Positive Neuroplasticity:

The Practical Science of Turning Good Moments into a Great Brain

Cape Cod

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Topics

- Self-directed neuroplasticity
- Self-compassion

- The evolving brain
- The negativity bias

- Taking in the good
- Healing old pain

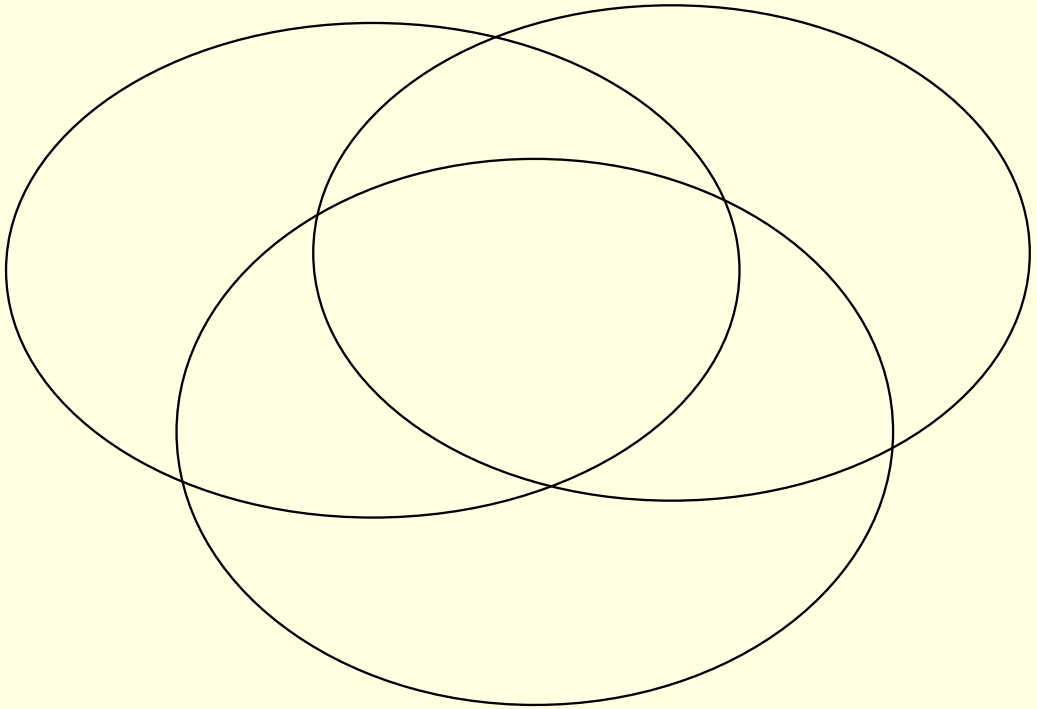
- De-fueling the fires of suffering

Perspectives

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

Common - and Fertile - Ground



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

What do you do?

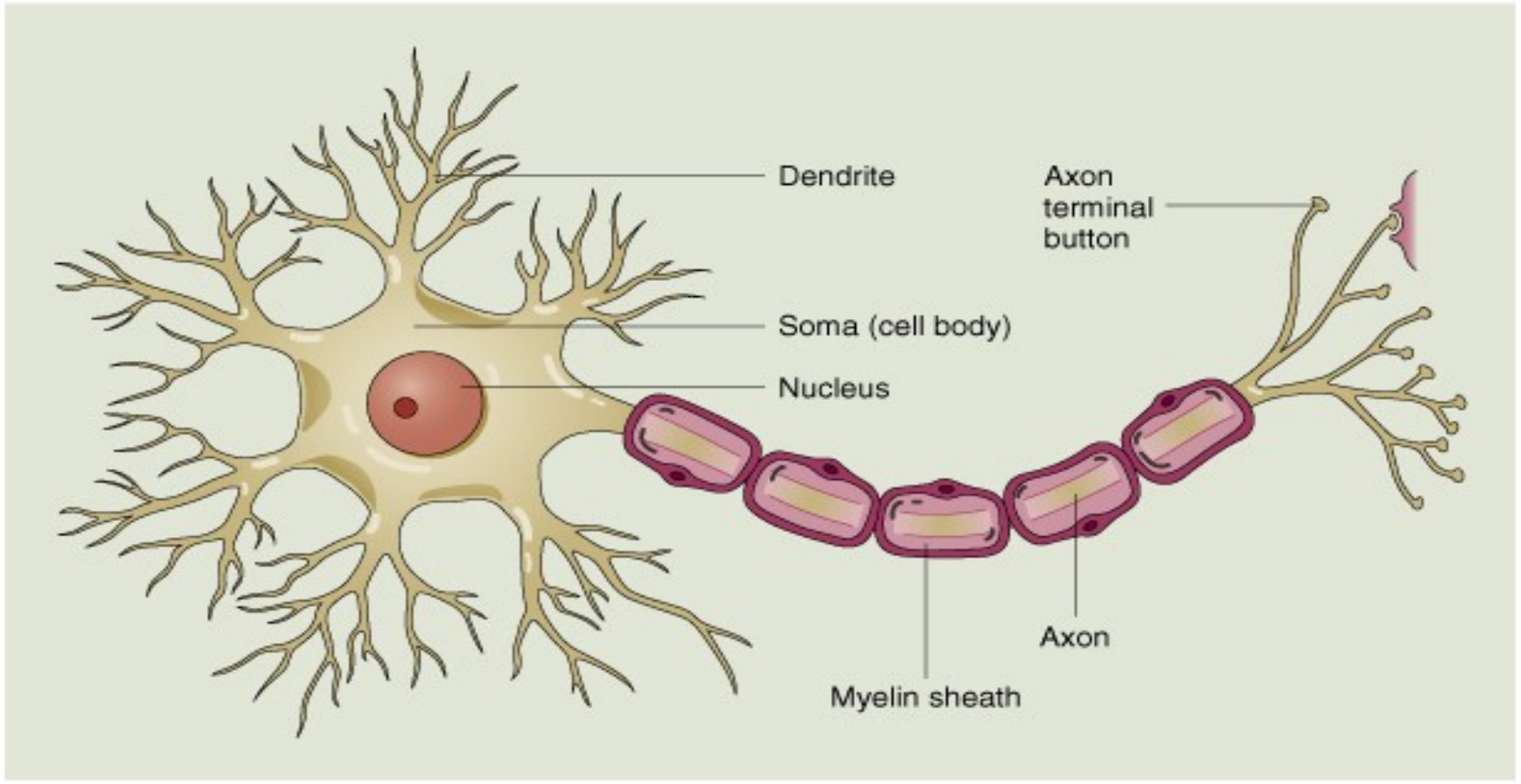
John Maynard Keynes

Self-Directed Neuroplasticity

[People] ought to know that
from nothing else but the brain
come joys, delights, laughter and sports,
and sorrows, griefs, despondency, and lamentations.

Hippocrates

A Neuron



Your Brain: The Technical Specs

- **Size:**
  - 3 pounds of tofu-like tissue
  - 1.1 trillion brain cells
  - 100 billion “gray matter" neurons

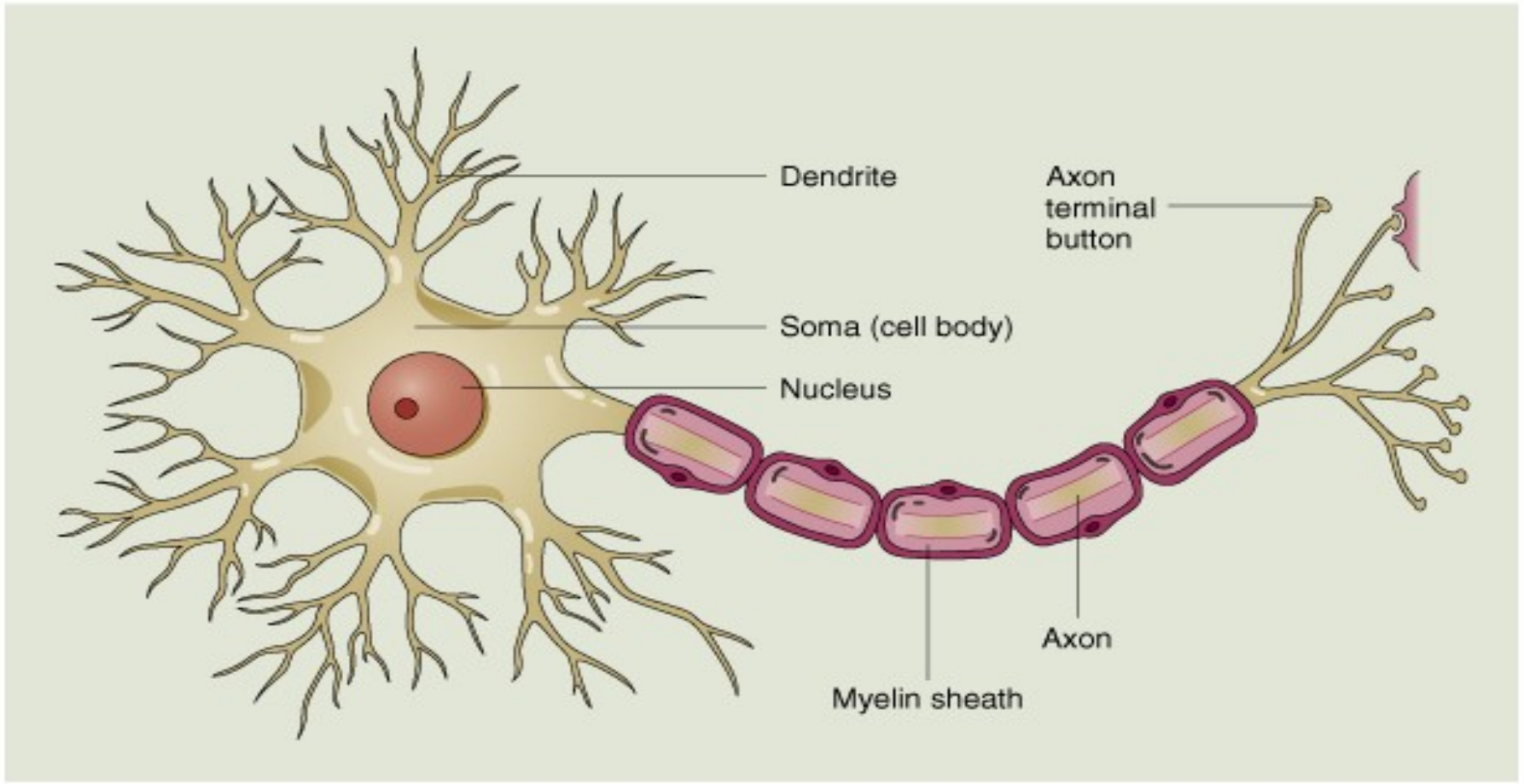
- **Activity:**
  - Always on 24/7/365 - Instant access to information on demand
  - 20-25% of blood flow, oxygen, and glucose

- **Speed:**
  - Neurons firing around 5 to 50 times a second (or faster)
  - Signals crossing your brain in a tenth of a second

