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# ***Using the Mind To Change the Brain***

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# Topics

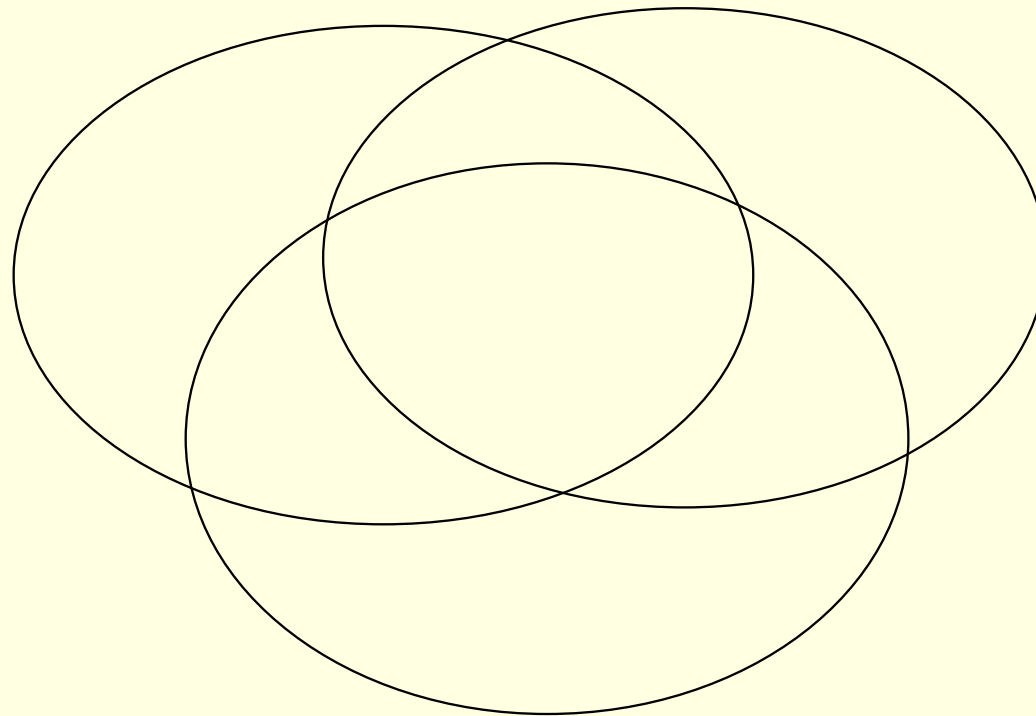
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- **Your Amazing Brain**
- **Self-Directed Neuroplasticity**
- **Paper Tiger Paranoia**
- **The Optimal Brain**

# Common and Fertile Ground

*Psychology*

*Neuroscience*



*Contemplative Practice*

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*We ask, “What is a thought?”*

*We don't know,*

*yet we are thinking continually.*

Venerable Tenzin Palmo



# **Your Amazing Brain**

# Technical Specs

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## ■ **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 or hundredth of a second

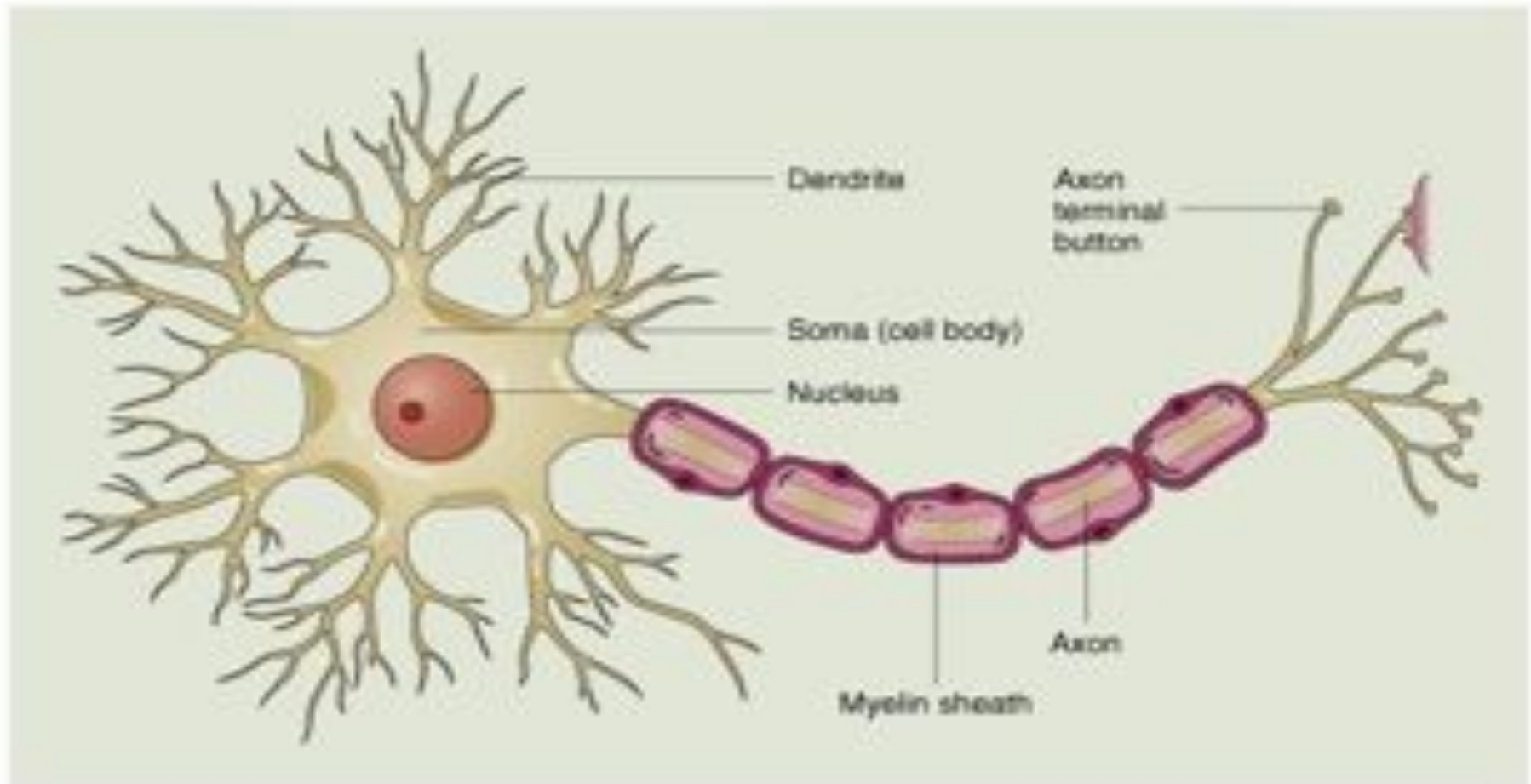
## ■ **Connectivity:**

- A typical neuron makes ~ 5000 connections: ~ 500 trillion synapses.
- During one breath, a quadrillion-plus signals coursed through your head.

