

The Neurology of Awakening:

Using the New Brain Research to Deepen Your Practice

Rick Hanson, Ph.D.

drh@comcast.net

Richard Mendius, M.D.

jrichardmendius@aol.com

© 2006

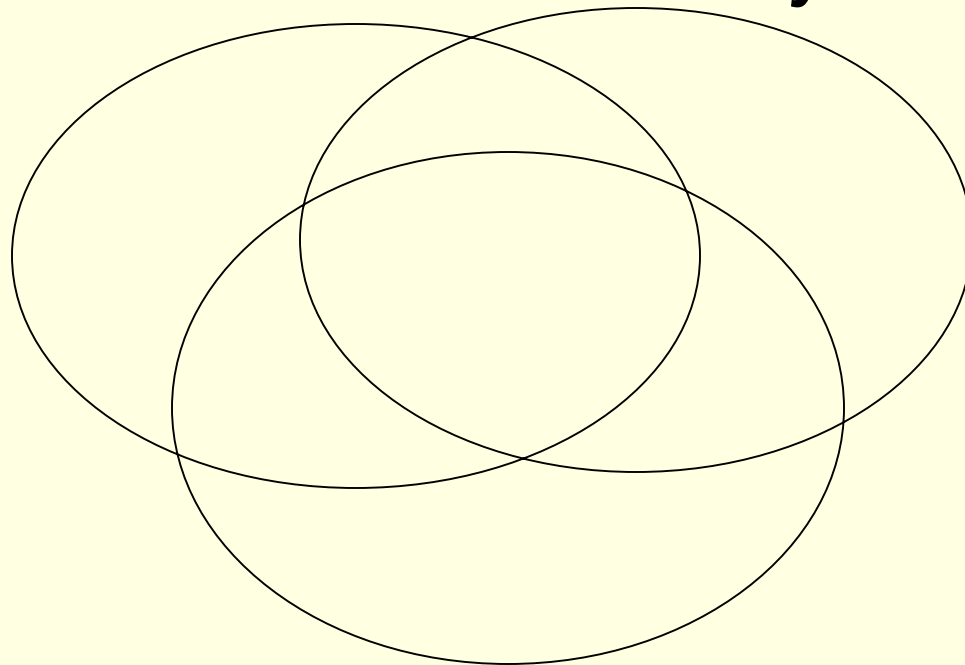
Plan for the Day

- Context
- Your Amazing Brain
- The Neurology of Suffering
- The Neurology of Happiness, Love, and Wisdom
- General Factors
- Steadying the Mind
- Quieting the Mind
- Coming to Singleness
- Concentration
- Liberating Insight

Common - and Fertile - Ground

Neuroscience

Psychology



Buddhism

Four Domains of Intervention

Mind

Body

Spirit

Relationships

Focus on the Body

Our focus today is on the body.

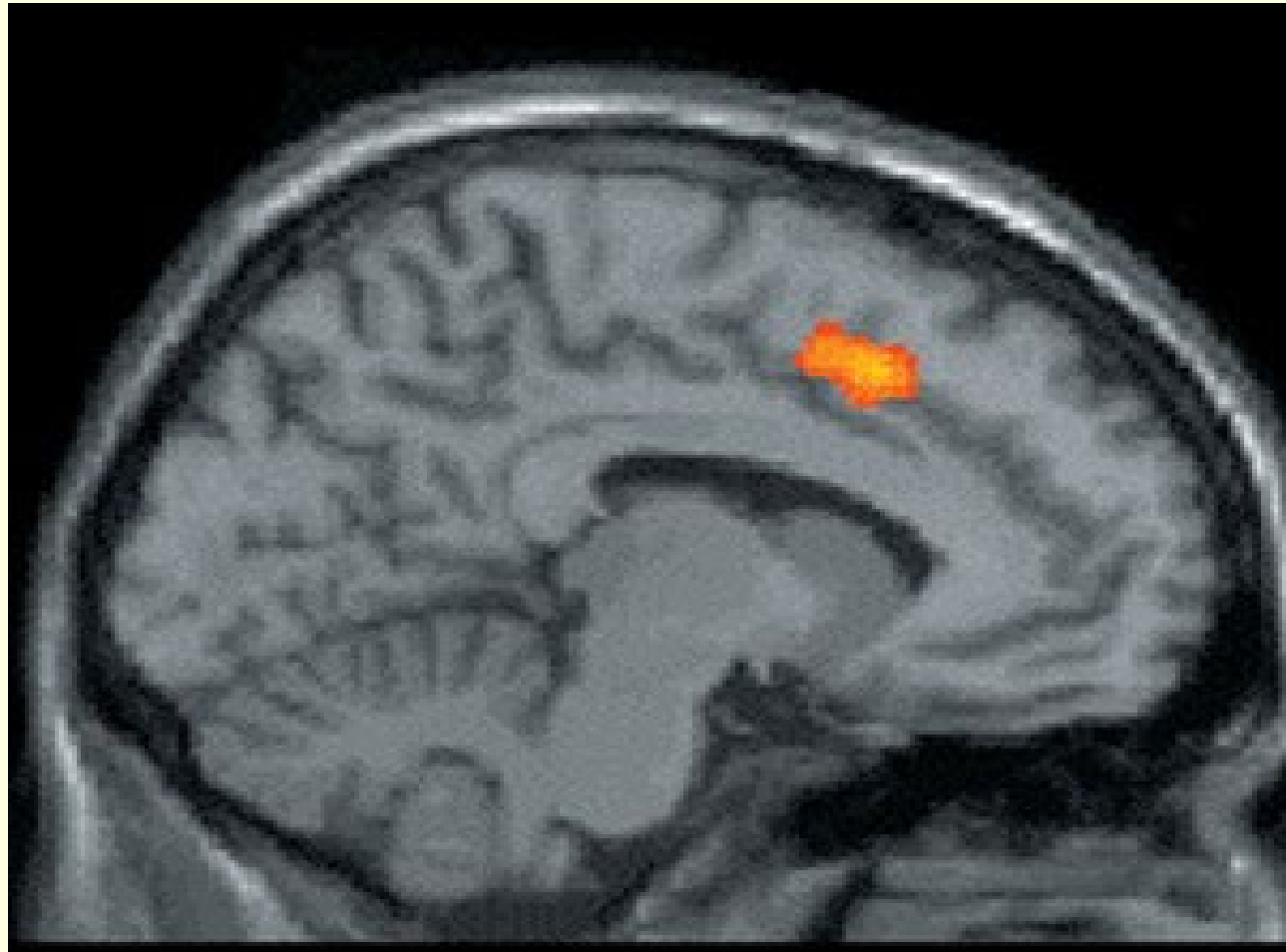
Specifically, on how to foster the causes and conditions in your brain that are most conducive to your happiness, peacefulness, wisdom, and meditative depth.