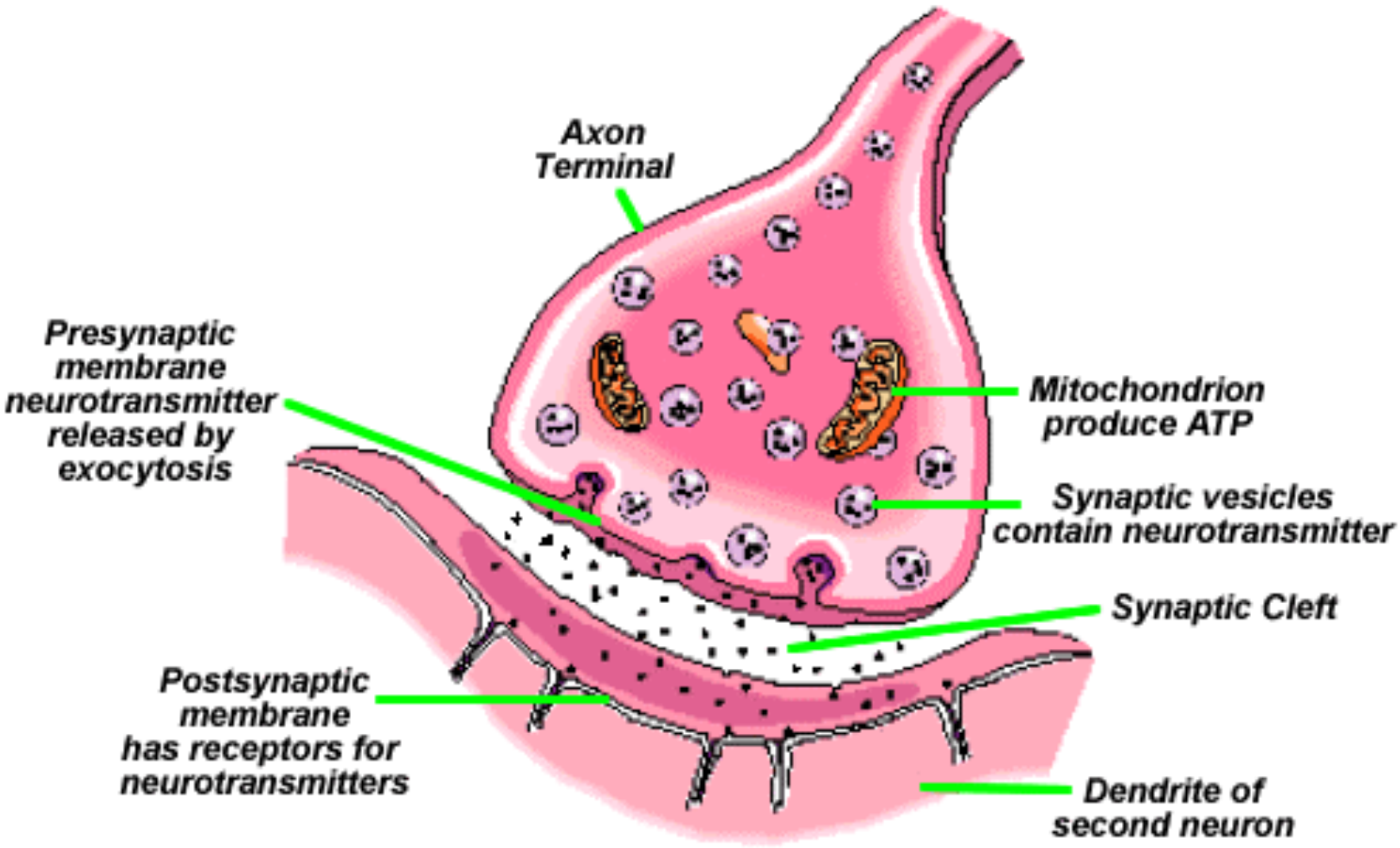
- **Connectivity:**
  - Typical neuron makes ~ 5000 connections with other neurons:

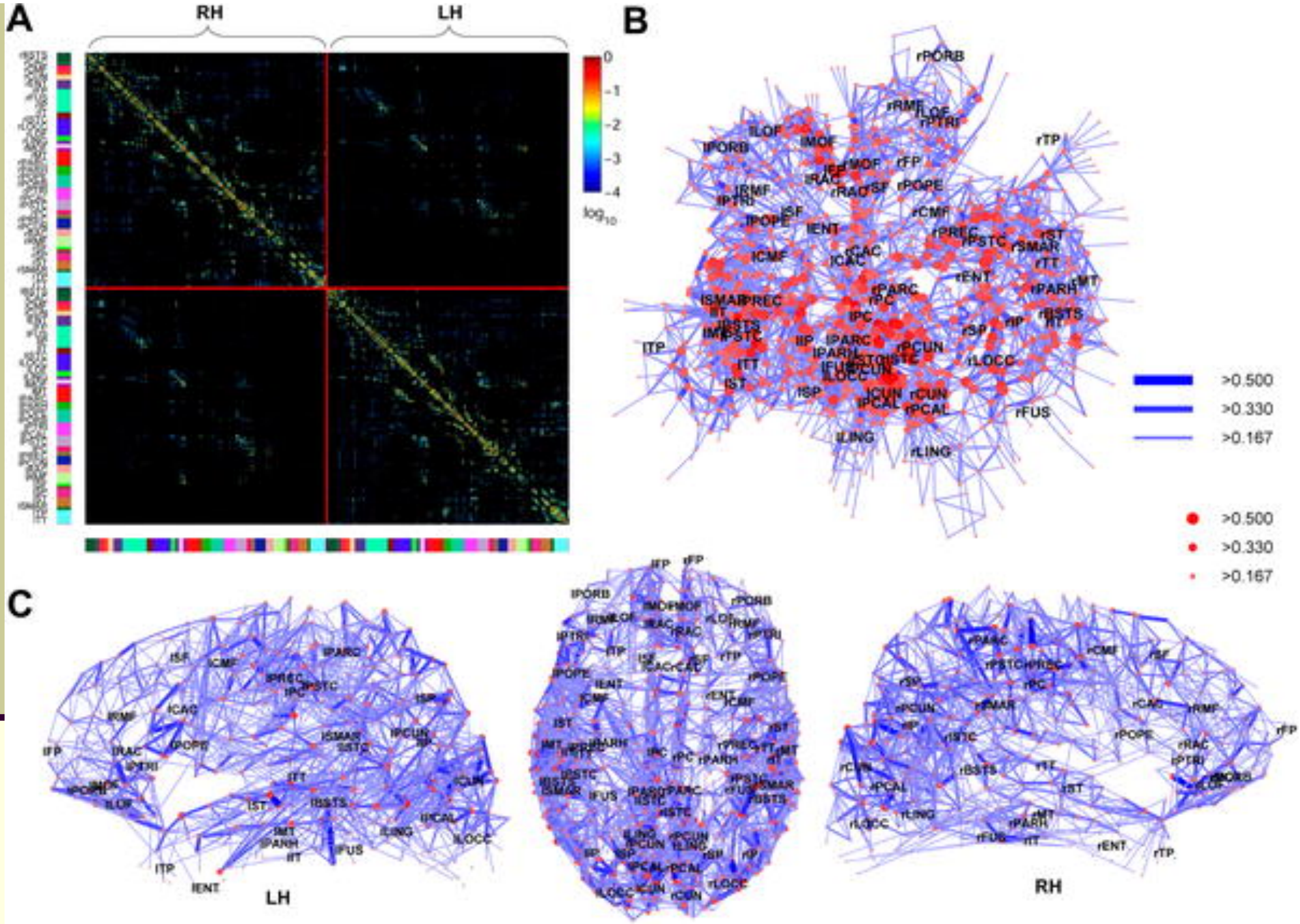
  ~ 500 trillion synapses

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



Hagmann, et al., 2008, *PLoS Biology,* 6:1479-1493

The Mind/Brain System - A Working Model

- Information in the nervous system:
  - Immaterial information is represented by a material substrate; the shapes of these words convey their meanings.
  - It includes signals, meanings, data, and instructions.

- "Mind" = the information in the nervous system (NS):
  - Mind is a natural phenomenon.
  - Most mind is unconscious.
  - Awareness, experience, and happiness are aspects of mind.
  - The NS constrains, conditions, and constructs mind.
  - Mind constrains, conditions, and constructs the NS.

- NS and mind co-arise interdependently, two aspects of one integrated system: "dual-aspect monism"

We ask, "What is a thought?"

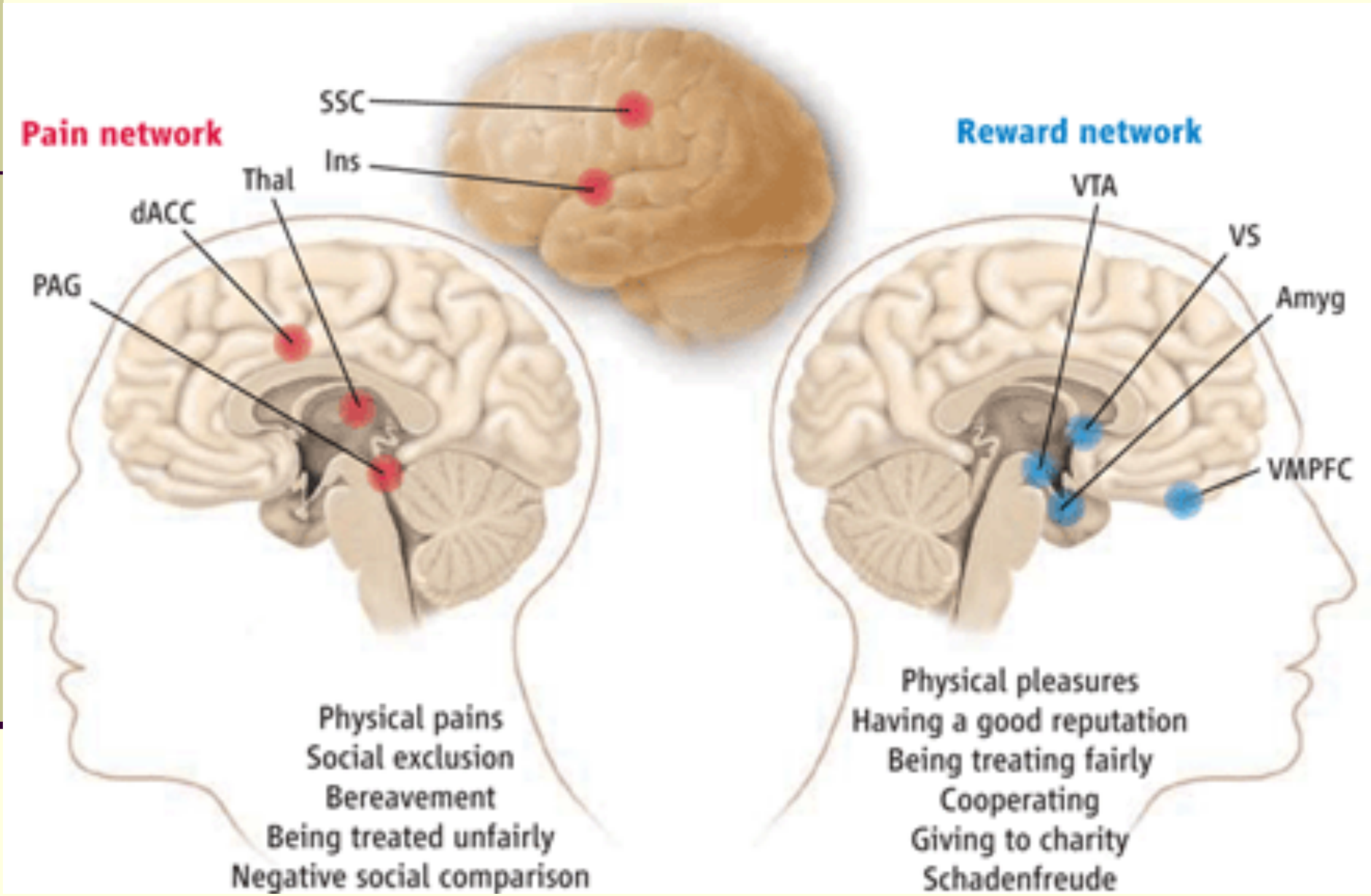
We don't know,

yet we are thinking continually.