## ■ **Complexity:**

- Potentially 10 to the millionth power brain states

# A Schematic Neuron



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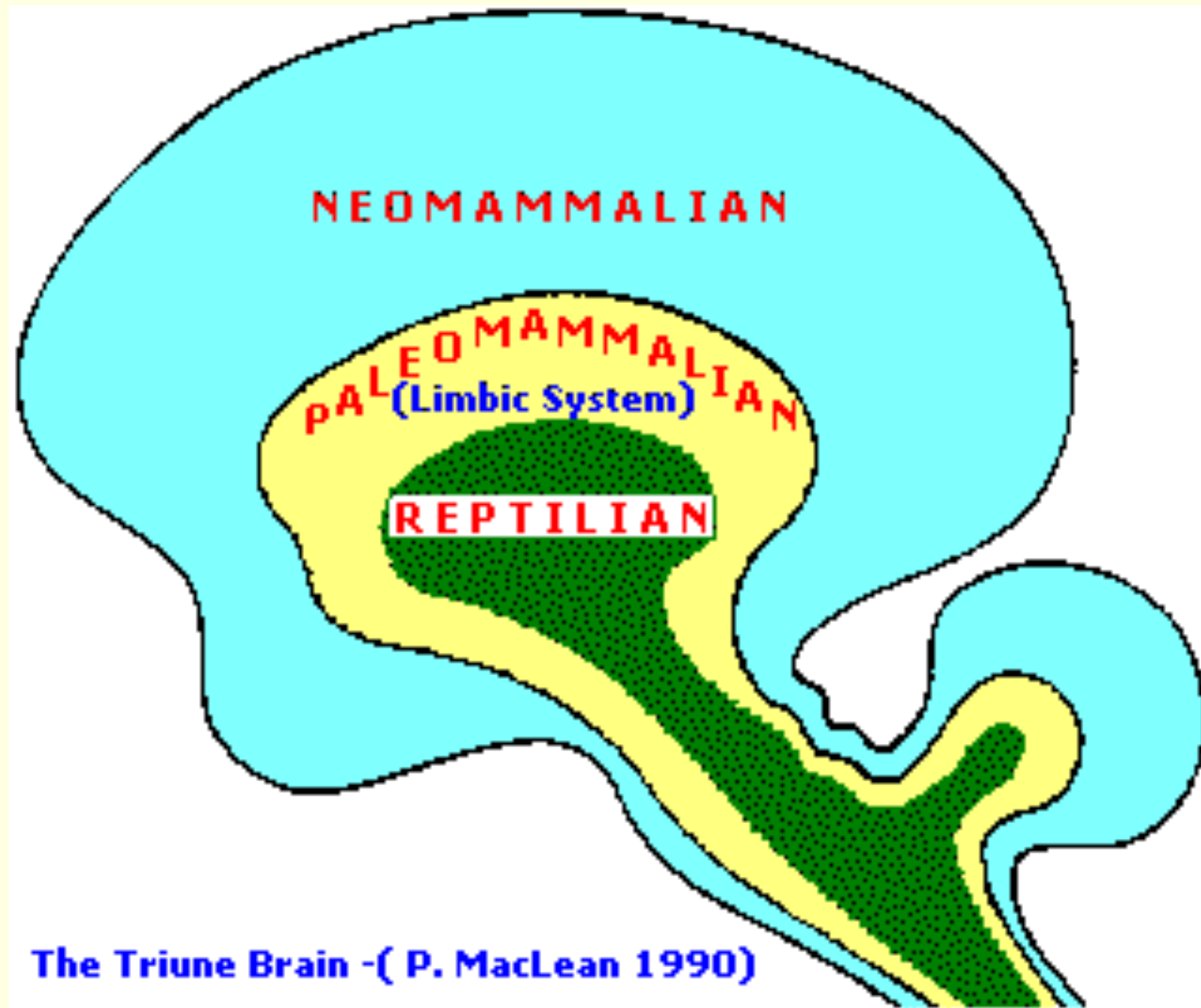


# The Mind/Brain System

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- “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.

# The Evolving Brain



# Three Goal-Directed Systems Evolved in the Brain

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- **Avoid** “sticks,” threats, penalties, pain
- **Approach** “carrots,” opportunities, rewards, pleasure
- **Attach** to “us,” 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.

# Love and the Brain

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- 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 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.



# **Self-Directed Neuroplasticity**

# First Fact about Your Brain

As your brain changes, your mind changes.



# Second Fact about Your Brain

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**As your mind changes, your brain changes.**

Immaterial mental activity maps to material neural activity.