We believe in - and love - the Transcendental, but that is not our focus today.

The Union of Mind and Body

- Subjective experience correlates with brain activities.
- Change your experience - and you change your brain, temporarily and then permanently.
- Change your brain - and you change your experience.

“Ardent, Resolute, Diligent, and Mindful”



A Few Disclaimers

- On the frontiers of science:
 - Skepticism
 - Suspension of too easy belief
- Neuroscience is no replacement for contemplative wisdom.
- Adapt this to your own needs and practices.

"We ask, 'What is a thought?'

We don't know,

yet we are thinking continually."

- Ven. Tenzin Palmo

Your Amazing Brain

Major Features

■ **Size:**

- 3 pounds of cottage cheese
- 1,100,000,000,000 neurons, total
- 100 billion "gray matter" neurons

■ **Activity:**

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

■ **Speed:**

- Neurons firing 10 to 100 times a second
- Signals crossing your brain in a tenth or hundredth of a second

■ **Connectivity:**

- Each neuron gets inputs from 10,000 neurons
 and sends its outputs to 10,000 more
 giving you one quadrillion synapses.

Lifelong Learning

- Longest childhood of any animal:
 - So much to learn
 - Particularly the prefrontal cortex (control of emotion, actions)
- Learning means changes in your brain
 - Neuronal “pruning” - Natural selection in the brain
 - Changes in excitability of individual neurons due to activity
 - Increased blood flow
 - *“Neurons that fire together, wire together.”* - Donald Hebb.
Observable thickening of cortical layers.

Fleeting, subjective experiences leave lasting, objective tracks.

- Fundamental plasticity - Profoundly hopeful

“I seem to be a verb.” - Buckminster Fuller

Specialization and Teamwork

- Specialized functions
 - Speech production differs from comprehension
 - Face recognition

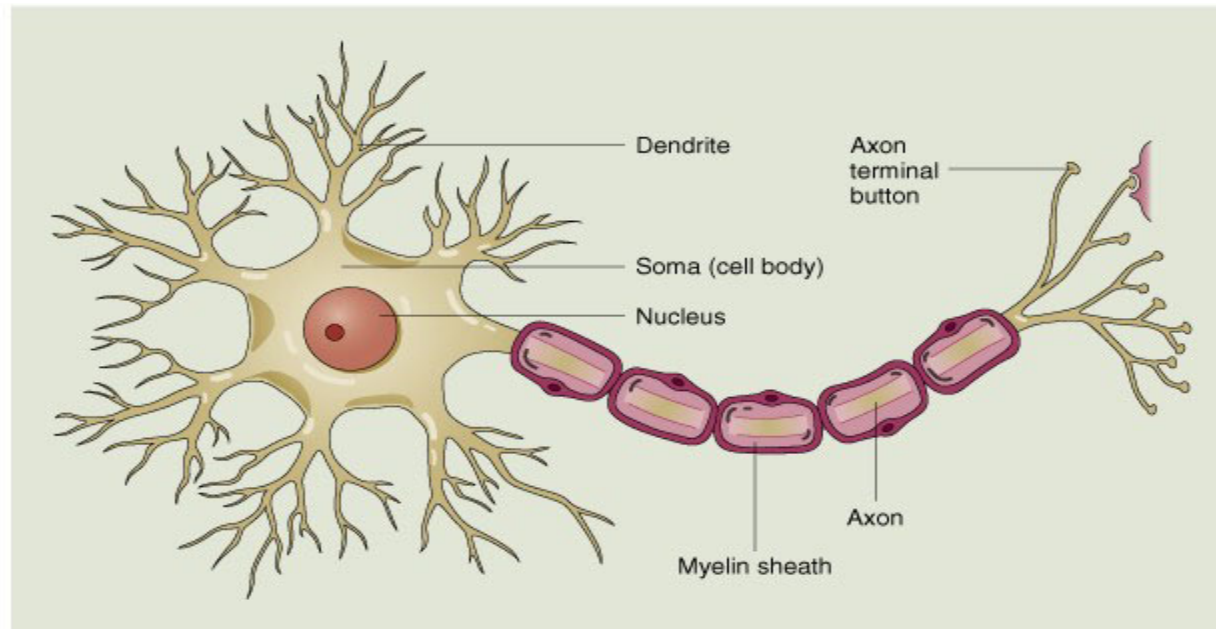
- Working in harmony as a network
 - Network “noise” facilitates individual signals
 - “*Specialization is for insects.*” - Robert Heinlein
 - Distributed information - “Holographic”
 - One part can compensate for damage to another

- No localized self -
 - “Self” is in the system, not the cells

Stability and Instability

- Stasis followed by updating followed by stasis
- Cycles a few milliseconds long. . . or decades
- Forever pulsing: Impermanence
- Fertile openness to creation: Emptiness

One Simple Neuron . . .



© 2000 John Wiley & Sons, Inc.

One neuron: on or off. A simple switch, yes?

... Firing for Complex Reasons

Not really.