Venerable Tenzin Palmo

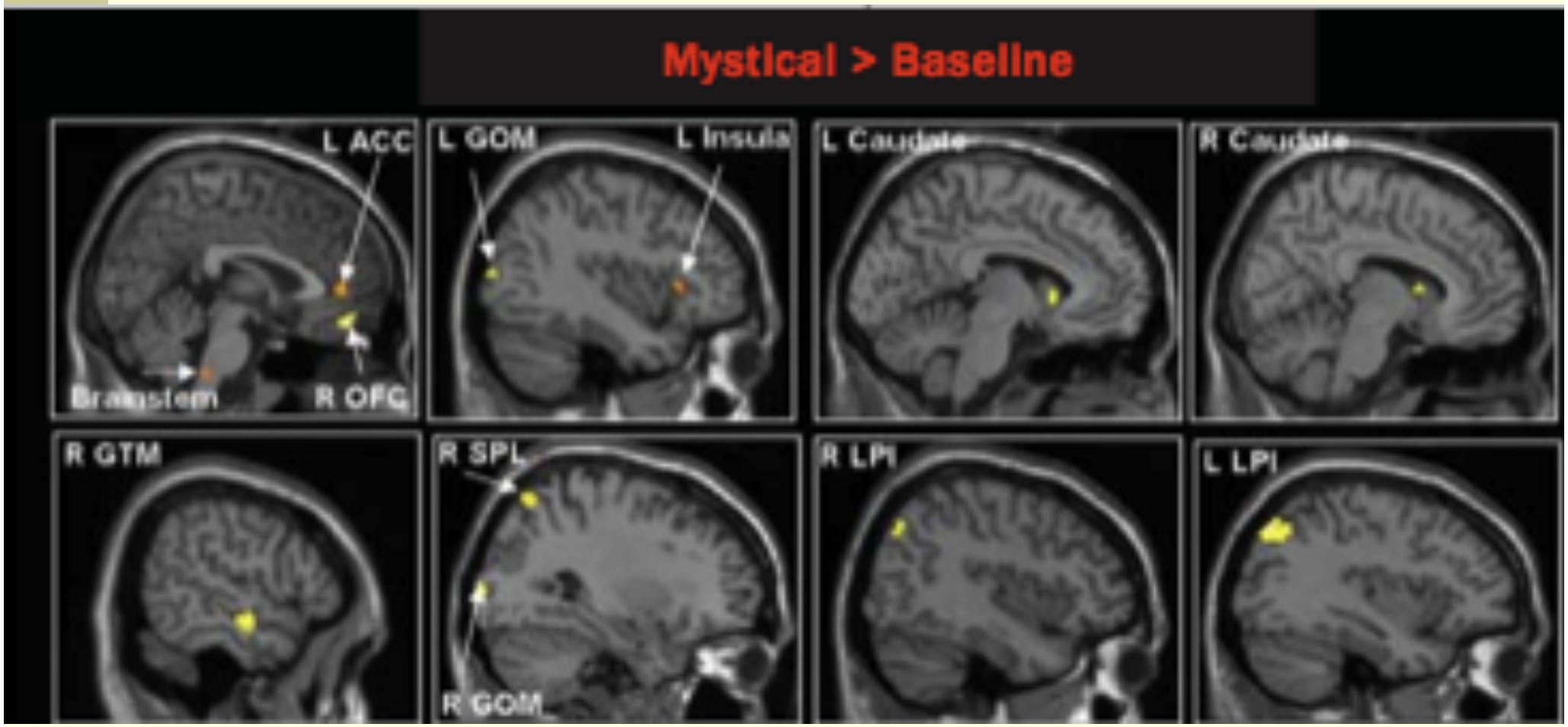
Three Facts about Brain and Mind

- As the brain changes, the mind changes.
  - Mental activity depends upon neural activity.
- As the mind changes, the brain changes.
  - Transient: brainwaves, local activation
  - Lasting: epigenetics, neural pruning, “neurons that fire together, wire together”
  - Experience-dependent neuroplasticity
- You can use the mind to change the brain to change the mind for the better: self-directed neuroplasticity.

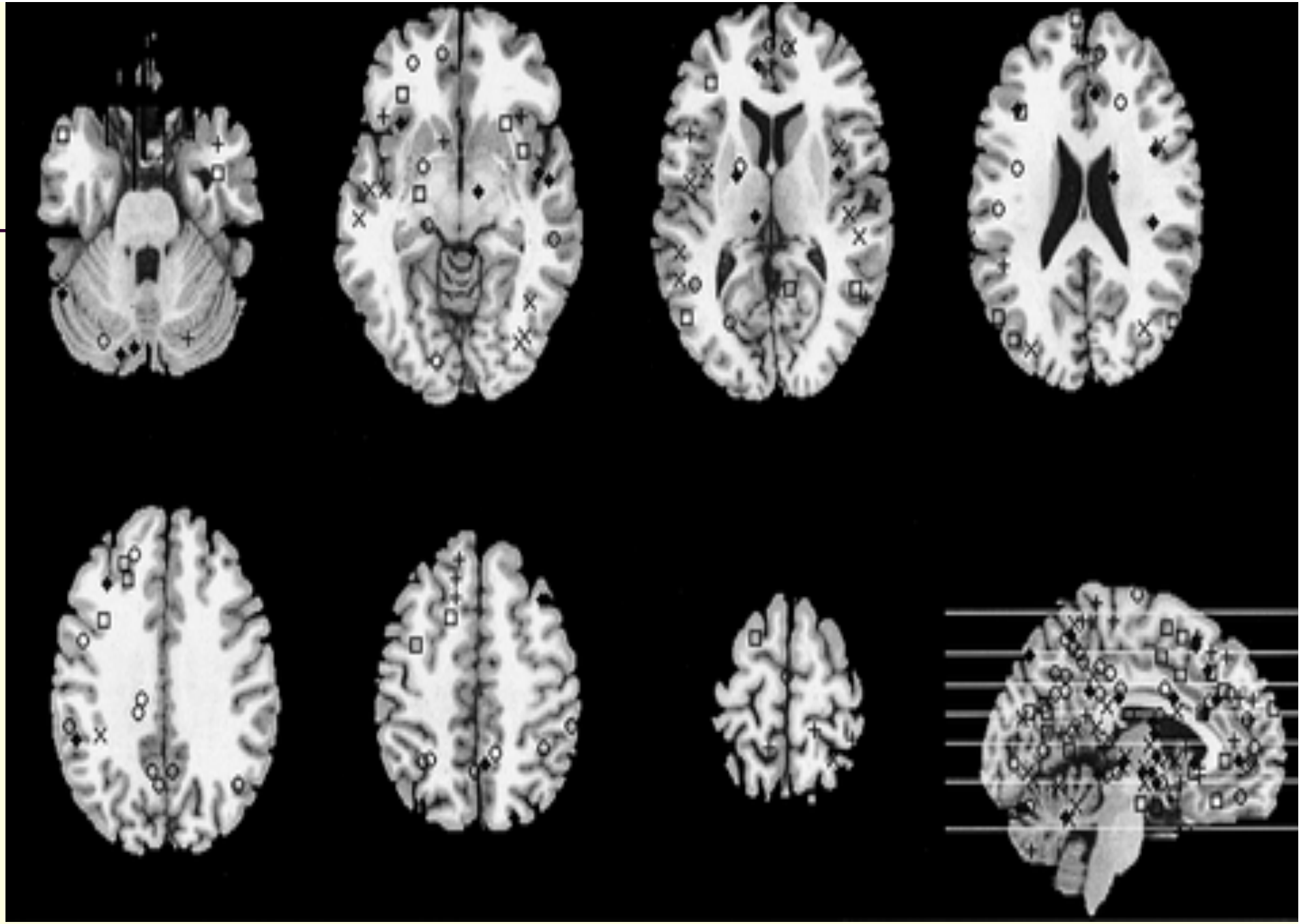


Pain network: Dorsal anterior cingulate cortex (dACC), insula (Ins), somatosensory cortex (SSC), thalamus (Thal), and periaqueductal gray (PAG). Reward network: Ventral tegmental area (VTA), ventral striatum (VS), ventromedial prefrontal cortex (VMPFC), and amygdala (Amyg). K. Sutliff, in Lieberman & Eisenberger, 2009, *Science*, 323:890-891

