The Neurology of Awakening:

*Using the New Brain Research to Deepen Your Practice*

Spirit Rock Meditation Center
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Plan for the Day

- Introduction
- Foundations of Meditation
- The Mind/Brain System
- Your Amazing Brain
- Three Pillars of Practice
- Factors of Concentration
- How Your Brain Pays Attention
- Applied and Sustained Attention
- Rapture, Joy, and Singleness
A Few Disclaimers

- On the frontiers of science
- Neuropsychology is no replacement for contemplative wisdom.
- It’s OK to focus more on psychology, neurology, or contemplation today.
- Within the frame of the Buddhist contemplative tradition, particularly its Theravadan wing
- In particular, an emphasis on steadying the mind for the concentration that fosters deep insights
- Adapt this to your own needs and practices.
- There are lots of important perspectives besides the ones you’ll hear today.

"We ask, 'What is a thought?'

*We don't know,*

*yet we are thinking continually.*

- Ven. Tenzin Palmo
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Basics of Meditation

- Relax
- 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
Foundations of Meditation

- Setting an intention - “top-down” frontal lobes, “bottom-up” limbic system
- Relaxing the body - parasympathetic nervous system
- Feeling safer - inhibits amygdala/hippocampus vigilance circuits
- Evoking positive emotion - dopamine, norepinephrine
- Absorbing the benefits - primes memory circuits throughout the brain

Common - and Fertile - Ground

Neuroscience

Psychology

Buddhism
Within the Frame of Western Science

Our focus today is on how to make changes within the material brain that benefit the immaterial mind.

There could well be Transcendental factors at work in the brain and the mind. (That’s our personal opinion.)

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

We bow to the possibility of the Transcendental, and then we’ll stay within the frame of Western science.

The Mind/Brain System

- “Mind” = flow of information within the nervous system; mainly forever unconscious

- Apart from hypothetical transcendental factors, your mind is what your brain does.

- As your brain changes, your mind changes. As your mind changes, your brain changes. Mental activity - the flow of information - maps to neural activity, the flow of matter and energy.

- Therefore, you can use your mind to change your brain to change your mind - to benefit your whole being and every other being you touch.
Mental Activity Sculpts Neural Structure

- What flows through your mind sculpts your brain. Immaterial experience leaves material traces behind.

- “Neurons that fire together wire together.”
  - Neuronal “pruning” - Natural selection in the brain
  - Changes in excitability of individual neurons due to activity
  - Increased blood flow
  - Strengthen existing synapses
  - Building new synapses; from in utero to your deathbed
  - Observable thickening of cortical layers

- Your experience matters. Both for how it feels in the moment and for the lasting residues it leaves behind, woven into the fabric of your being.

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“Ardent, Resolute, Diligent, and Mindful”

Know the mind.

Shape the mind.

Free the mind.
Your Amazing Brain

Major Features

- **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 gets inputs from 1000 neurons . . . .
  - . . . . and sends its outputs to 1000 more . . . .
  - . . . . giving you one hundred trillion synapses.

One Simple Neuron . . .
Your Amazing Brain

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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
The Connectome - 1

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

The Connectome - 2

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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...
Multiplied by Billions of Neurons

- 100 billion neurons with 100 trillion synapses
- Possible brain states: 1 followed by a million zeros
- The most complex object known in the universe

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”

The Connectome - 2

Hagmann, et al., 2008, PLoS Biology, 6:1479-1493
The Three Pillars of Practice

- Virtue (sila) - expressing natural goodness, restraining what's harmful to oneself and others
- Concentration (samadhi) - mindfulness, steadiness of mind, meditative absorption
- Wisdom (panna) - insight, understanding the Four Noble Truths
- A path of practice in which one both uncovers the Buddhanature that is already present, and purifies and transforms the mind and heart
- The path itself is its own reward. And it ultimately culminates in enlightenment and complete freedom from suffering.

The Importance of Concentration

- We’ll focus on one aspect of one pillar: meditative depth.
- That aspect has often been under-emphasized as Buddhism came to the West.
- But strong concentration is recommended by the Buddha and traditional teachers. It brings heft to insight, strengthens the will, and purifies the mind.
- The Noble Eightfold Path includes Wise Concentration, which is four jhanas, profound states of meditative absorption.
- We’re not teaching the jhanas, but how to nourish the brain states that support the mental states that are their factors.
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

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A Road Map from the Buddha

The Buddha described a progressive process in which:
...the mind is steadied internally, quieted, brought to singleness, and concentrated - Anguttara Nikaya 3:100 - leading to liberating insight.

- **Steady** - attention is stable
- **Quiet** - tranquility, little verbal or emotional activity
- **Single** - integrative awareness, minimal thought, deep and nearly effortless engagement with the target of attention
- **Concentrated** - the jhanas or related non-ordinary states of consciousness; great absorption; often powerful feelings of rapture, bliss, happiness, contentment, and equanimity

Cultivating Vipassana

- Insight is the ultimate aim.
- Insight is nourished by stable, quiet, collected, and concentrated states . . . of the brain.
- Liberating insight - and Nibbana itself - is the fruit of virtue, 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

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Penetrative insight

joined with calm abiding

utterly eradicates

afflicted states.

Shantideva
Heartwood

This spiritual life does not have gain, honor, and renown for its benefit, or the attainment of moral discipline for its benefit, or the attainment of concentration for its benefit, or knowledge and vision for its benefit.

But it is this unshakable liberation of mind that is the goal of this spiritual life, its heartwood, and its end.

The Buddha

The Factors of Concentration

- Applied attention - bringing it to bear
- Sustained attention - staying with the target
- Rapture - great interest in the target, bliss
- Joy - happiness, contentment, and tranquility
- Singleness - unification of awareness
Awake and Alert

- You can't be attentive unless you're awake.
- Get enough sleep
- Good posture - Reticular formation
- "Brighten the mind" - Norepinephrine
- Oxygen - Gas for the brain

How the Brain Pays Attention

- Holding onto information
- Updating awareness
- Seeking stimulation
- Dopamine and the gate to awareness
- The basal ganglia stimostat
The education of attention would be an education par excellence.

William James

Applied and Sustained Attention

- Compassion, mingling thought and emotion - ACC
- Establishing intentions - Prefrontal cortex
- "Channeling" a teacher - Embodied emotion
- Applying attention - PFC and ACC
- Sustaining attention - ACC
- Overseer - ACC
- Fondness for the breath - Emotion heightens stimulation
- Noticing details - Heightens stimulation, satisfies BG
- Batting away - Interrupts neural coalitions before consolidating
- Disenchantment - Beginnings of equanimity, non-reactivity to the feeling tone (pleasant, unpleasant, neutral)
Rapture, Joy, and Singleness

- Surrender control of breathing - Quieting, singleness
- Whole body awareness - Right hemisphere, quiets the mind
- Rapture - Intensifies dopamine, steadies and quiets the mind
- Joy - Reduces basal ganglia need for stimulation
- Contentment and tranquility - Gateways to equanimity
- Unification of awareness - Fast gamma wave entrainment
- Natural absorption in breath - Less “effortful control” by the ACC
- Tastes of equanimity - Not chasing or resisting experience

In the deepest forms of insight,
we see that things change so quickly
that we can’t hold onto anything,
and eventually the mind lets go of clinging.

Letting go brings equanimity.
The greater the letting go, the deeper the equanimity.
In Buddhist practice, we work to expand
the range of life experiences in which we are free.

U Pandita
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!
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
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
- 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.