1. The receiving side of a synapse is the most molecularly complex structure in the body.
 - Six factors trigger a neuron to fire:
 - Its initial setting
 - Number of excitatory neurons signalling it
 - Number of inhibitory neurons signalling it
 - Firing rate of each of those 10,000 neurons
 - Direction and rate of changes in their firing
 - Random electrochemical dynamics within it

... Multiplied by Billions of Neurons

- Multiply the complexity of a single neuron by 100,000,000,000 neurons (and that's only gray matter)
- Each with 10,000 synapses:
 - One quadrillion - 1,000,000,000,000,000 - synapses total
 - Most synapses flickering 1 - 50 times a second
 - Neural nets rocked by bursts of 80/second waves
- Possible brain states: 1 followed by a million zeros
- Circular loops:
 - Recursion and self-observation
 - Dynamic, “chaotic” effects: determined, but unpredictable
 - Shared circuitry triggers wandering stream of consciousness
- Overlapping, connected sub-networks
“Stream of consciousness”

... A Profoundly Complex System

*YOUR BRAIN IS THE MOST COMPLEX OBJECT
KNOWN IN THE UNIVERSE.*

*MORE COMPLEX THAN THE CLIMATE,
OR A SUPERNOVA*

Sources of Individuality

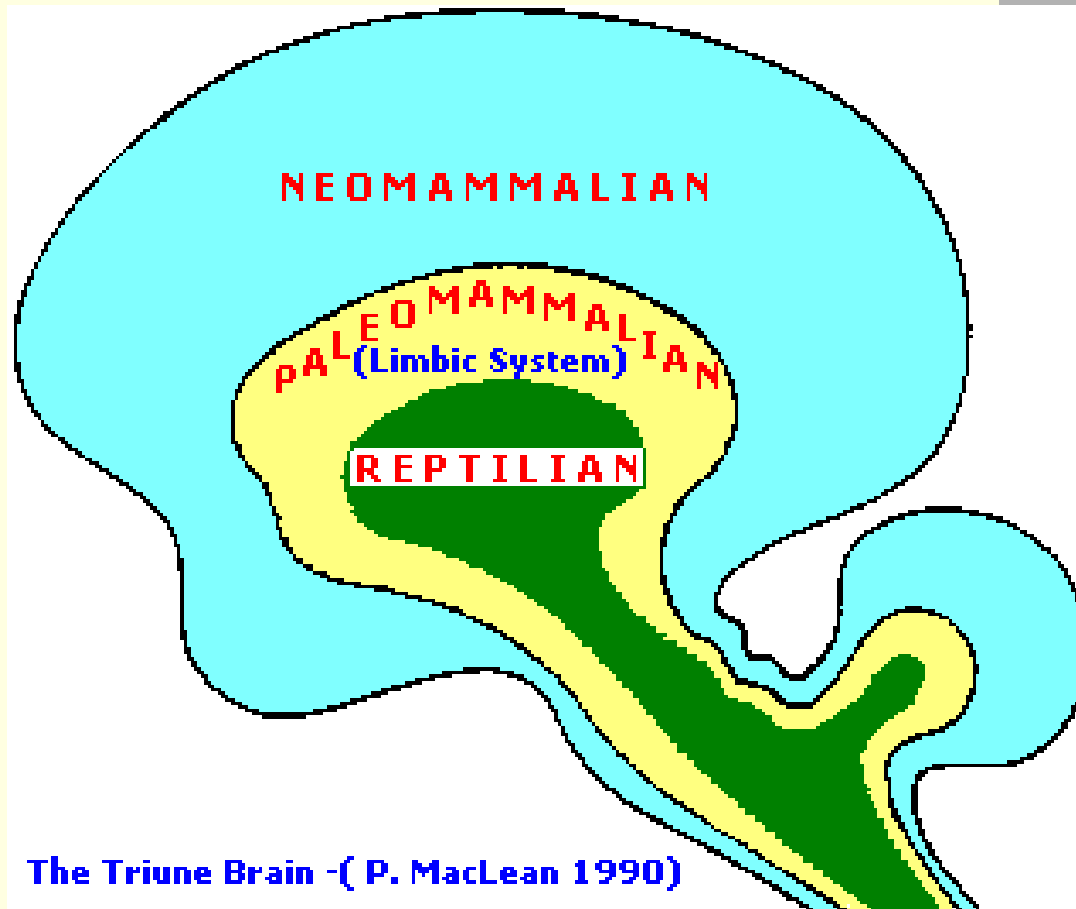
- **Genetic:**
 - Variation in the receptors for neurotransmitters
 - Variation in the numbers of neurons and their connections
- **Gender:**
 - Subtle differences
 - The similarities greatly outweigh the differences
- **Variation in synaptic connections** for exactly the same reflex . . . or concept
- **History:**
 - In utero
 - Forever after

The brain is congealed karma.

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.
“We are all just prisoners here, Of our own device” - Eagles

Evolutionary History



The Triune Brain -(P. MacLean 1990)

The Triune Brain

Three Stages of Brain Evolution

■ Reptilian:

- Brainstem, cerebellum, hypothalamus
- Reactive and reflexive

■ Mammalian:

- Limbic system, hypothalamus, thalamus, hippocampus, amygdala
- Memory, emotion, social behavior

■ “Clever Ape” (*Homo sapiens*):

- Cerebral hemispheres
- Self-reflection, sophisticated planning, abstract thought, language

Evolution Grinding Away

- 3.5 billion years of life on this planet
- 600 million years of multi-celled animals
- 80 million years of mammals
- 10 million years of ape-like ancestors
- 2.5 million years of stone tool-using relatives
- 100,000+ years of our own species

The 2% Difference

- Chimpanzee DNA is 98-99% identical to yours and mine.
- Most of that crucial 1-2% difference codes genes for your brain.
- Human evolution is about mainly one thing:
Brain. Brain. Brain.

All for what purpose?

Grandchildren!



A Poignant Truth

Your magnificent brain is the reason
humans stand atop the planet's food chain.

Thank you, Mother Nature.

But Mother Nature, alas, does not care if we suffer . . .

The Neurology of Suffering

- The Buddha's insights on experience:
 - Impermanent, constantly changing
 - Interdependent, co-arising, non-dual, empty, "not-self"
 - Unsatisfying, suffering
- Suffering is caused by ignorance and clinging

How and why

does your brain generate

ignorance and clinging?

