Self-Directed Neuroplasticity, Mindfulness, and Meditation

Visual Studies 198/298
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Topics

- Perspectives
- Self-directed neuroplasticity
- Taking in the good
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

Neuroscience

Psychology

Contemplative Practice
Brain Basics
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
Self-Directed Neuroplasticity
All cells have specialized functions. Brain cells have particular ways of processing information and communicating with each other. Nerve cells form complete circuits that carry and transform information.

Electrical signaling represents the language of mind, the means whereby nerve cells, the building blocks of the brain, communicate with one another over great distances. Nerve cells generate electricity as a means of producing messages.

All animals have some form of mental life that reflects the architecture of their nervous system.

Eric R. Kandel
The Mind/Brain System

“Mind” = flow of information within the nervous system:
- Information is represented by the nervous system.
- Most mind is unconscious; awareness is an aspect of mind.
- The headquarters of the nervous system is the brain.

In essence then, apart from hypothetical transcendental factors, the mind is what the 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.
Evolution is a tinkerer. In living organisms, new capabilities are achieved by modifying existing molecules slightly and adjusting their interaction with other existing molecules.

Science has found surprisingly few proteins that are truly unique to the human brain and no signaling systems that are unique to it.

All life, including the substrate of our thoughts and memories, is composed of the same building blocks.

Eric R. Kandel
We ask, “What is a thought?”

We don’t know,

yet we are thinking continually.

Venerable Tenzin Palmo
Fact #1

As your brain changes, your mind changes.
Ways That Brain Can Change Mind

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

For worse:
- Intoxication; imbalances in neurotransmitters
- Concussion, stroke, tumor, Alzheimer’s
- Cortisol-based shrinkage of hippocampus: less capacity for contextual memory
Fact #2

As your mind changes, your brain changes.

Immaterial mental activity maps to material neural activity.

This produces temporary changes in your brain and lasting ones.

Temporary changes include:

- Alterations in brainwaves (= changes in the firing patterns of synchronized neurons)
- Increased or decreased use of oxygen and glucose
- Ebbs and flows of neurochemicals
Rewards of Love
Tibetan Monk, Boundless Compassion
Christian Nuns, Recalling a Profound Spiritual Experience

Beauregard, et al., Neuroscience Letters, 9/25/06
Mind Changes Brain in Lasting Ways

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

- Increased blood/nutrient flow to active regions
- Altered epigenetics (gene expression)
- “Neurons that fire together wire together.”
  - Increasing excitability of active neurons
  - Strengthening existing synapses
  - Building new synapses; thickening cortex
  - Neuronal “pruning” - “use it or lose it”
Honoring Experience

One’s experience \textit{matters}.

Both for how it feels in the moment and for the lasting residues it leaves behind, woven into the fabric of a person’s brain and being.
Fact #3

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

This is self-directed neuroplasticity.

*How to do this, in skillful ways?*
Meditation: Effects on the Brain

- Thickens prefrontal (PFC) regions that help control attention
- Thickens insula (interoception, self-awareness, empathy)
- Less cortical thinning with aging in the PFC and insula above
- Increases gray matter density in hippocampus (creating context for memory, inhibiting the amygdala)
- Increases activation of left frontal regions, which lifts mood
- Increases gamma-range brainwaves (integration)
- Increases overall brain connectivity
Meditation: Physiological Benefits

- Decreases stress-related cortisol
- Stronger immune system
- Helps many medical conditions, including cardiovascular disease, asthma, type II diabetes, PMS, and chronic pain
- Aids wound healing and post-surgical recovery
Meditation: Psychological Benefits

- Improves attention (including for ADHD)
- Increases compassion
- Increases empathy
- Reduces insomnia, anxiety, phobias, eating disorders
- MBCT for depression decreases relapse
Steadying the Mind
How the Brain Pays Attention

Key functions:
- Holding onto information
- Updating awareness
- Seeking stimulation

Key mechanisms:
- Dopamine and the gate to awareness
- The basal ganglia stimostat
Challenges to Mindfulness and Concentration

- We evolved continually scanning, shifting, wide focus attention in order to survive: “monkey mind.”

- This generic, hard-wired tendency varies in the normal range of temperament, extending from “turtles” to “jackrabbits.”

- Life experiences - in particular, painful or traumatic ones - can heighten scanning and distractibility.

