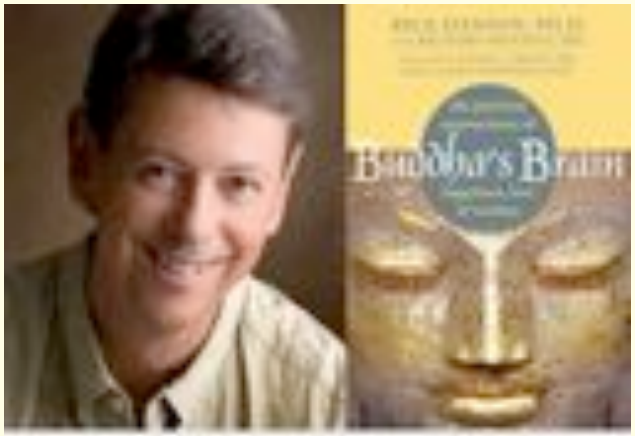
Where to Find Rick Hanson Online

http://www.youtube.com/BuddhasBrain

http://www.facebook.com/BuddhasBrain



Buddha's Brain: The Practical Neuroscience of Happiness, Love and Wisdom
Available at Amazon

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www.WiseBrain.org