The Construction of Suffering

The brain has five properties that help you survive, but also lead to your suffering:

1. Separation of organism and world
2. Identification with the body
3. Anxiety of survival
4. Seeking stability in a changing world
5. Pursuing pleasure and avoiding pain

Organism Separate from World

- **Vital benefits:**
 - Necessary boundary to protect internal states
 - Basic conceptual framework - saves time on the savannah
- But everything is actually all entirely interconnected, from quanta to the “Great Wall” of galaxies.
- The brain remains ignorant of its illusion of duality.
- **And so it suffers:**
 - Felt sense of contraction and loss as a separate self
 - View of world as “other” - to be controlled or resisted
 - Loss of opportunities to be in harmony with others and world

Identification with the Body

- Any organism must monitor its internal state to maintain equilibrium and health.
- Monitoring changes in these “instrument panels” gives a moving picture of the organism in its environment.
- These layers of monitoring the monitors - guarding the guardians - become more complex up the ladder of evolution.
- This builds a neurological architecture of identification with the body . . .
- . . . which, in humans, could be the root of “core consciousness”
- . . . and the fundamental sense of being a self.

Anxiety of Survival

- We were prey before we were predators.
- Brain is hard-wired to be watchful and wary to detect threats:
 - Sleep: Waking up ten times a night to check for leopards
 - Motivated by ongoing trickle (river?) of anxiety
 - Getting nervous because you're not nervous enough
- Anxiety gives us grandchildren and suffering:
 - Unpleasant in itself
 - Overestimates dangers, overlooks opportunities
 - Suppresses positive feelings
 - Distracting on - or off - the cushion
 - Makes it harder to bring attention inward

Seeking Stability in a Changing World

- The universe is change: Quantum volatility . . . Hawaii sinks in 80 million years . . . Sun swallows Earth in 4 billion years . . .
- The brain is change: Synapses and circuits . . . Sensory input fire hose . . . A boiling electrochemical teapot . . .

“A buzzing, blooming confusion” - William James

- To cope and survive, multiple regulatory systems in your brain:
 - Try to play traffic cop in Tokyo . . .
 - . . . clutching every second at the lip of the waterfall . . .
 - . . . trying to grasp what has already vanished over the edge.

Pursuing Pleasure, Avoiding Pain

- Fundamental survival decision, viruses to voters:
 - Absorb or spit out
 - Approach or avoid
- The deep machinery of:
 - Pleasant/unpleasant/neutral
 - Likes and dislikes
 - Grasping, aversion, and obliviousness
- All of which lead to suffering.

“The Great Way is easy—for one with no preferences.”

Concluding Unscientific Postscript

- The quest for happiness - and spiritual realization - often involves swimming upstream against these ancient currents.
- Ironic, poignant, necessary . . . and also ennobling
- Holding thoughts, emotions, and memories in proper perspective can free brain circuits from entrapments in ignorance.

*Be compassionate toward your brain,
'cause it's the only one you've got.*

And Now the Good News:

The Neurology of

Happiness, Love, and Wisdom

Brain States in Relaxed Well-Being

- Autonomic nervous system:
 - Parasympathetic activation
 - Sympathetic (“fight or flight”) is quiet
- Pleasant, rewarding hormones and neurotransmitters: Norepinephrine, oxytocin, dopamine, endorphins
- Brain waves:
 - Emphasize delta (1 - 3 Hz) and theta (4 - 7 Hz), with some beta (14 - 30 Hz) mixed in
 - Increased coherence and resonance

Your Natural Condition

- Settled, even-keeled after a decision
- EMDR (Eye Movement Desensitization and Reprocessing):
 - Start with pain, do EMDR, get peaceful
 - Start peaceful, do EMDR, stay peaceful
- Hit the reset button, get bodhicitta
- No matter if obscured by greed, hatred, delusion, or other reactions to the thousand slings and arrows

. . . . There is light under that bushel basket.

Meditation Trains the Brain - 1

- Activates frontal lobes - nourishes the will
- Trains attention, self-observation, and thus observing ego
- Trains “meta-attention” - awareness of awareness
“A person whose mind is distracted lives between the fangs of mental afflictions.” - Shantideva
- Increases empathy

Meditation Trains the Brain - 2

- Trains wholesome habits of mind:
 - Triggers hypothalamus/brainstem reward circuits
 - Positive states become positive goals
 - Positive blocks negative; flowers crowd out weeds
- Integrates thinking and feeling
- Some lasting changes in the brain:
 - Resting state brain waves in calm, contented pattern
 - Thicker brain regions for attention, interoception, and integrating thinking and feeling
 - Less cortical thinning with aging:
Neurological nodes of wisdom!

Thus, a Key Question:

How to Cultivate

Positive Brain States?

A Road Map from the Buddha

- *Milestones toward Awakening . . .*
 - A gradual, progressive process in which:
 - “...the mind is steadied internally*
 - . . . quieted*
 - . . . brought to singleness*
 - . . . and concentrated.”*
- Anguttara Nikaya 3:100
- Leading to liberating insight

Steadied Internally

A stable

stability of attention . . .

Quiet

- Little verbal activity
- Minimal sensorimotor stimuli
- A still pond with few emotional waves

Singleness

- Great collectedness
- Largely absorbed in the object of attention
- Withdrawn from most everything else
- Only wispy, peripheral thoughts
- Integrated, inclusive awareness: all one percept
- Near-perfect equanimity

Concentrated

- Non-ordinary state of consciousness:
Jhana, samadhi
- Intensification of experience
- Profound absorption
- Pervading feelings of rapture, bliss,
happiness, contentment, tranquillity

Cultivating Vipassana

- Insight is the ultimate aim
- Insight is nourished by stable, quiet, collected, and concentrated states . . . of the brain.
- The Buddha: Liberating insight - and Nibbana itself - is the fruit of morality, wisdom, and contemplative practice.