- Modern culture - with its fire hose of information and routine multi-tasking - leads to stimulation-hunger and divided attention.
# Individual Differences in Attention

<table>
<thead>
<tr>
<th>Holding Information</th>
<th>Updating Awareness</th>
<th>Seeking Stimulation</th>
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</thead>
<tbody>
<tr>
<td><strong>High</strong></td>
<td>Porous filters</td>
<td>Hyperactive</td>
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<tr>
<td>Obsession</td>
<td>Distractible</td>
<td>Thrill-seeking</td>
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<td>Over-focusing</td>
<td>Overload</td>
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<td><strong>Mod</strong></td>
<td>Flexible</td>
<td>Enthusiastic</td>
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<td>Concentrates</td>
<td>Assimilation</td>
<td>Adaptive</td>
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<td>Divides attention</td>
<td>Accommodation</td>
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<td><strong>Low</strong></td>
<td>Fixed views</td>
<td>Stuck in a rut</td>
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<td>Fatigues w/Conc.</td>
<td>Oblivious</td>
<td>Apathetic</td>
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<tr>
<td>Small WM</td>
<td>Low learning</td>
<td>Lethargic</td>
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7 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
Increased **Medial** PFC Activation Related to Self-Referencing Thought

Self-Focused (blue) and Open Awareness (red) Conditions (in the novice, pre MT group)
Self-Focused (blue) vs Open Awareness (red) Conditions (following 8 weeks of MT)
Ways to Activate “Being” Mode

- Relax
- Focus on bare sensations and perceptions
- Sense the body as a whole
- Take a panoramic, “bird’s-eye” view
- Engage “don’t-know mind”; release judgments
- Don’t try to connect mental contents together
- Let experience flow, staying here now
- Relax the sense of “I, me, and mine”
Dual Modes

“Doing”
Mainly representational
Much verbal activity
Abstract
Future- or past-focused
Goal-directed
Sense of craving
Personal, self-oriented perspective
Focal view
Firm beliefs
Evaluative
Lost in thought, mind wandering
Reverberation and recursion
Tightly connected experiences
Prominent self-as-object
Prominent self-as-subject

“Being”
Mainly sensory
Little verbal activity
Concrete
Now-focused
Nothing to do, nowhere to go
Sense of peace
Impersonal, 3rd person perspective
Panoramic view
Uncertainty, not-knowing
Nonjudgmental
Mindful presence
Immediate and transient;
Loosely connected experiences
Minimal or no self-as-object
Minimal or no self-as-subject
“Bahiya, you should train yourself thus.”

In reference to the seen, there will be only the seen. To the heard, only the heard. To the sensed, only the sensed. To the cognized, only the cognized.

When for you there will be only the seen in reference to the seen, only the heard in the heard, only the sensed in the sensed, only the cognized in the cognized, then, Bahiya, there’s no you in that.

When there’s no you in that, there’s no you there. When there’s no you there, you are neither here nor yonder nor between the two.

This, just this, is the end of all suffering.

The Buddha
Mindful Internalization of Positive Experiences
Evolutionary History

The Triune Brain - (P. MacLean 1990)
Three Stages of Brain Evolution

- **Reptilian:**
  - Brainstem, cerebellum, hypothalamus
  - Reactive and reflexive
  - Avoid hazards

- **Mammalian:**
  - Limbic system, cingulate, early cortex
  - Memory, emotion, social behavior
  - Approach rewards

- **Human:**
  - Massive cerebral cortex
  - Abstract thought, language, cooperative planning, empathy
  - Attach to “us”
Negativity Bias: Causes in Evolution

- “Sticks” - Predators, natural hazards, social aggression, pain (physical and psychological)

- “Carrots” - Food, sex, shelter, social support, pleasure (physical and psychological)

During evolution, avoiding “sticks” usually had more effects on survival than approaching “carrots.”

  - **Urgency** - Usually, sticks must be dealt with immediately, while carrots allow a longer approach.
  - **Impact** - Sticks usually determine mortality, carrots not; if you fail to get a carrot today, you’ll likely have a chance at a carrot tomorrow; but if you fail to avoid a stick today - whap! - no more carrots forever.
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.
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.
How to Take in the Good

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.
Why It’s Good to Take in the Good

- Rights an unfair imbalance, given the negativity bias
- Gives oneself today the caring and support one should have received as a child, but perhaps didn’t get in full measure; an inherent, implicit benefit
- Increases positive resources, such as:
  - Positive emotions
  - Capacity to manage stress and negative experiences
- Can help bring in missing “supplies” (e.g., love, strength, worth)
- Can help painful, even traumatic experiences
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
The benefits of positive emotions are a proxy for many of the benefits of TIG.

Emotions organize the brain as a whole, so positive ones have far-reaching benefits, including:

- Promote exploratory, “approach” behaviors
- Lift mood; increase optimism, resilience
- Counteract trauma
- Strengthen immune and protect cardiovascular systems
- Overall: “broaden and build”
- Create positive cycles
“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
If one going down into a river, swollen and swiftly flowing, is carried away by the current -- how can one help others across?

The Buddha
Outstanding behavior,
blameless action,
open hands to all,
and selfless giving:

This is a blessing supreme.

The Buddha
Great Books

See www.RickHanson.net for other great books.

Key Papers - 1

See www.RickHanson.net for other scientific papers.


Key Papers - 2


- 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.


Where to Find Rick Hanson Online

http://www.youtube.com/BuddhasBrain
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