Christian Nuns, Recalling a Profound Spiritual Experience

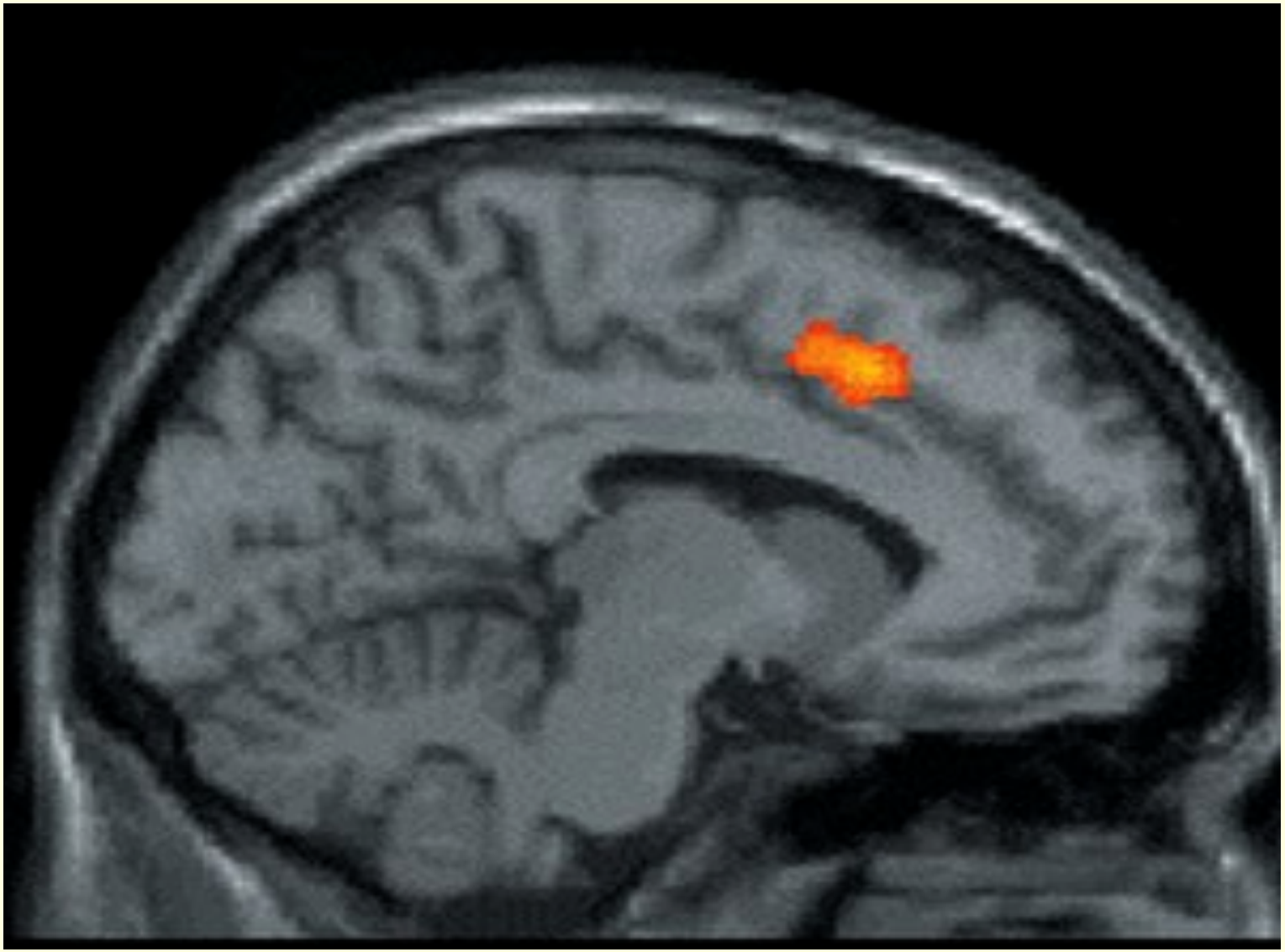


Beauregard, et al., *Neuroscience Letters,* 9/25/06



Brain activations of “selfing” - Gillihan, et al., Psych Bulletin, 1/2005

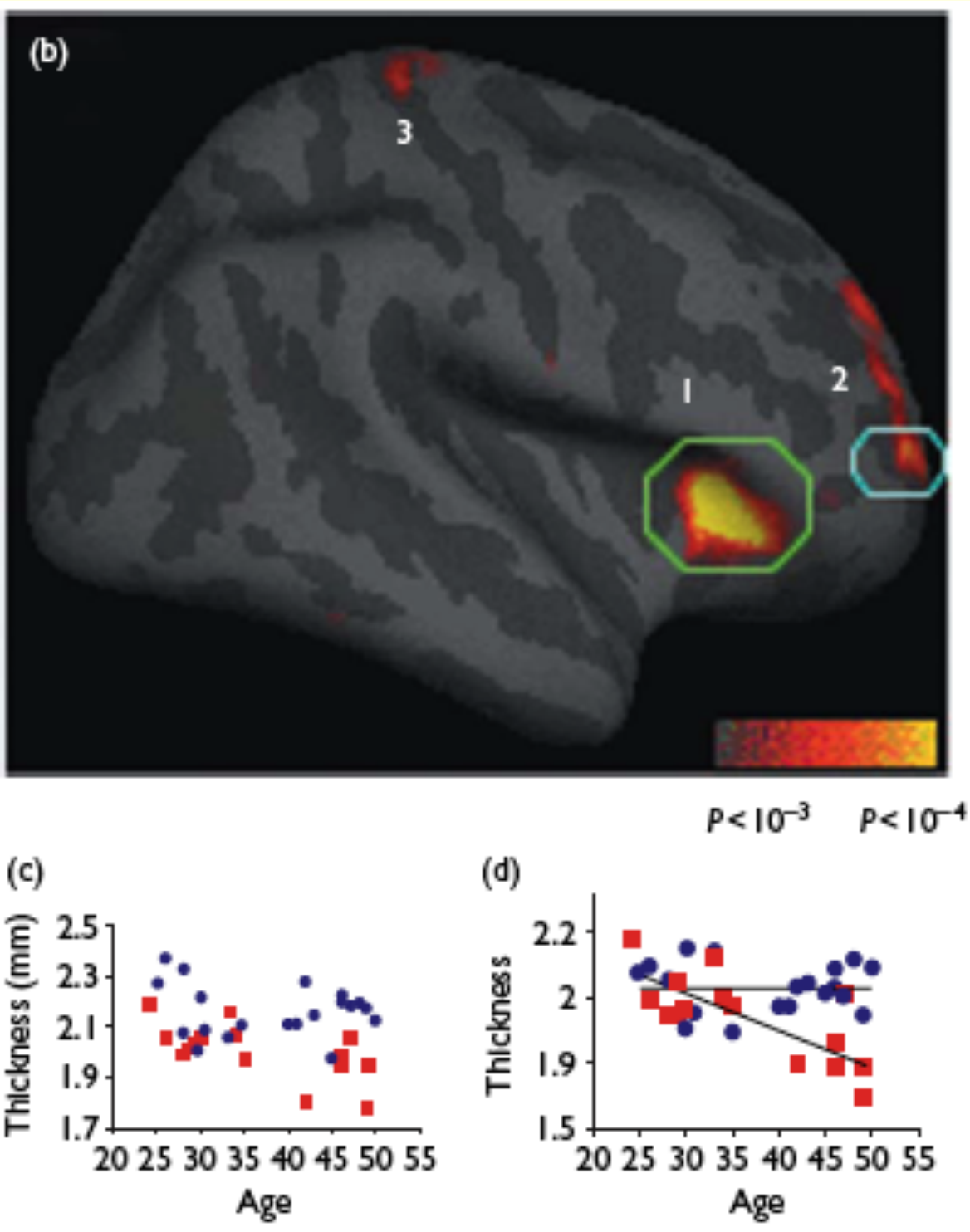
Ardent, Diligent, Resolute, and Mindful



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.



Meditation - Neural Benefits

- Increased gray matter in the:
  - Insula - interoception; self-awareness; empathy for emotions
  - Hippocampus - visual-spatial memory; establishing context; inhibiting amygdala and cortisol
  - Prefrontal cortext (PFC) - executive functions; attention control
- Reduced cortical thinning with aging in insula and PFC
- Increased activation of left frontal regions, which lifts mood
- Increased gamma-range brainwaves - may be associated with integration, “coming to singleness,” “unitary awareness”
- Preserved telomere length

Causes and Effects

Mental and physical phenomena arise, persist, and pass away due to causes.

Causes in the brain are shaped by the mental/neural states that are activated and then installed within it.

Inner "poisons" (e.g., hatred, greed, heartache, delusion) cause suffering and harm.

I**nner strengths** (e.g., virtue, mindfulness, wisdom, peace, contentment, love) cause happiness and benefit for oneself and others.

The Power of Mindfulness

Why Mindfulness Matters

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

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

Basics of Meditation

- Relax; find a posture that is comfortable and alert
- Simple good will toward yourself
- Awareness of your body
- Focus on something to steady your attention
- Accepting whatever passes through awareness, not resisting it or chasing it
- Gently settling into peaceful well-being

Some Neural Factors of Mindfulness

- **Setting an intention -** “top-down” frontal, “bottom-up” limbic
- **Relaxing the body -** parasympathetic nervous system
- **Feeling cared about -** social engagement system
- **Feeling safer -** inhibits amygdala/ hippocampus alarms
- **Encouraging positive emotion -** dopamine, norepinephrine
- **Panoramic view -** lateral networks
- **Absorbing the benefits -** positive implicit memories

Self-Compassion

The root of compassion is compassion for oneself.

Pema Chodron

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.”

“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

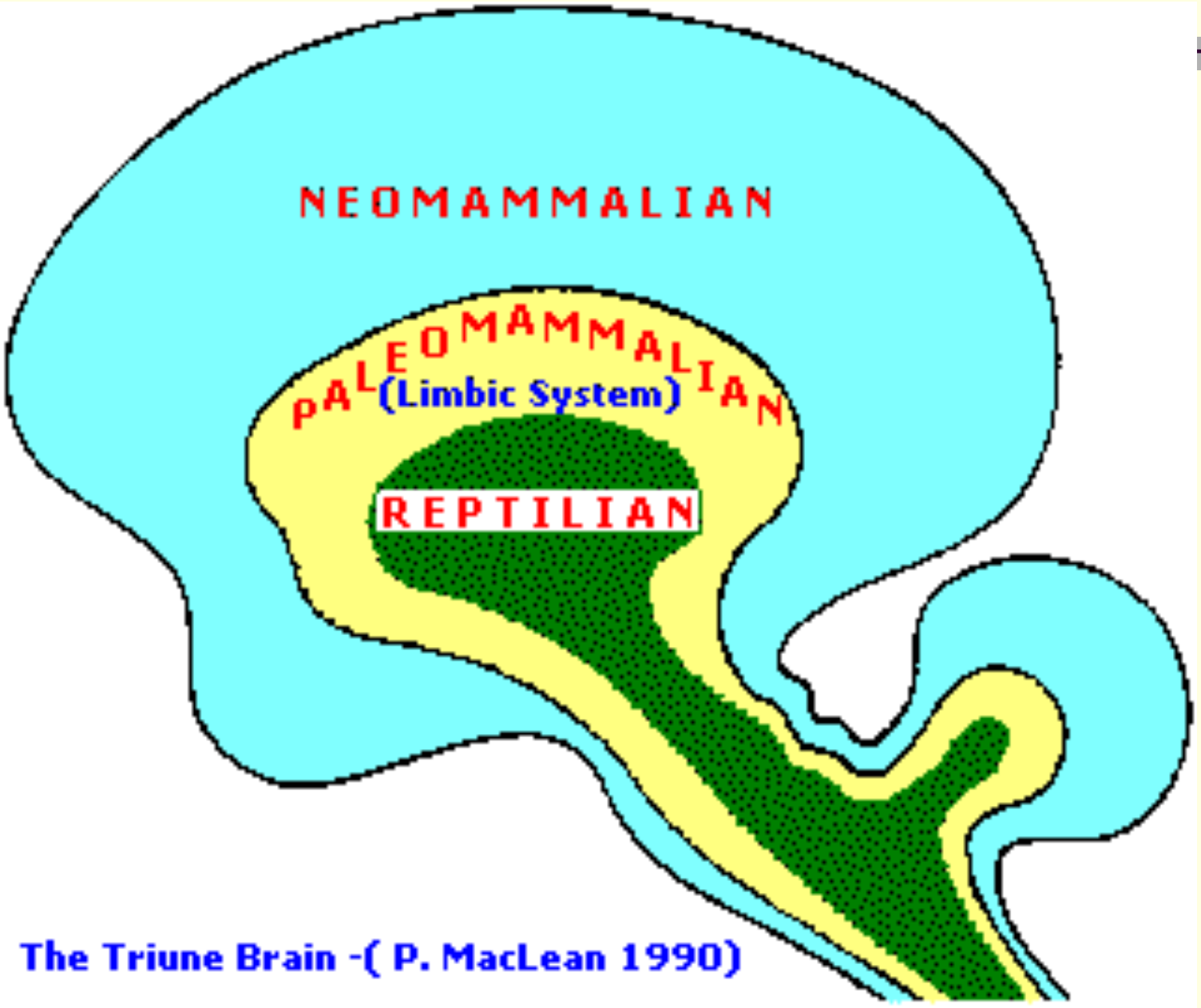
Leonard Cohen

The Evolving Brain

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 (the “great apes” include gorillas, orangutans, chimpanzees, bonobos, and humans)
- 2.5 million years ago, making tools (brains 1/3 our size)
- ~ 150,000 years of *homo sapiens*
- ~ 55,000 years of modern humans
- ~ 5000 years of blue, green, hazel eyes

Evolutionary History



Three Stages of Brain Evolution

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

Three Fundamental Motivational and Self-Regulatory Systems

- **Avoid Harms:**
  - Primary need, tends to trump all others
- **Approach Rewards:**
  - Elaborated via sub-cortex in mammals for emotional valence, sustained pursuit
- **Attach to Others:**
  - Very elaborated via cortex in humans for pair bonding, language, empathy, cooperative planning, compassion, altruism, etc.