*Even if the ripe apple falls ultimately by grace,
its ripening was caused
by the watering, feeding, protecting, and shaping of its tree.*

Watering Your Fruit Tree

Steady

Quiet

Single

Concentrated

Insightful

General Factors

Supporting Wholesome Brain States

Being Awake and Alert

Feeling Safe

Compassion and Happiness

Balanced Neurochemistry

Being Awake

- Meditate during times of natural alertness.
- Minimize drains on wakefulness:
 - Lack or disturbance of sleep
 - Physical fatigue
 - Illness
 - Hormonal conditions
 - Surges of sugars
 - Depression
- Take care of yourself. Set reasonable goals.

Being Alert

- Posture - feedback to reticular formation:
“wake up”
- “Brightening the mind:”
 - Energize without jangling
 - Norepinephrine, not adrenaline
- Oxygen in the breath

Feeling Safe

- To bring attention inside, you must withdraw from the world.
- But the brain is hardwired to check for threats.
- So, cultivate a sense of inner safety, bringing the sentries in.
- The Buddha:
 - Find a place of seclusion (a secure base)
 - Sit at the base of a tree
 - . . . (where he found his own enlightenment)
 - . . . protecting your most vulnerable flank
- Especially important for more anxious people

Methods to Feel Safe

- Familiarize the setting - Find the tree
- Relax the body - Drop the armor
- Diaphragm breathing - Especially on exhalation
- Imagery of spaciousness - *“This, too.”*
- Taking refuge - *“We all need somebody to lean on.”*

Compassion and Lovingkindness

- Arise from awareness of interdependence, emptiness, not-self
- A practical training of the mind
- Both a heart and a hormone practice

"Through compassion one is free from lethargy and depression." - Acariya Dhammapala

Opening the Heart

- Natural variability of beat to beat interval
- Large, smooth changes in variability:
 - Activate parasympathetic nervous system, lower blood pressure, and support immune function
- A simple method:
 - Even breathing - inhalation equals exhalation
 - Imagine breathing through your heart
 - Evoke a heartfelt feeling (e.g., gratitude, love)

Metta Practice

- The deliberate cultivation of lovingkindness and compassion
- May trigger cascades of oxytocin
 - . . . like the warmth of a long, caring hug
 - . . . or nursing an infant
- Positive intentions and good wishes. Classic phrases:
 - May you be happy.*
 - May you be safe from harm.*
 - May you be healthy.*
 - May you be at peace.*
 - May you live with joy and ease.*

Happiness

- Why it trains the brain:
 - Fosters vigour, alertness, “pep”
 - Activates parasympathetic system, which reduces stress hormones and relaxes the body
 - Increases resilience
 - Counteracts depression and anxiety

- *Happiness is skillful means:*
 - Joy is one of the seven factors of enlightenment.
 - Bliss and joy are factors of the jhanas.

Generating Positive Emotions

- Soft smile
- Remember past positive feelings.
 - “Taking in the good” builds up positive emotional memory stores.
- Think about things that make you happy.
- Keeping the right hemisphere busy

Brain Hemispheres and Emotion

- Left hemisphere moderates negative feelings
 - Stroke victims
- Right hemisphere processes visual field for threats
- Occupying the right hemisphere:
 - Frees up left hemisphere for greater emotional control
 - Can reduce anxiety
 - Other benefits: holistic awareness, body sensing

Ya gotta be in your left brain to be in your right mind.

Engaging the Right Hemisphere

- Visualization
- Musical chanting, singing, drumming
- Whole body awareness
- Meditations on spaciousness (e.g., blue sky)

Optimizing Brain Chemistry

- Two core functions of neurotransmitters:
 - Calming down - “Inhibitory”
 - Energizing up - “Excitatory”
- Supplementing these neurotransmitters or their co-factors - In a context of overall health
- Individual differences:
 - More benefit from inhibitory neurotransmitters

Inhibitory Neurotransmitters

- Serotonin
 - 5-HTP (Do NOT take if on an anti-depressant)
 - Iron, B-6 as pyridoxal-5-phosphate (P-5-P)
- Taurine
- Glycine
- GABA

Excitatory Neurotransmitters

- For balance, make sure sufficient inhibitory neurotransmitters are already on board.
- L-Phenylalanine
- L-Tyrosine

Do not use these if you are taking an antidepressant or other medication that increases norepinephrine and/or dopamine.

General Considerations

- Most people do well with supplements. Natural molecules the body knows how to metabolize
- But if you feel funny, just stop, and any adverse symptoms should resolve in a day.
- Make sure other co-factors are adequate, especially B-6 and iron.
- Consider further testing (e.g., amino acids)

Steadying The Mind

- Continuity of attention
 - Cat at mousehole - having taken the First Precept, of course! - or you tracking the breath
 - Attention increases neuronal sensitivity
- Screen out the unwanted, heighten the desired
- Attention applied - skater plants her skate - “vitaka” - prefrontal cortex
- Attention sustained - skater glides - “vichara” - anterior cingulate

But easier said than done . . .

Challenges to Stable Focus

■ Primary challenges:

- Fatigue with concentration
- Porous filters (sensations, emotions, thoughts, desires, etc.)
- Stimulus “hunger” (or “thirst” - “tanha”)
 - Heightened with anxiety, spirited/ADHD temperament

■ Secondary challenges:

Riding through these holes in steady attention come the five horsemen of the Hindrances:

Greed - Aversion - Sloth - Restlessness - Doubt

Resources for Steadying the Mind

- Cultivating four mental resources:
 - Strong intention
 - “Gluing” attention to an object
 - Filtering out distractions
 - Staying satisfied with one object
- These reveal the multi-component nature of attention

What are your strengths and weaknesses with these four resources?