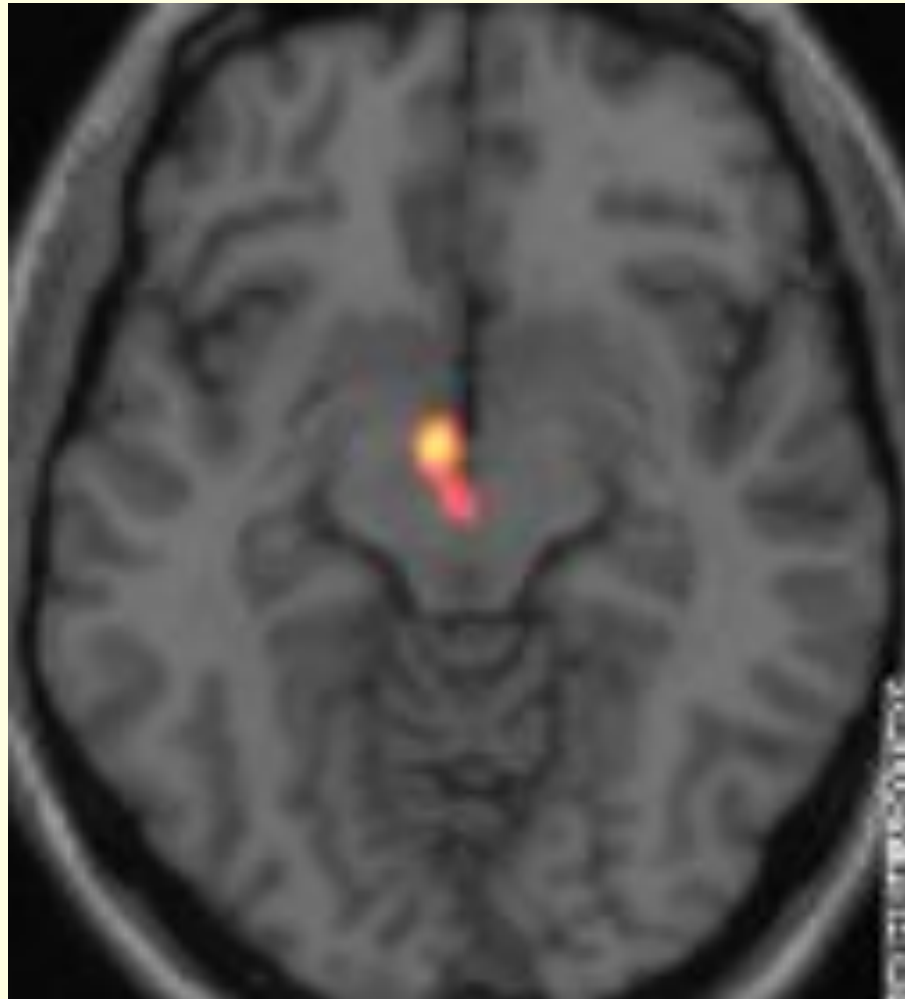
This produces temporary changes in your brain and lasting ones.

*Temporary* changes include:

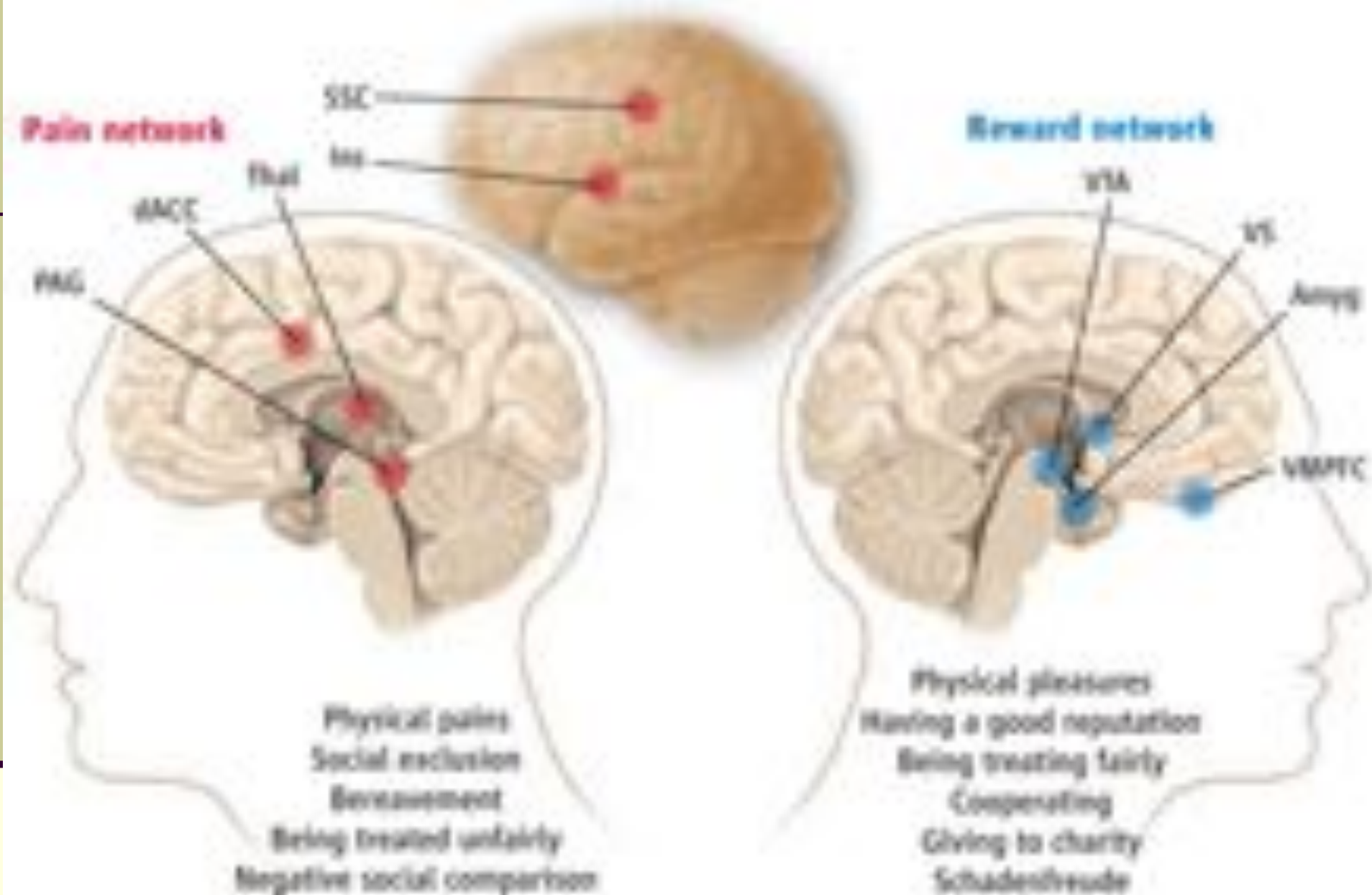
- Alterations in brainwaves (= changes in the firing patterns of synchronized neurons)
- Increased or decreased use of oxygen and glucose
- Ebbs and flows of neurochemicals