"With all due respects, I find your disparaging remarks about the 'reptilian brain' unnecessary"

Love and the Brain

- Social capabilities have been a primary driver of brain evolution.
- Reptiles and fish avoid and approach. Mammals and birds *attach* as well - especially primates and humans.
- Mammals and birds have bigger brains than reptiles and fish.
- The more social the primate species, the bigger the cortex.
- Since the first hominids began making tools ~ 2.5 million years ago, the brain has roughly tripled in size, much of its build-out devoted to social functions (e.g., cooperative planning, empathy, language). The growing brain needed a longer childhood, which required greater pair bonding and band cohesion.

All sentient beings developed through natural selection in such a way that pleasant sensations serve as their guide, and

especially the pleasure derived from sociability and from loving our families.

Charles Darwin

In the Green Zone

When not disturbed by threat, loss, or rejection [no deficit of safety, satisfaction, and connection]

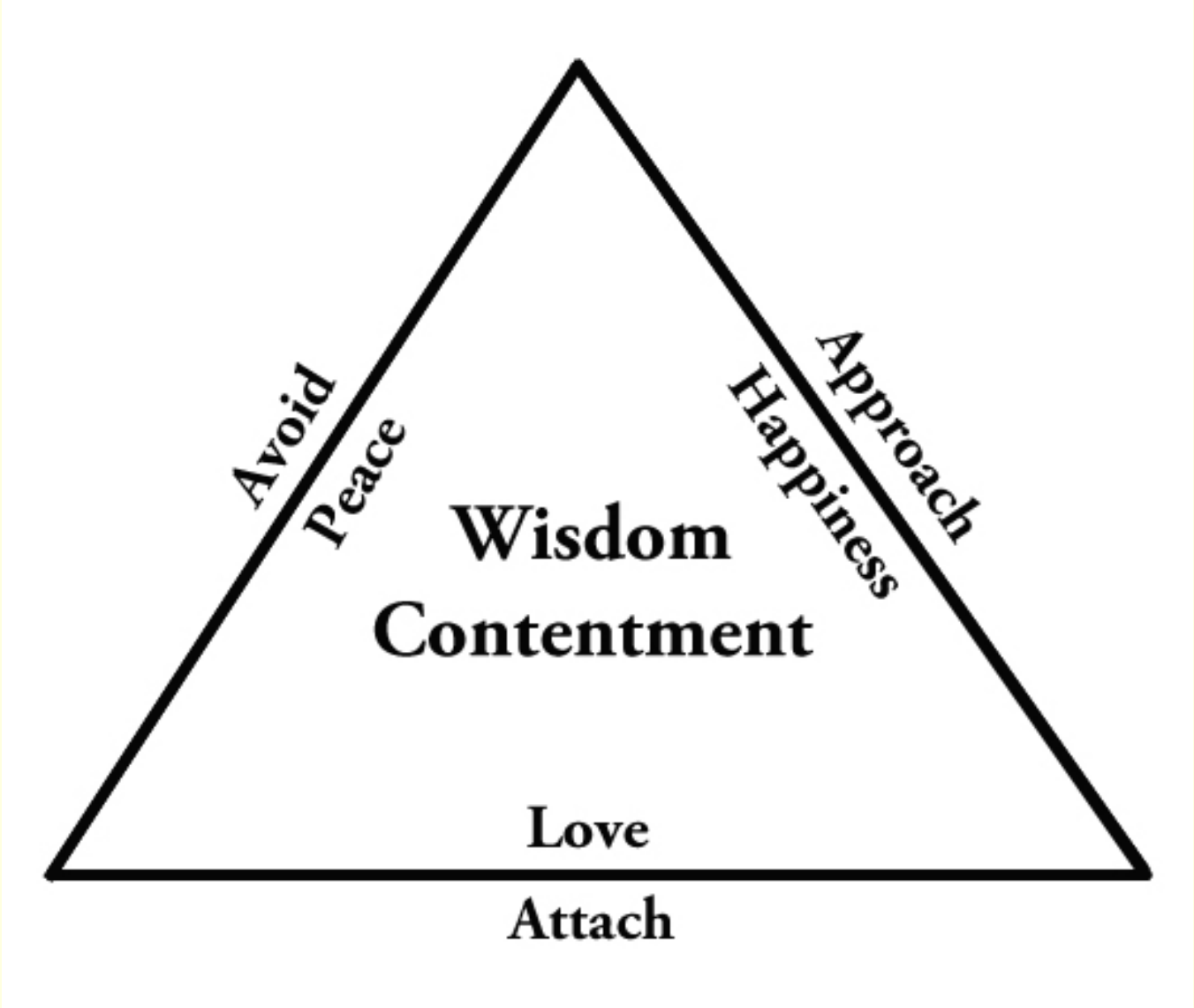
The body defaults to a sustainable equilibrium of refueling, repairing, and pleasant abiding.

The mind defaults to a sustainable equilibrium of:

- **Peace** (the Avoiding system)
- **Contentment** (the Approaching system)
- **Love** (the Attaching system)

This is the brain in its homeostatic ***Responsive,*** *minimal craving* mode.

The Responsive Mode



Key Benefits of Responsive Mode

- Fueling for Reactive mobilizations; recovery after
- Positive emotions, cognitions, and behaviors
- Positive cycles
- Promotes virtue and benevolence

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

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*

In the Red Zone

When disturbed by threat, loss, or rejection [deficit of safety, satisfaction, or connection]:

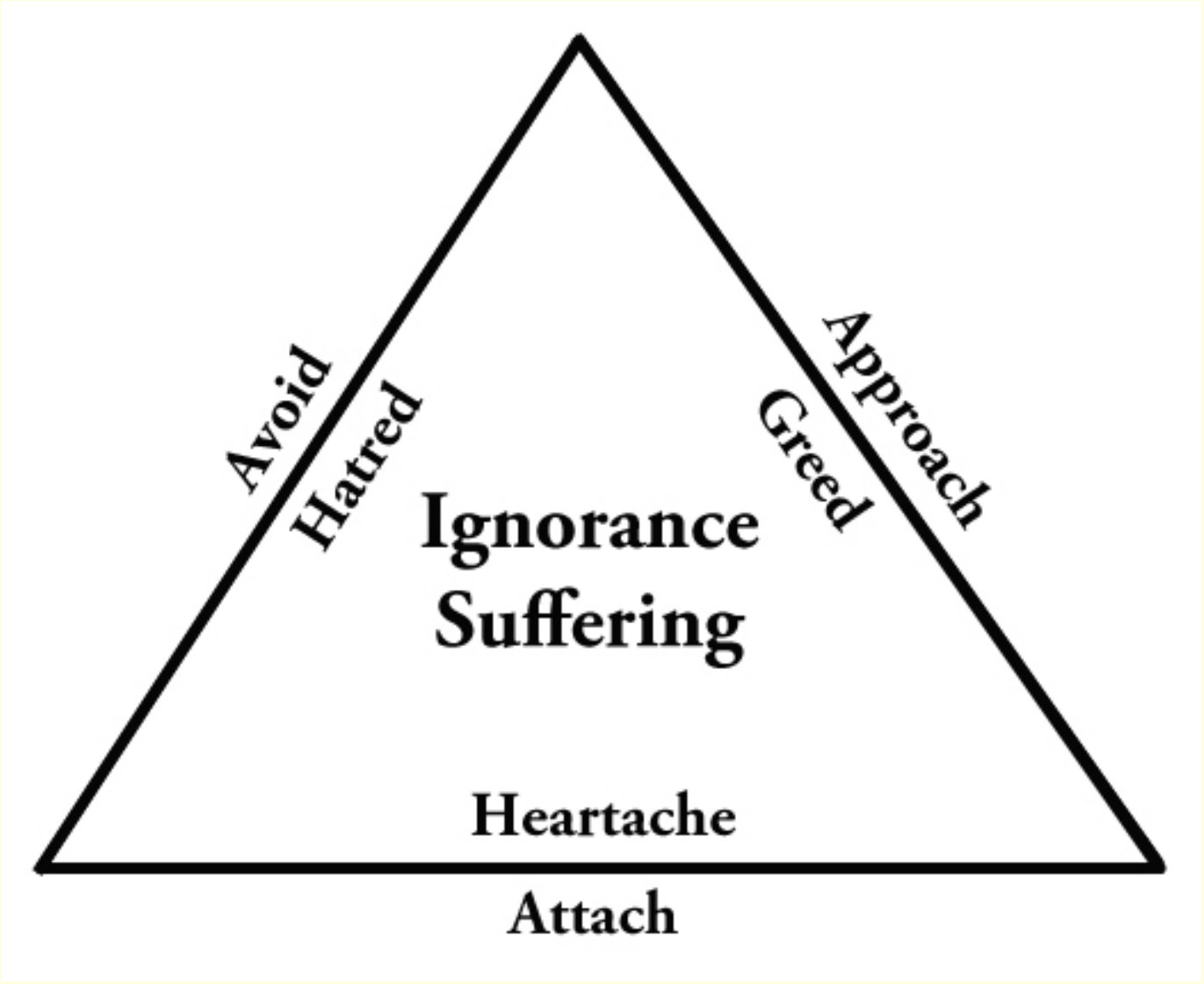
The body fires up into the stress response; outputs exceed inputs; long-term building is deferred.