Generating/Regenerating Intention

- Centrality of intention in psychology and Buddhism
- *“Diligent, ardent, and resolute. . .”* - The Buddha
- Instructions from frontal lobes, executive oversight via anterior cingulate
- How to:
 - Evoke sense of the desired state
 - Establish intentions at start of meditating
 - ”Channel” a teacher/mentor/guru
 - Re-intend at short intervals

Managing Attention Fatigue

- Enlist language centers for more resources:
 - Count breaths, steps, etc.
 - "Soft noting"
- Set up overseer function to watch the watcher
 - Probably centered in the anterior cingulate (AC)
 - Warm up the AC with compassion
- Evoke warmth, fondness, devotion for the breath
 - Increases positive emotion
 - Deepens engagement

Barbarians at Attention's Gate

- Sustained focus:
 - Prefrontal cortex (PFC) in stable state
 - Gate closed, blocking out other information
- Updated shift in focus:
 - Gate opens, most intense message slips through
 - Gate closes behind, new stability in PFC
- Steady dopamine closes gate; spikes open it
- Steady, high positive emotion maxes dopamine production - so spikes aren't possible!

Filtering out Distractions

- Siate on stimuli: Recurring, safe to ignore
- Use frontal lobe intentionality to set "high filtering"
- Batting away other stimuli before they take root
- Postpone planning, worrying, thinking, getting upset, etc., to later
 - Scarlett O'Hara on the zafu: *"Gone with the Breath"*
- If necessary, focus on the intrusive stimulus
 - "Alright, already!"*

Hungry for Stimulation

- Aiding the brain's survival vigilance:
“Help me make it through the night.”
- Basal ganglia (BG) monitor stimulation through the six “sense doors”
 - Below threshold, they pulse cravings for more.
 - Above threshold, BG and thalamus trigger reward circuits:
“Y’all get some dopamine round hyear!”
- Normal temperamental variations: Spirited, ADHD?
- The Buddha: Different practices for different people

Satisfied with Less

- Increase sensitivity to stimuli, so less is more
- Sensory awareness practices - like mindfulness - thicken cortical layers in your brain
- Focus on the neutral feeling tone

“The neutral is actually very close to peace and ease. It’s a real doorway to resting in the eventless.” - Christina Feldman

Increasing Stimulation with Contact

- Re-orient to each breath as a fresh stimulus
 - Beginner's mind, "don't-know mind"
- Intensify contact (= more stim): details, subtleties
- Attend to breath as a whole
- Move attention among its parts
(It's not cheating if it keeps you there.)
- Walking meditation

Increasing Stimulation with Positive Emotion

- Dampen BG/thalamus system with positive feelings
(So reward the sucker, already.)
- Evoke feelings of sufficiency, contentment, fullness.
 - Aspect of sukha - one of the jhana factors
- Activate oxytocin, giving yourself a mental hug.
- Savor the pleasant sense of absorption itself.

Disenchanted with Stimulation

- Recall the truth that all stimuli are fundamentally impermanent, empty, and ultimately unsatisfying.
- Call up a sense of disenchantment with the inner and outer worlds that is an important step along the path toward Awakening.

Disenchantment is a good “dis.”

Quieting the Mind

- Sense of ease, spaciousness, non-clamor
- High signal to noise ratio. Lots of coherence
- Arising and disappearing . . .
of experience is clear

*A thought unfolds like a bright flower blooming in vast space,
the petals unfurl, open, and drop away,
the Flower Sutta - wordless, perfect*

Quiet . . . and Silence

- Two kinds of quietness:
 - Exceptional states, with preserved awareness of outside stimuli (not uncommon)
 - Extraordinary states with no awareness of outside stimuli (fairly rare)
- We're generally referring to the first of these.

What Does a Quiet Brain Look Like?



Neuroimaging of a Quiet Brain

- Frontal lobes, the seat of intention, are “lit up”
- High parietal lobes - sensory association centers - are “cooled down”
- Gender, type of contemplation, and religious framework . . . made no observable difference within the brain.

A Hush Begins to Fall

- Quick review of previous methods:
 1. Sate on and then ignore stimuli
 2. Tell yourself to plan, worry, etc. later
 3. “Bat away” distracting thoughts and feelings
 4. If necessary, make the intrusion the focus

Whole Body Awareness

- Right hemisphere:
 - Specialized processing of bodily sensations
 - . . . Especially gestalt awareness of body as a whole
- Whole body awareness activates right brain, shifting energy away from verbal chatter of left brain
- Track breath as a whole, then body as a whole:
 - One unified "percept"
 - Also aids neurological integration of mind-in-singleness

Let's try it

Stilling the Verbal Centers

- Mantra meditation - occupies verbal circuits
 - Neuroimaging study
- Gentle instructions to verbal mind:
“There will be time for this later, so relax.”
- Keep returning to physical sensations

Coming to Singleness

- "Ekaggata" - last of the five jhana factors

- Deep, abiding absorption in one object:
 - Withdrawal from surrounding environs
 - Wispy, peripheral thoughts - if any, at all

- Four characteristics:
 1. Effortless stability; utterly given over to the breath
 2. Unification of experience; one whole thing; coherence
 3. Equanimity: impartiality toward experience
 4. Spacious selflessness; breathing without a breather

Effortless Stability

- High-frequency gamma waves:
 - Growing distribution and intensity
 - Gradually drawing the brain into "one vibration"
- Monitoring of attention disperses from "muscular" anterior cingulate to "mellow" whole-system property
- Shifts in the machinery of "self":
 - "Autobiographical consciousness" fades
 - Abiding in core consciousness:
 - Where the "feeling of what is happening" arises

Perhaps the subjective sense in singleness of "being deep down" is the brain's spatial metaphor for immersion in its ancient circuitry.