# The Rewards of Love

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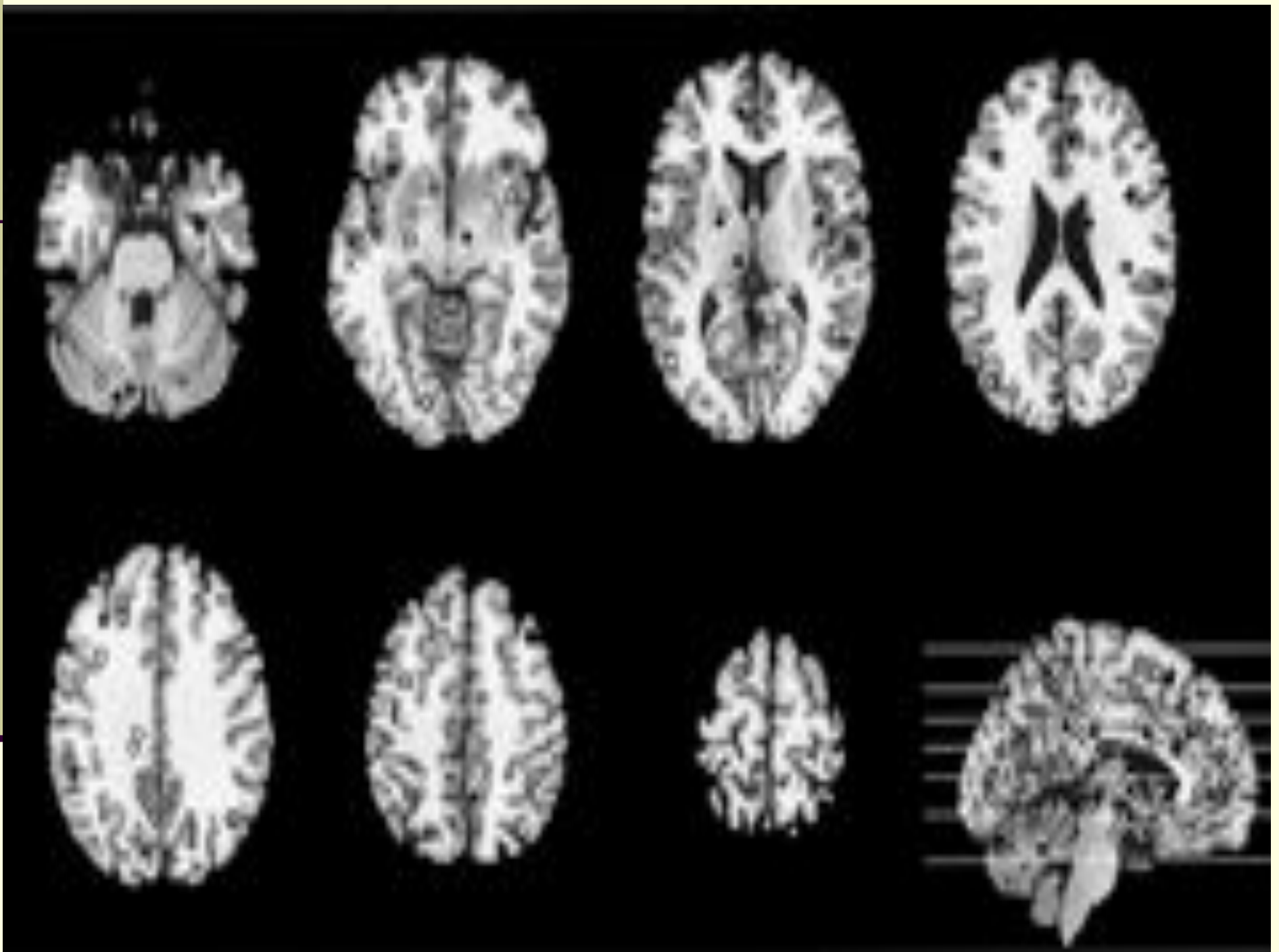




Pain network: Dorsal anterior cingulate cortex (dACC), insula (Ins), somatosensory cortex (SSC), thalamus (Thal), and periaqueductal gray (PAG).