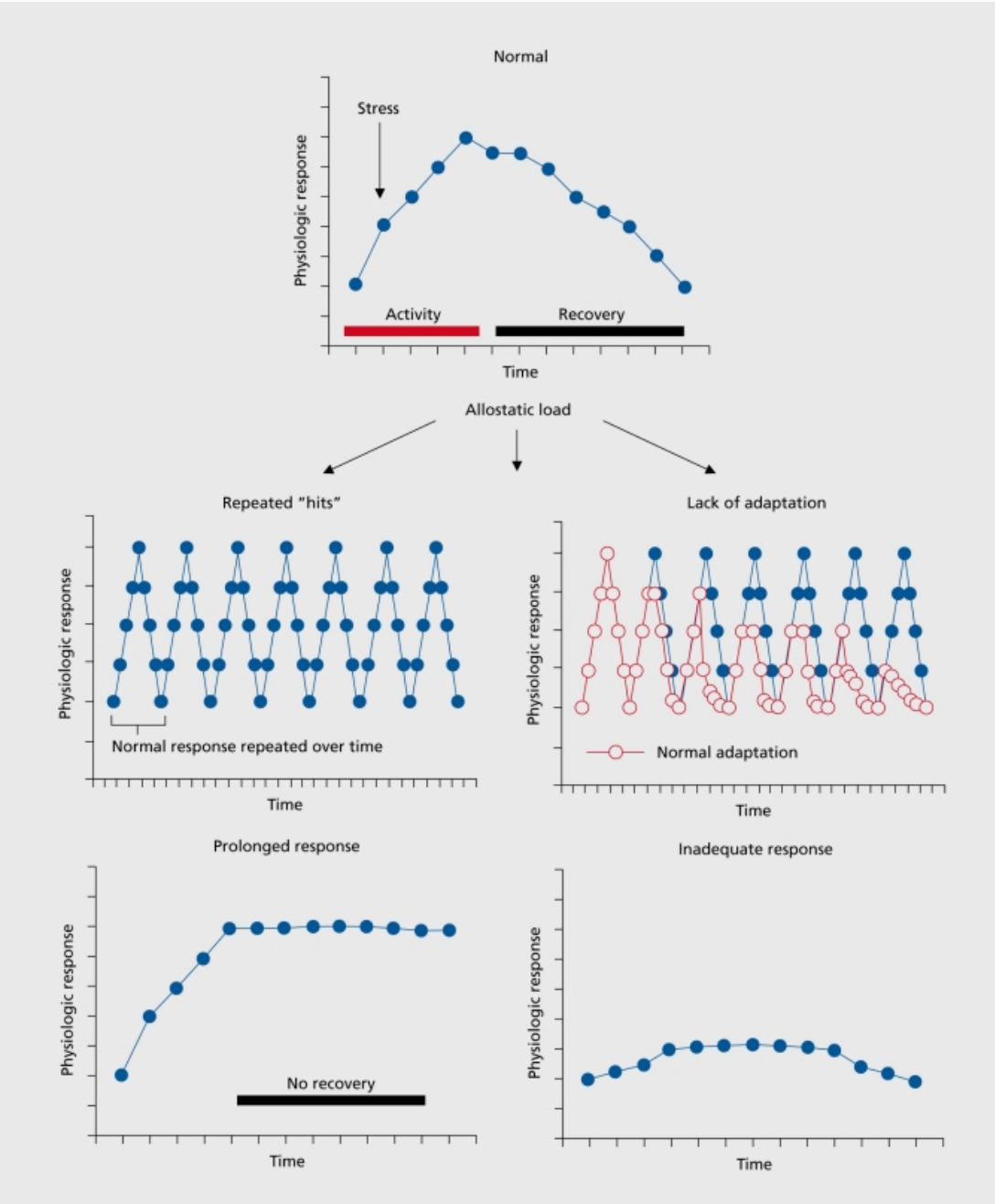
The mind fires up into:

- **Fear** (the Avoiding system)
- **Frustration** (the Approaching system)
- **Heartache** (the Attaching system)

This is the brain in allostatic, ***Reactive,*** *craving* mode.[47]

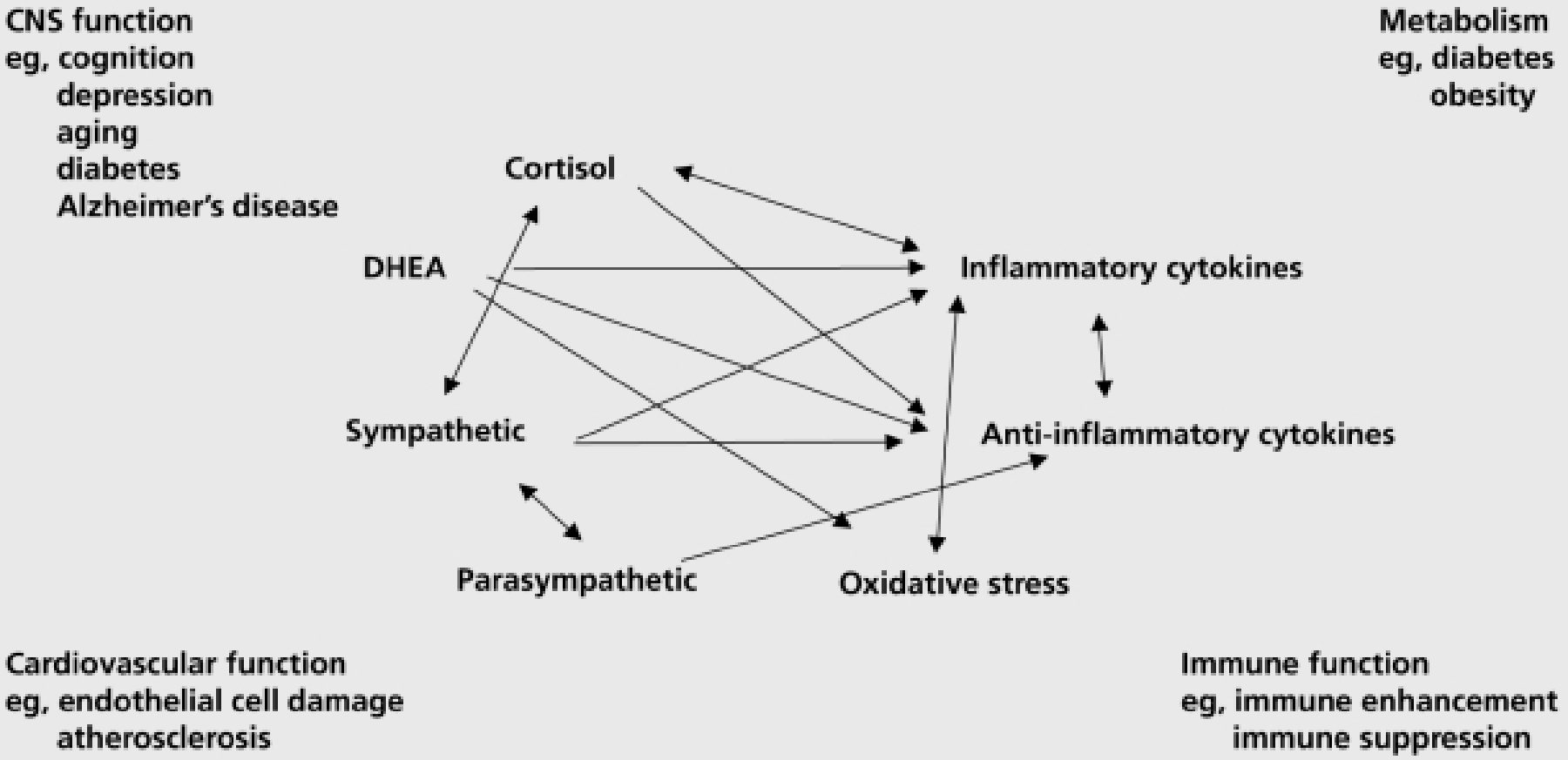
The Reactive Mode





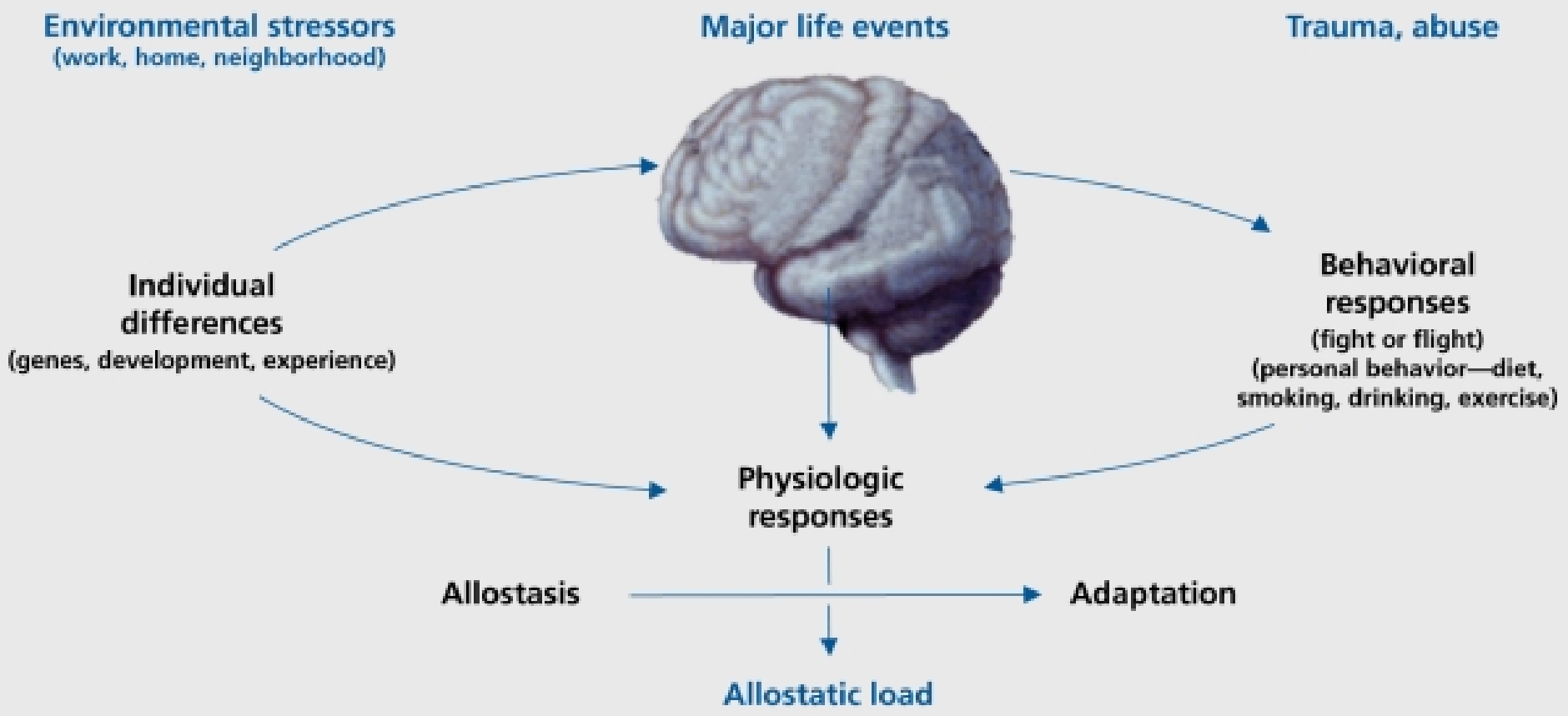
Adaptive and maladaptive responses to challenges

Top panel: adaptive stress response. Lower panels: Top left - repeated stressors, no time for recovery. Top right - adaptation wears out. Bottom left - stuck in stress activation. Bottom right - inadequate stress response. McEwen, 1998. New England Journal of Medicine, 338:171-179.