Unification of Experience

- Relax into whole body awareness: activates the mesial (middle) parietal lobes which integrate sensory experience
- Rest in the effortless intention of singleness:
 - Recall or imagine unification of experience (hippocampus)
 - Sustain that aim (prefrontal lobes)
- Invoke the jhanic factor: “*May ekaggata arise.*”
- Open up to the “ka-woosh” of it all coming together

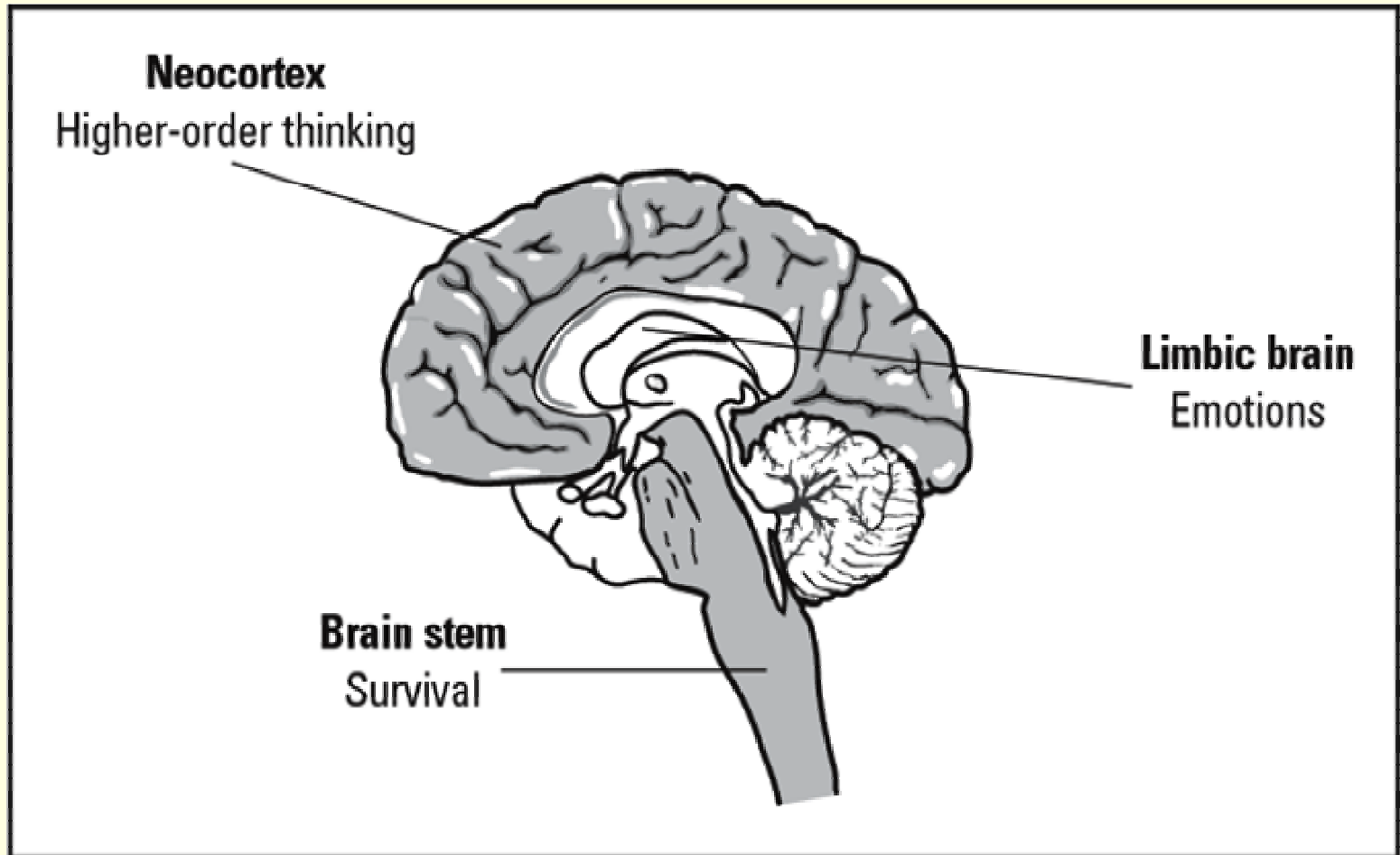
Equanimity

- More than calm:
Equanimity means not reacting to your reactions
- Impartial about the “feeling tone:”
Positive, negative, or neutral
- Breaking the chain of "dependent origination:"
From contact to feeling to craving to clinging

Yes, the first dart lands.

But not the second one.

Circuits of Emotional Responses



The Anatomy of Reactivity

- Incoming stimuli processed by amygdala
 - Central switchboard
 - Ancient, reptilian structure
- Snap judgements (influenced by ties to hippocampus [memory]):
 - Pleasant → Approach
 - Unpleasant → Avoid or fight
 - Neutral → Ignore and forget
 - *The amygdala could source the feeling tone of the "2nd aggregate."*
- Reacts before frontal lobes can process perception signals
 - *"Jump first, ask questions later!"*
 - Why the feeling aggregate comes before the perception aggregate
- But leads primitive reactions to hijack modern, reasoning mind
 - (Especially with history of trauma)
 - Triggering secondary cascade of reactive emotions, views, actions

Retraining the Amygdala

- Primed to go negative: anxious combativeness
- Block initial storage of negative experiences in memory
 - Hippocampus influences amygdala's packaging
- Shift existing memories in a positive direction:
 - Memories are not recalled, but reconstructed.
 - Infuse the reconstruction with positive qualities:
 - Context of spaciousness
 - Compassion and encouragement for yourself
 - That you coped and got through; your own good qualities
 - Forgiveness practices
- Re-conditioning amygdala labeling:
 - Cultivate positive emotion
 - Dampen sympathetic nervous system
 - Increase sensitivity to neutral stimuli

Strengthening Your Circuit Breaker

- Close attention to the feeling tone: Frontal lobe oversight short-circuits the secondary cascade.
- Impartiality toward the ten thousand things:
 - Good, bad, beautiful, ugly, etc. are all “empty”
 - Relax judgmental labelling
 - Compassion and lovingkindness, no matter what
- Disenchantment and dispassion
- *“The Great Way is easy for one with no preferences.”*

"I" Is a Fictional Character

- Self functions are widely distributed throughout the brain.
 - No Great and Powerful Oz behind the curtain
 - No homunculus inside your head
 - Nervous system activities co-arising due to causes and conditions
(Now, where have we heard this before?)

- Less self means more resources for unification with the breath.