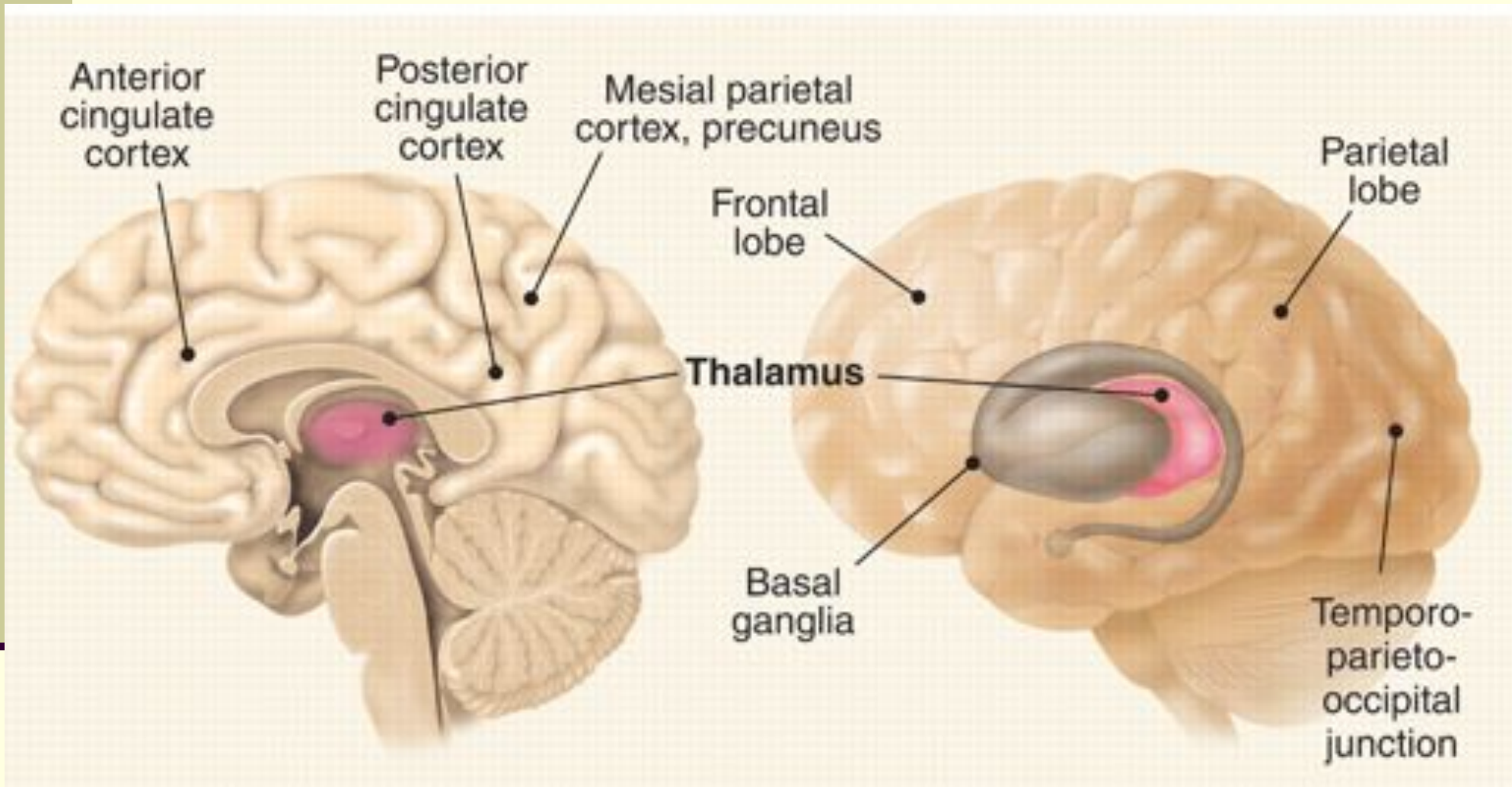
Reward network: Ventral tegmental area (VTA), ventral striatum (VS), ventromedial prefrontal cortex (VMPFC),<sup>17</sup> and amygdala (Amyg).

K. Sutliff, in Lieberman & Eisenberger, 2009, *Science*, 323:890-891



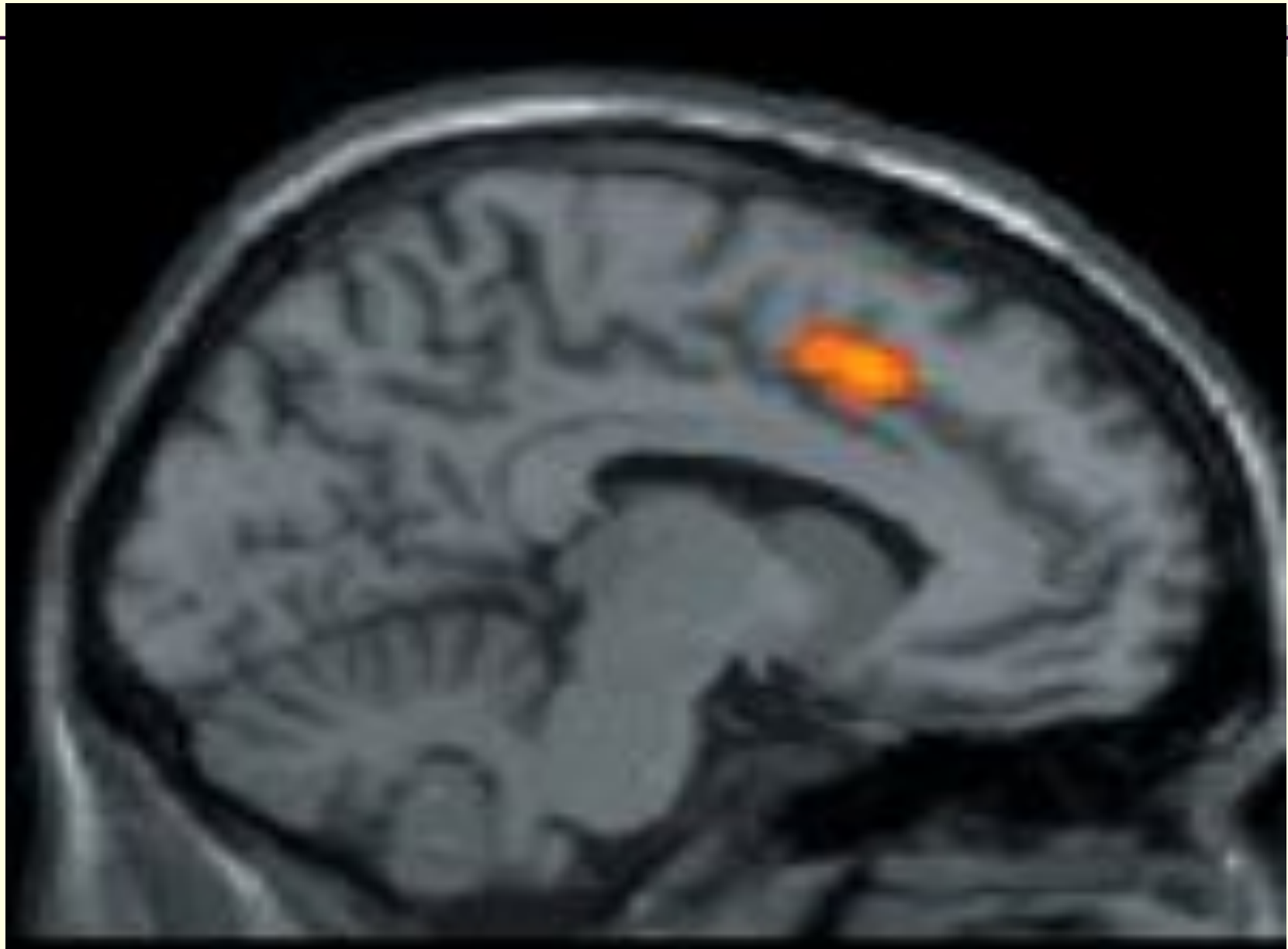
Brain activations of “selfing” - Gillihan, et al., *Psychological Bulletin*, 1/2005