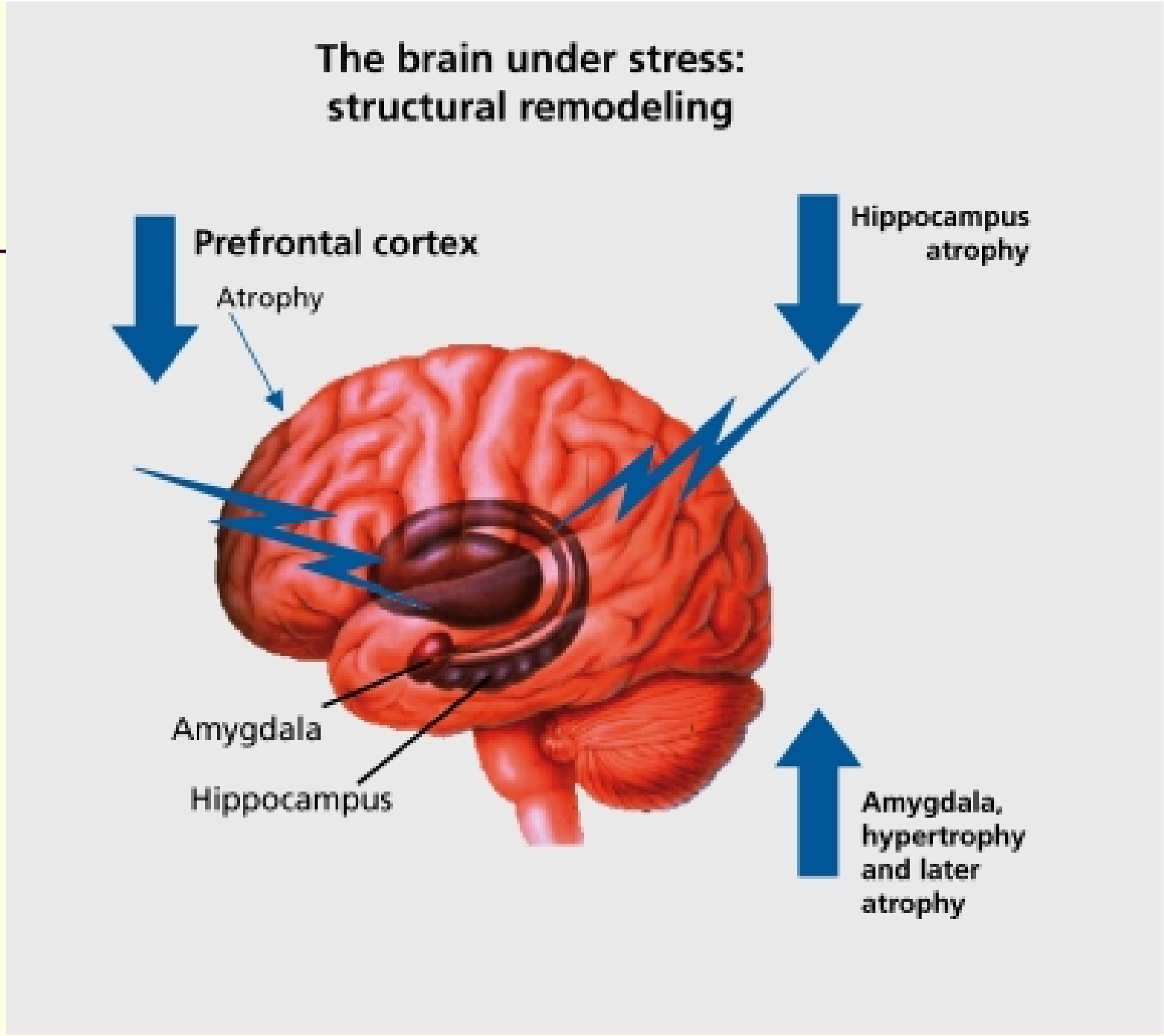
Nonlinear network of multiple regulators of the stress response

Inflammatory cytokine production is *decreased* via anti-inflammatory cytokines, parasympathetic, and glucocorticoid pathways, but *increased* by sympathetic activity. Parasympathetic activity *decreases* sympathetic activity. McEwen, 2006. Dialogues in Clinical Neuroscience, 8:367-381.



Central role of the brain in the stress response

McEwen, 1998. New England Journal of Medicine, 338:171-179.



How stress changes the brain

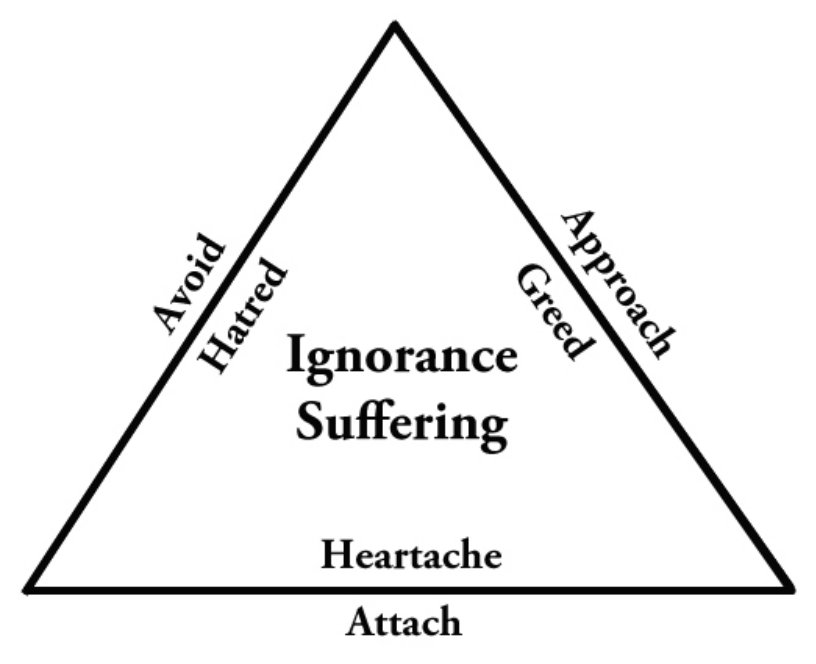
McEwen, 2006. Dialogues in Clinical Neuroscience, 8:367-381

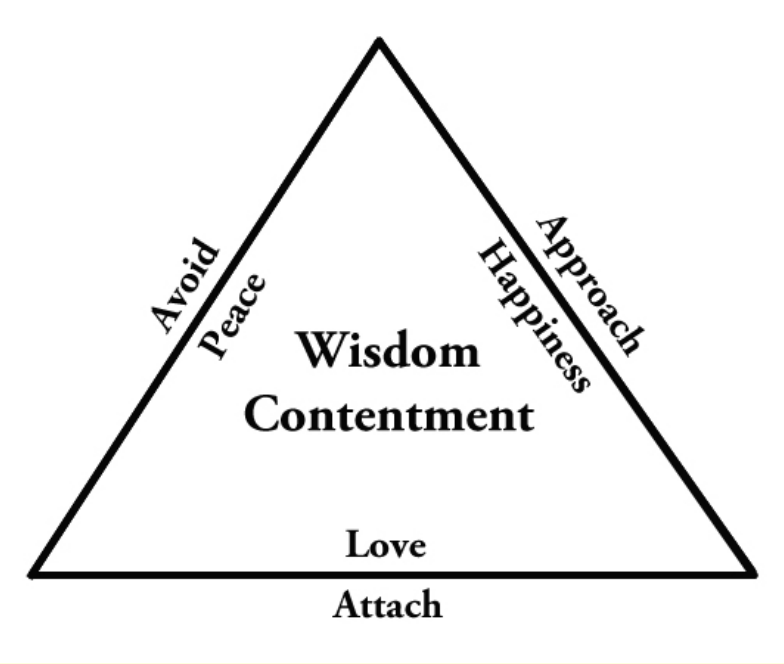
Reactive Dysfunctions in Each System

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

Choices . . .

Or?





Reactive Mode

Responsive Mode

The Negativity Bias

Negativity Bias

- As our ancestors evolved, not getting hit by “sticks” was more important for survival than getting “carrots.”
- Negative stimuli get more attention and processing. Loss aversion.
- Preferential encoding in implicit memory:
  - Easy to create learned helplessness, hard to undo
  - Negative interactions: more powerful than positive
  - Good at learning from bad, bad at learning from good
  - Most good experiences are wasted on the brain: lowers both the results of practice and motivation

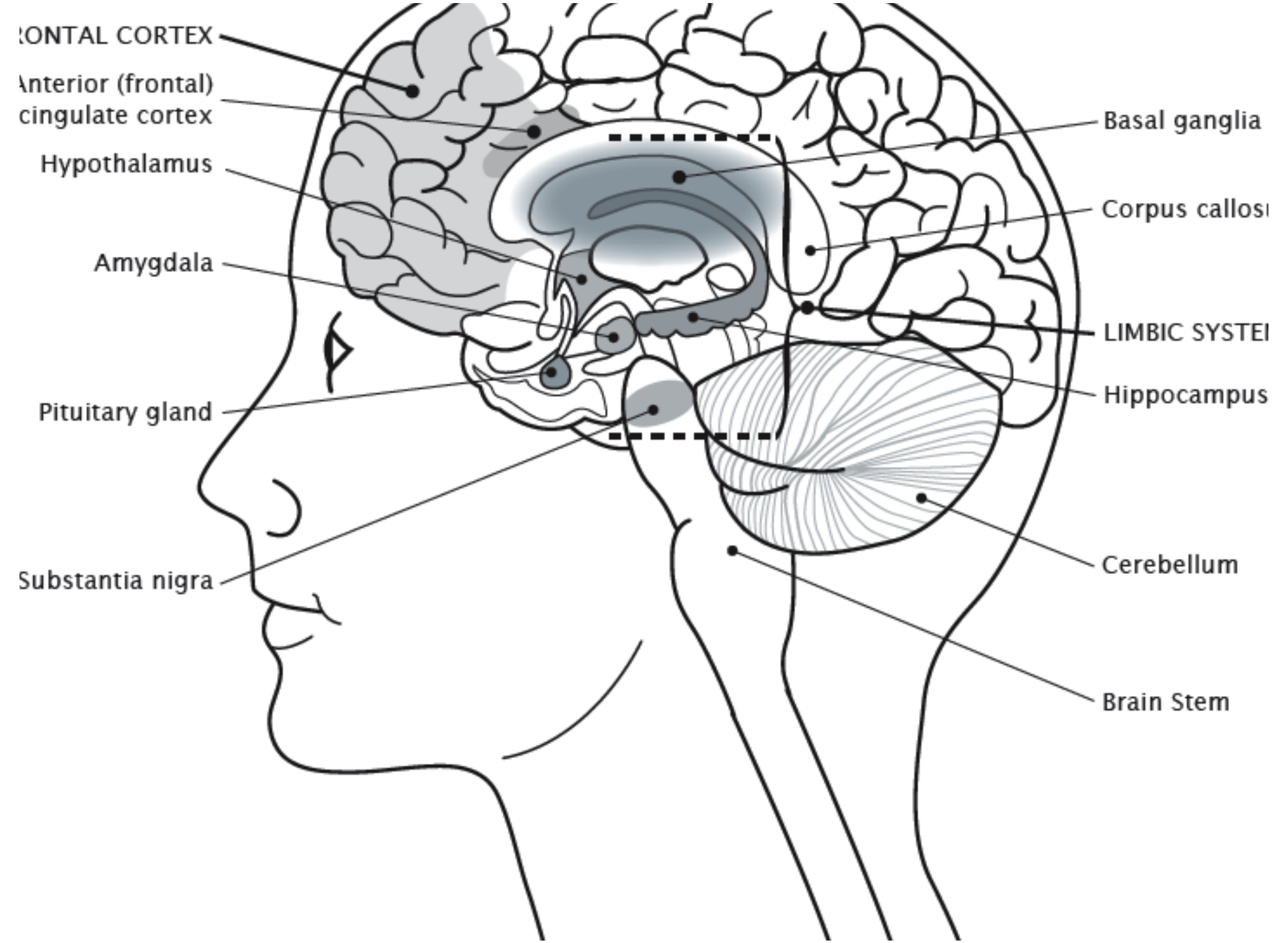
Negativity Bias: Some Consequences

- Negative stimuli get more attention and processing.
- We generally learn faster from pain than pleasure.
- People work harder to avoid a loss than attain an equal gain (“endowment effect”)
- Easy to create learned helplessness, hard to undo
- Negative interactions: more powerful than positive
- Negative experiences sift into implicit memory.