- Fostering selflessness:
 - Quiet parietal lobes to dissolve body-in-world and self-in-body
 - Open into spaciousness, emptiness, blurred boundaries of "me"
 - Abandon, release sense of self in this moment
 - Receive the breath as a space, not an "agent" pursuing it
 - Feeling of devotion, giving "self" over to the breath
 - View experience as provisional, just the flickering brain, not "mine"

Concentration

“And what, friends, is right concentration? Here, quite secluded from sensual pleasures, secluded from unwholesome states, a person enters upon and abides in the first jhana, which is accompanied by applied and sustained thought, with rapture and pleasure born of seclusion.

With the stilling of applied and sustained thought, the person enters upon and abides in the second jhana, which has self-confidence and singleness of mind without applied and sustained thought, with rapture and pleasure born of concentration.

With the fading away as well of rapture, the person abides in equanimity, and mindful and fully aware, still feeling pleasure with the body, enters upon and abides in the third jhana, on account of which noble ones announce: 'He or she has a pleasant abiding who has equanimity and is mindful.'

With the abandoning of pleasure and pain, and with the previous disappearance of joy and grief, he or she enters upon and abides in the fourth jhana, which has neither-pain-nor-pleasure and purity of mindfulness due to equanimity. This is called right concentration.”

- The Buddha

Concentration and Neuroscience

- These are non-ordinary states of consciousness - yet undoubtedly experienced by millions of people over thousands of years.
- There are corresponding neurological states and processes: EEG's - concentration differing from mindfulness
- Subjective experiences can point to physical conditions: Gut feelings, falling in love at first sight
- This is provisional speculation on best available data.

Hold on for the ride.

The First Jhana:

“Accompanied by applied and sustained thought, with rapture and pleasure born of seclusion.”

- Applied thought - Prefrontal cortex is active
- Sustained thought - Anterior cingulate cortex: active, too
- Rapture - Dopamine from ventral tegmentum to nucleus accumbens and prefrontal lobes; orgasmic sense
- Pleasure - Norepinephrine from locus ceruleus to cingulate cortex, brightening the mind; dopamine, too.
- Seclusion - Withdrawal from internal clamor; great sense of safety and absence of threats; quiet amygdala and sympathetic system; maybe oxytocin

The Second Jhana:

“Self-confidence and singleness of mind without applied and sustained thought, with rapture and pleasure born of concentration.”

- Applied and sustained thought fade away:
 - Prefrontal cortex quiets, not needed to focus attention
 - Entire frontal and left temporal lobes get quiet:
No more conceptualization and language
 - Anterior cingulate is freewheeling on attention itself.
 - Basal ganglia, thalamus, parietal cortex:
Sufficiently fed by the intensity of awareness itself

- Rapture and pleasure persist . . .
. . . Dopamine and norepinephrine keep pulsing

- . . . But now due to the bliss of absorption itself.

The Third Jhana:

“With the fading away as well of rapture, she abides in equanimity [with the disappearance of joy and grief], still feeling pleasure with the body.”

- Applied and sustained thought remain absent:
Prefrontal and frontal lobes are very quiet
- Rapture fades away:
Dopamine reward system in the ventral tegmental area quiets down; attention is increasingly the object of attention.
- Equanimity:
Amygdala gets very, very quiet.
Other emotion centers go off-line.
Tranquil immersion in frontal lobe "circuit breaker"
- Pleasure
Anterior cingulate cortex and the norepinephrine circuit are cruising along in recursive positive feedback.
- . . . in the body:
Basal ganglia, thalamus, and parietal cortex are still activated

The Fourth Jhana:

*“Abandoning of pleasure and pain
[with] purity of mindfulness due to equanimity.”*

- Pleasure and pain abandoned:
 - The amygdala, basal ganglia, thalamus, and hippocampus are turned way down.
 - Stuff just isn't being labeled any more.
 - Dopamine down to a mere trickle.

- Purity of mindfulness due to equanimity:
 - Profound disengagement from emotional reactivity
 - Extreme brightness of mind and steadiness of bare awareness suggests that the anterior cingulate cortex and norepinephrine from the locus coeruleus are running free.

The Fruit of Practice

*“Concentration is
the proximate cause of wisdom.*

*Without concentration, one cannot even secure
one’s own welfare, much less the lofty goal of
providing for the welfare of others.”*

- Acariya Dhammapala

(And great virtue - sila - as well)

Enlightening Realizations

***What happens in your brain
when you understand something
that changes you forever?***

Ignorant of Its Ignorance

- The brain sets up beliefs, assumptions, concepts - frameworks - to help it succeed in its complex internal and external environments.
- Then it forgets that it created them in the first place, so it acts like - and thinks - they're real.
- The brain acts on its frameworks quickly and automatically, imposing them upon the world. Whether they fit or not.

(Anybody smell karma here?)

Impacts of Insight

- True insight, inherently a creative act, couples things together in novel ways.
- If the brain is at stillness, the relationship of one electrical resonance to another can be seen/felt.
- This new “seeing” gets stored in memory, changing your brain - and you.

Seeing Conditioned and Unconditioned

- In great quiet and singleness, the constructed, empty nature of experience and the self are readily seen.
- "Behind" it, the ineffable, unnameable true reality can be perceived.

*“Like living in a valley surrounded by high mountains.
Then one day you're standing atop the tallest peak,
seeing everything from an utterly fresh perspective.
It's so clear and extraordinary there, yet your life is in the valley.
And so you come back.
But that seeing changes you forever.”*

- Steve Armstrong

Flashes of Nibbana

"Actually, when we meditate we do experience little breakthroughs, like tiny flashes of the unconditioned mind. But that's just the beginning of the processes. It's certainly not the end!"

Wisdom is a huge subject. It is all about understanding the underlying spacious and empty quality of the person and of all experienced phenomena. To attain this quality of deep insight, we must have a mind that is quiet and malleable. Achieving such a state of mind requires that we first develop the ability to regulate our body and speech so as to cause no conflict."

- Ven. Tenzin Palmo

***May you know love, joy,
wonder, and wisdom,
in this life,
just as it is.***

Thank you!