# Key Brain Areas for Consciousness



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

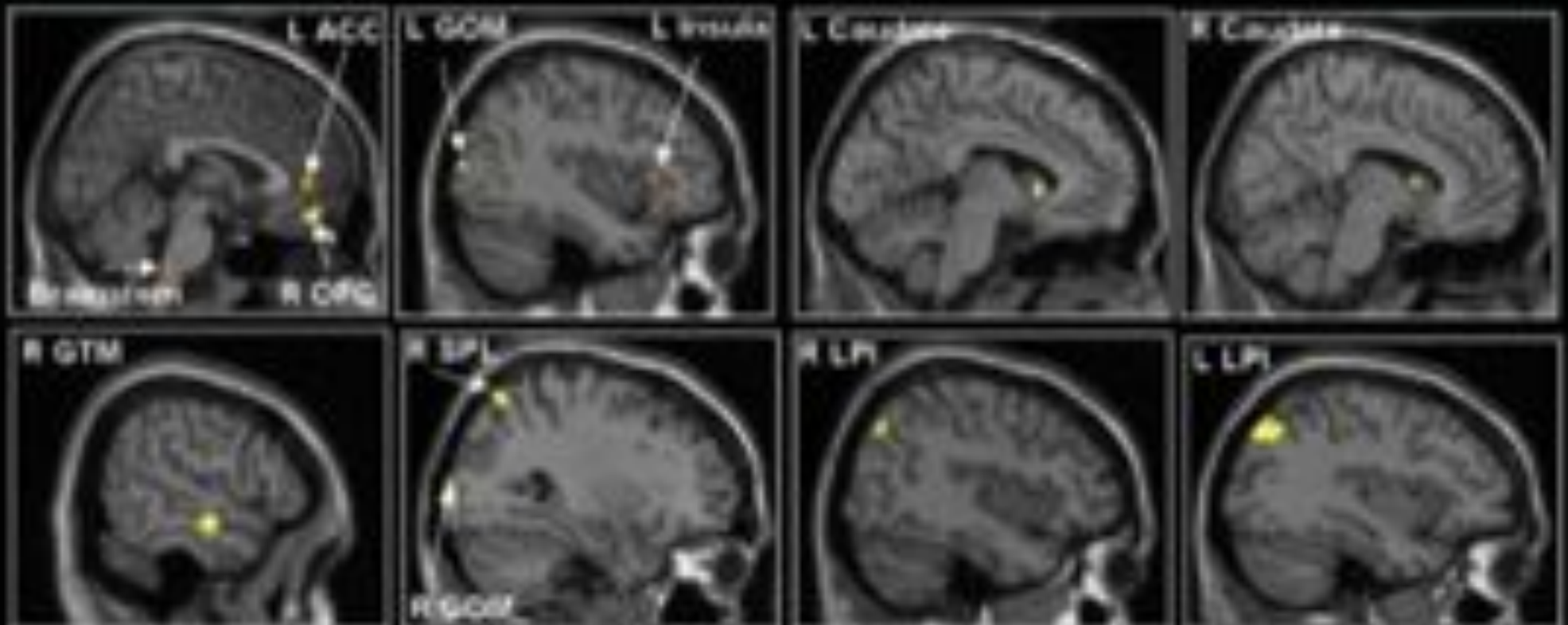
# Buddhist Meditation





# Christian Nuns in Prayer

Mystical > Baseline



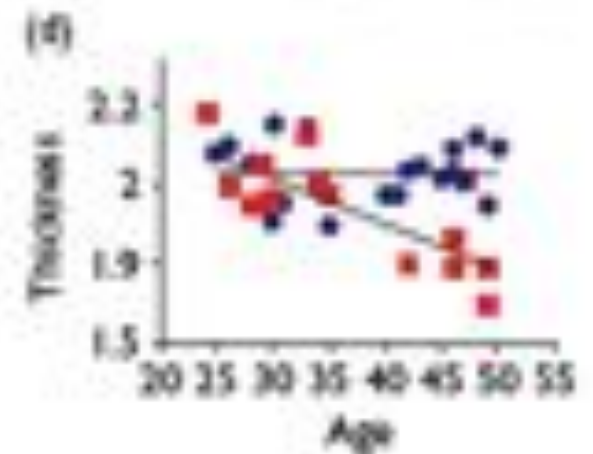
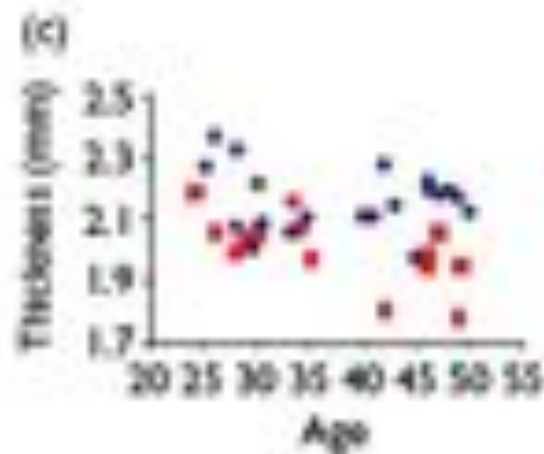
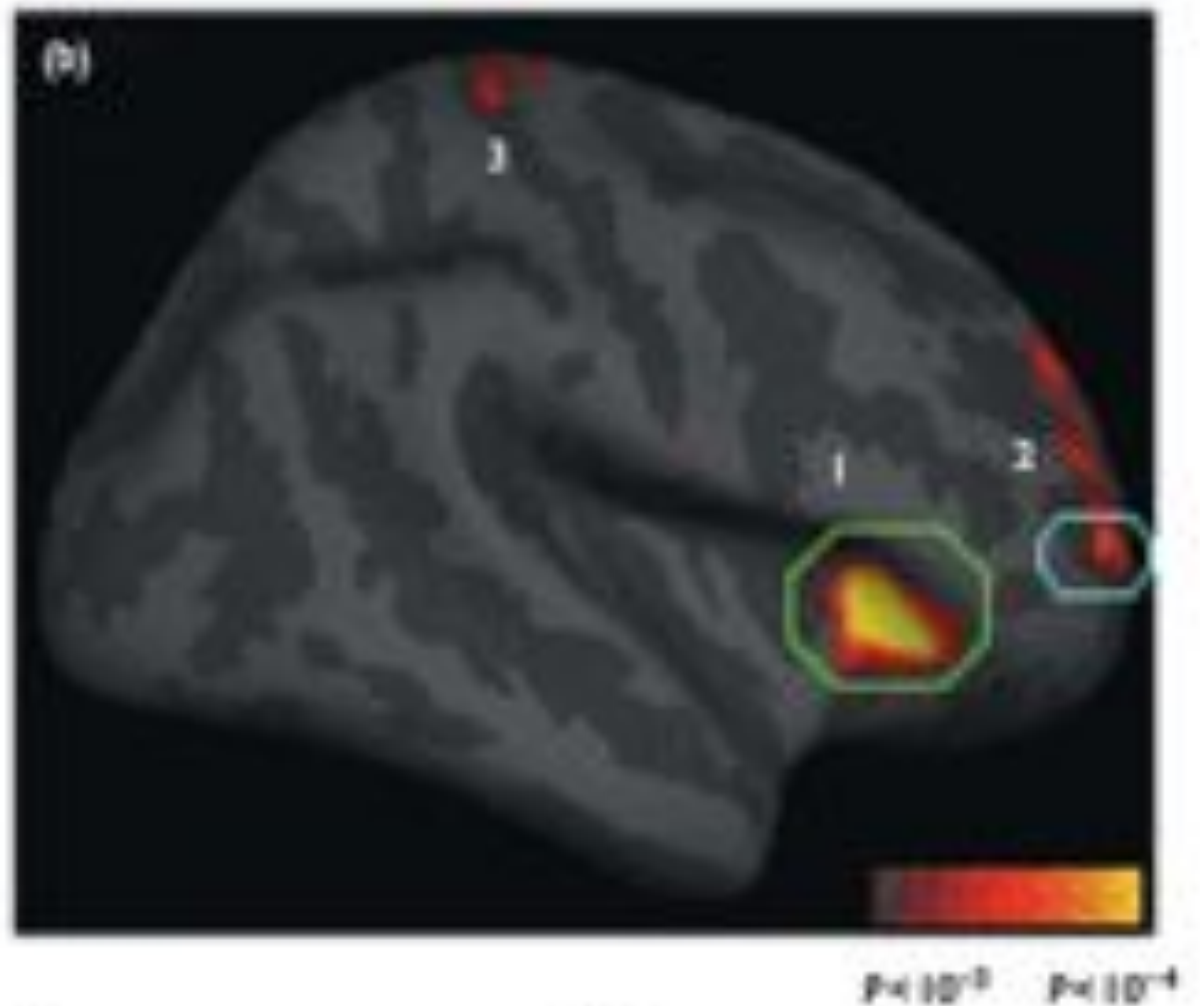
Beauregard, et al., *Neuroscience Letters*, 9/25/06

# Mental Activity Shapes Neural Structure

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- The flows of mind sculpt the brain.
- Immaterial information 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.



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*The principal activities of brains  
are making changes in themselves.*

Marvin L. Minsky



# Perspectives on Neuroplasticity

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- Neuroplasticity is not breaking news: For a century or more, it's been presumed that mental activity changed neural structure: what else is learning? (The news is in the details of how.)
- Most neuroplasticity is incremental; occasionally it's dramatic.
- Awareness increases neural structure-building. Residues of conscious experience continually sift into implicit memory.
- Your experience *matters*. Both for how it feels now and for the lasting threads it weaves into the fabric of your brain and being.
- Most experience is background, in the “simulator.” Thus the importance of mindfulness, of searching inside yourself.

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*The education of attention  
would be an education par excellence.*

William James

# Third Fact about Your Brain

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**With that mindfulness:**

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



# **Paper Tiger Paranoia**

# The Negativity Bias

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- In our evolutionary history, threats usually had more impact on survival than opportunities. Sticks are more salient than carrots:
  - The amygdala is primed to label experiences negatively.