One Neural Consequence of Negative Experiences

- Amygdala (“alarm bell”) initiates stress response
- Hippocampus:
  - Forms and retrieves contextual memories
  - Inhibits the amygdala
  - Inhibits cortisol production
- Cortisol:
  - Stimulates and sensitizes the amygdala
  - Inhibits and can shrink the hippocampus

- Consequently, chronic negative experiences:
  - Sensitize the amygdala alarm bell
  - Weaken the hippocampus: this reduces memory capacities and the inhibition of amygdala and cortisol production.
  - Thus creating vicious cycles in the NS, behavior, and mind


RONTAL CORTEX
Anterior (frontal)
cingulate cortex
Hypothalamus
Amygdala
Pituitary gland
Substantia nigra
Basal ganglia
Corpus callosu
LIMBIC SYSTEI
Hippocampus
Cerebellum
Brain Stem

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A Poignant Truth

Mother Nature is tilted toward producing gene copies.

But tilted against personal quality of life.

And at the societal level, we have caveman/cavewoman brains armed with nuclear weapons.

What shall we do?

Taking in the Good

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.

Inner Resources Include

- **Virtues** (e.g., patience, energy, generosity, restraint)
- **Executive functions** (e.g., meta-cognition)
- **Attitudes** (e.g., optimism, openness, confidence)
- **Capabilities** (e.g., mindfulness, emotional intelligence, resilience)
- **Positive emotions** (e.g., gratitude, self-compassion)
- **Approach orientation** (e.g., curiosity, exploration)

Cultivation in Context

- Three ways to engage the mind:
  - Be with it. Decrease negative. Increase positive.
  - The garden: Observe. Pull weeds. Plant flowers.
  - Let be. Let go. Let in.
  - Mindfulness present in all three ways to engage mind
- While “being with” is primary, it’s often isolated in mindfulness-based practices.
- Skillful means for decreasing the negative and increasing the positive have developed over 2500 years. Why not use them?

HEAL by Taking in the Good

1. **H**ave a positive experience. Notice or create it.

2. **E**nrich the experience through duration, intensity, multimodality, novelty, personal relevance

3. **A**bsorb the experience by intending and sensing that it is sinking into you as you sink into it.

4. **L**ink positive and negative material.

Benefits: Specific contents internalized. Implicit value of being active and treating yourself like you matter. Gradual sensitization of the brain to the positive.

The Four Ways to Offer a Method

- Doing it implicitly
- Teaching it and then leaving it up to the person
- Doing it explicitly with the person
- Asking the person to do it on his or her own

Targets of TG

- **Bodily states** - healthy arousal; PNS; vitality
- **Emotions** - both feelings and mood
- **Views** - expectations; object relations; perspectives on self, world, past and future
- **Desires** - values, aspirations, passions, wants
- **Behaviors** - skills; inclinations

Instances of Taking in the Good

- You find yourself already having a good experience.
- You self-activate a good experience by:
  - Looking for a good fact
  - Recalling a good fact
  - Creating a good fact
  - Imagining a good fact that has never been
- Situations:
  - On the fly
  - At specific times (e.g., meals, before bed)
  - When prompted (e.g., by a therapist)

Types of Good Facts

- Conditions (e.g., food, shelter, fresh air, have friends, dog loves you, flowers blooming, ain't dead yet)
- Events (e.g., finished a load of laundry, someone was friendly to you, this cookie tastes good)
- Qualities within oneself (e.g., fairness, decency, determination, good at baking, loving toward kids)

Resources for Taking in the Good

- Intention; willing to feel good
- Identified target experience
- Openness to the experience; embodiment
- Mindfulness of the steps of TG to sustain them
- Working through obstructions

Some Types of Resource Experiences

Avoiding Harms

- Feeling basically alright right now
- Feeling protected, strong, safe, at peace
- The sense that awareness itself is untroubled

Approaching Rewards

- Feeling basically full, the enoughness in this moment as it is
- Feeling pleasured, glad, grateful, satisfied
- Therapeutic, spiritual, or existential realizations

Attaching to Others

- Feeling basically connected
- Feeling included, seen, liked, appreciated, loved
- Feeling compassionate, kind, generous, loving

Implicit TG in Therapy

- Drawing attention to good facts
- Encouraging a positive response to a good fact
- Drawing attention to key aspects of an experience
- Slowing the client down; not moving on
- Linking rewards to desired thoughts and actions
- Doing TG oneself

Explicit TG in Therapy

- Teaching the method
  - Background helps about brain, negativity bias
  - Emphasizing facts and mild experiences
  - Surfacing obstructions
- Doing TG with client(s) during a session
  - To reinforce a key resource state
  - To link rewards to desired thoughts or actions
- Encouraging TG between sessions
  - Naming occasions
  - Identifying key positive facts and experiences

Obstructions to Taking in the Good

- General
  - Distractibility
  - Blocks to self-awareness in general
- Specific
  - Fears of losing one's edge or lowering one's guard
  - Sense of disloyalty to others (e.g., survivor guilt)
  - Culture (e.g., selfish, vain, sinful)
  - Gender style
  - Associations to painful states
  - Secondary gains in feeling bad
  - Not wanting to let someone off the hook
  - Thoughts that TG is craving that leads to suffering

Doing TG with a Couple

- Basic steps (often informal):
  - Attention to a good fact
  - Evoking and sustaining a good experience
  - Managing obstructions
  - Awareness of the impact on one's partner
  - Debriefing, often from both partners

- Pitfalls to avoid:
  - Seeming to side with one person
  - Unwittingly helping a person overlook real issues
  - Letting the other partner pile on

TG and Children

- All kids benefit from TIG.
- Particular benefits for mistreated, anxious, spirited/ ADHD, or LD children.
- Adaptations:
  - Brief
  - Concrete
  - Natural occasions (e.g., bedtimes)

Healing Old Pain

Using Memory Mechanisms to Help Heal Painful Experiences

- The machinery of memory:
  - When explicit or implicit memory is reactivated, it is rebuilt from schematic elements, not retrieved *in toto*.
  - When attention moves on, the memory gets reconsolidated.
- The open processes of memory reactivation and reconsolidation create a window of opportunity for shaping your internal world.
- Reactivated material associates with other things in awareness, especially if they are prominent and lasting.
- When memory returns to storage, it takes associations with it.
- You can imbue memory with positive associations.

The Fourth Step of TG

- When you are having a positive experience:
  - Sense the current positive experience sinking down into old pain, and soothing and replacing it.
- When you are having a negative experience:
  - Bring to mind a positive experience that is its antidote.
- In both cases, have the positive experience be big and strong, in the forefront of awareness, while the negative experience is small and in the background.
- You are not resisting negative experiences or getting attached to positive ones. You are being kind to yourself and cultivating positive resources in your mind.

Psychological Antidotes

Avoiding Harms

- Strength, efficacy --> Weakness, helplessness, pessimism
- Safety, security --> Alarm, anxiety
- Compassion for oneself and others --> Resentment, anger

Approaching Rewards

- Satisfaction, fulfillment --> Frustration, disappointment
- Gladness, gratitude --> Sadness, discontentment, “blues”

Attaching to Others

- Attunement, inclusion --> Not seen, rejected, left out
- Recognition, acknowledgement --> Inadequacy, shame
- Friendship, love --> Abandonment, feeling unloved or unlovable

The Tip of the Root

- For the fourth step of TIG, try to get at the youngest, most vulnerable layer of painful material.
- The “tip of the root” is commonly in childhood. In general, the brain is most responsive to negative experiences in early childhood.
- Prerequisites
  - Understanding the need to get at younger layers
  - Compassion and support for the inner child
  - Capacity to “presence” young material without flooding

TG and Trauma

- General considerations:
  - People vary in their resources and their traumas.
  - Often the major action is with “failed protectors.”
  - Cautions for awareness of internal states, including positive
  - Respect “yellow lights” and the client’s pace.

- The first three steps of TIG are generally safe. Use them to build resources for tackling the trauma directly.

- As indicated, use the fourth step of TIG to address the peripheral features and themes of the trauma.

- With care, use the fourth step to get at the heart of the trauma.

First of all, do no harm.

De-Fueling the Fires of Suffering

The Fruit as the Path

Peace

Contentment

Love

Cultivation Undoes Craving

- All life has goals. The brain continually seeks to avoid harms, approach rewards, and attach to others - even that of a Buddha.
- It is wholesome to wish for the happiness, welfare, and awakening of all beings - including the one with your nametag.
- We rest the mind upon positive states so that the brain may gradually take their shape. This disentangles us from craving as we increasingly rest in a peace, happiness, and love that is independent of external conditions.
- With time, even the practice of cultivation falls away - like a raft that is no longer needed once we reach the farther shore.

Think not lightly of good, saying,
"It will not come to me."

Drop by drop is the water pot filled.

Likewise, the wise one,
gathering it little by little,
fills oneself with good.

Dhammapada 9.122

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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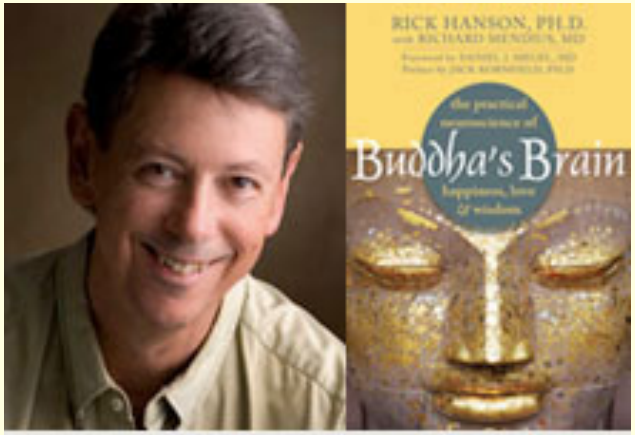
Where to Find Rick Hanson Online

http://www.youtube.com/drrhanson

http://www.facebook.com/rickhansonphd



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