  - The amygdala-hippocampus system flags negative experiences prominently in memory.
  - *The brain is thus like Velcro for negative experiences but Teflon for positive ones.*
- Consequently, the Avoid system routinely hijacks the Approach and Attach systems, and “bad is stronger than good”:
  - It takes five positive interactions to undo a negative one.
  - People will do more to avoid a loss than get a gain.
  - It's easy to create learned helplessness, but hard to undo.

# Negative Experiences Can Have Benefits

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- There's a place for negative emotions:
  - Anxiety alerts us to inner and outer threats
  - Sorrow opens the heart
  - Remorse helps us steer a virtuous course
  - Anger highlights mistreatment; energizes to handle it
  
- Negative experiences can:
  - Increase tolerance for stress, emotional pain
  - Build grit, resilience, confidence
  - Increase compassion and tolerance for others

*But is there really any shortage of negative experiences?*

# One Effect of Negative Experiences: Health Consequences of Chronic Stress

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## ■ Physical:

- Weakened immune system
- Inhibits GI system; reduced nutrient absorption
- Reduced, dysregulated reproductive hormones
- Increased vulnerabilities in cardiovascular system
- Disturbed nervous system

## ■ Mental:

- Lowers mood; increases pessimism
- Increases anxiety and irritability
- Increases learned helplessness (especially if no escape)
- Often reduces approach behaviors (less for women)
- Primes aversion (SNS-HPAA negativity bias)

# Self-Compassion

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- Compassion is the wish that someone not suffer, combined with feelings of sympathetic concern. Self-compassion simply applies that to oneself. It is not self-pity, complaining, or wallowing in pain.
- Self-compassion is a major area of research, with studies showing that it 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 focus of compassion to yourself, perhaps with phrases like: “May I not suffer. May the pain of this moment pass.”



# Major Result of the Negativity Bias: Threat Reactivity

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- Two mistakes:
  - Thinking there is a tiger in the bushes when there isn't one.
  - Thinking there is no tiger in the bushes when there is one.
- We evolved to make the first mistake a hundred times to avoid making the second mistake even once.
- This evolutionary tendency is intensified by temperament, personal history, culture, and politics.
- Threat reactivity affects individuals, couples, families, organizations, nations, and the world as a whole.

# Results of Threat Reactivity (Personal, Organizational, National)

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- Our initial appraisals are mistaken:
  - Overestimating threats
  - Underestimating opportunities
  - Underestimating inner and outer resources
- We update these appraisals with information that confirms them; we ignore, devalue, or alter information that doesn't.
- Thus we end up with views of ourselves, others, and the world that are ignorant, selective, and distorted.

# Costs of Threat Reactivity

## (Personal, Organizational, National)

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- Feeling threatened feels bad, and triggers stress consequences.
- We over-invest in threat protection.
- The boy who cried tiger: flooding with paper tigers makes it harder to see the real ones.
- Acting while feeling threatened leads to over-reactions, makes others feel threatened, and creates vicious cycles.
- The Approach system is inhibited, so we don't pursue opportunities, play small, or give up too soon.
- In the Attach system, we bond tighter to "us," with more fear and anger toward "them."

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**Besides its impacts at the personal and organizational level, threat reactivity is a major source of prejudice, oppression, and war.**

**Reducing threat reactivity is a key way to make this world a better place.**



# The Optimal Brain

# Reverse Engineering the Brain

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*What is the nature of the brain when a person is:*

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

# Home Base of the Human Brain

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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

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# To Survive, We Leave Home . . .

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- **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

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**How to come home?**

**How to recover the natural, responsive mode  
of the brain?**

# “Know the Mind, Shape the Mind, Free the Mind”

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- **Mindfulness, virtue, and wisdom** are identified in Buddhism, other contemplative traditions, and Western psychology as central pillars of practice.
- These map to central functions of the nervous system: receiving/learning, regulating, and prioritizing. And map to the three phases of psychological healing and personal growth:
  - Be mindful of, release, replace.
  - Let be, let go, let in.
- Mindfulness is vital, but not enough by itself.

# General Factors for Responsive Mode

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- Self-compassion
- Getting on your own side
- Mindful self-awareness
- Seeing the world clearly (Google could help here)
- Taking life less personally
- Taking in the good

# How to Take in the Good

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1. Look for positive **facts**, and let them become positive experiences.
2. Savor the positive experience:
  - Sustain it for 10-20-30 seconds.
  - Feel it in your body and emotions.
  - Intensify it.
3. Sense and intend that the positive experience is soaking into your brain and body - registering deeply in emotional memory.

# Benefits of Positive Emotions

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- The benefits of positive emotions are a proxy for many of the benefits of Taking in the Good.
- Emotions organize the brain as a whole, so positive ones have far-reaching benefits
- These include:
  - Stronger immune system; less stress-reactive cardiovascular
  - Lift mood; increase optimism, resilience
  - Counteract trauma
  - Promote exploratory, “approach” behaviors
  - Create positive cycles

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*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 for Each Motivational System

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## Approach system

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

## Affiliate 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.

# “Taking the Fruit as the Path”

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**Gladness**

**Love**

**Peace**

# Choices . . .



**Reactive Mode**

Or?



**Responsive Mode**

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*Penetrative insight*

*joined with calm abiding*

*utterly eradicates*

*afflicted states.*

Shantideva

# Great Books

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See [www.RickHanson.net](http://www.RickHanson.net) for other great books.

- Austin, J. 2009. *Selfless Insight: Zen and the Meditative Transformations of Consciousness*. MIT Press.
- Begley, S. 2007. *Train Your Mind, Change Your Brain: How a New Science Reveals Our Extraordinary Potential to Transform Ourselves*. Ballantine.
- Hanson, R. 2009 (with R. Mendius). *Buddha's Brain: The Practical Neuroscience of Happiness, Love, and Wisdom*. New Harbinger.
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- Kornfield, J. 2009. *The Wise Heart: A Guide to the Universal Teachings of Buddhist Psychology*. Bantam.
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- Thompson, E. 2007. *Mind in Life: Biology, Phenomenology, and the Sciences of Mind*. Belknap Press.

# Key Papers - 1

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See [www.RickHanson.net](http://www.RickHanson.net) for other scientific papers.

- Atmanspacher, H. & Graben, P. 2007. Contextual emergence of mental states from neurodynamics. *Chaos & Complexity Letters*, 2:151-168.
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- Carter, O.L., Callistemon, C., Ungerer, Y., Liu, G.B., & Pettigrew, J.D. 2005. Meditation skills of Buddhist monks yield clues to brain's regulation of attention. *Current Biology*. 15:412-413.

# Key Papers - 2

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- Hanson, R. 2008. Seven facts about the brain that incline the mind to joy. In *Measuring the immeasurable: The scientific case for spirituality*. Sounds True. 55

# Key Papers - 3

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- Lazar, S., Kerr, C., Wasserman, R., Gray, J., Greve, D., Treadway, M., McGarvey, M., Quinn, B., Dusek, J., Benson, H., Rauch, S., Moore, C., & Fischl, B. 2005. Meditation experience is associated with increased cortical thickness. *Neuroreport*. 16:1893-1897.
- Lewis, M.D. & Todd, R.M. 2007. The self-regulating brain: Cortical-subcortical feedback and the development of intelligent action. *Cognitive Development*, 22:406-430.
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- Lutz, A., Greischar, L., Rawlings, N., Ricard, M. and Davidson, R. 2004. Long-term meditators self-induce high-amplitude gamma synchrony during mental practice. *PNAS*. 101:16369-16373.
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- Takahashi, H., Kato, M., Matsuura, M., Mobbs, D., Suhara, T., & Okubo, Y. 2009. When your gain is my pain and your pain is my gain: Neural correlates of envy and schadenfreude. *Science*. 323:937-939.
- Tang, Y.-Y., Ma, Y., Wang, J., Fan, Y., Feng, S., Lu, Q., Yu, Q., Sui, D., Rothbart, M.K., Fan, M., & Posner, M. 2007. Short-term meditation training improves attention and self-regulation. *PNAS*. 104:17152-17156.
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