Self-Directed Neuroplasticity

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Topics

- Fertile intersections
- Your brain: technical specs
- Self-directed neuroplasticity
- The brain: so what?
- Cultivating inner resources
- Natural happiness
Fertile Intersections
Common - and Fertile - Ground

Neuroscience  Psychology

Contemplative Practice
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
Do not go by oral tradition, by lineage of teaching, by hearsay, by a collection of texts, by logic, by inferential reasoning, by reasoned cognition, by the acceptance of a view after pondering it, by the seeming competence of a speaker, or because you think, “this . . . is our teacher.”

But when you know for yourselves, “these things are wholesome, these things are blameless; these things are praised by the wise; these things, if undertaken and practiced, lead to welfare and happiness,” then you should engage in them.

The Buddha
Great questioning, great enlightenment; little questioning, little enlightenment; no questioning, no enlightenment.

Dogen
We ask, “What is a thought?”

We don’t know,

yet we are thinking continually.

Venerable Tenzin Palmo
When the facts change, 
I change my mind, sir.

What do you do?

John Maynard Keynes
Domains of Intervention

- We can intervene in three domains:
  - World (including relationships)
  - Body
  - Mind

- All three are important. And they work together.

- We have limited influence over world and body.

- In the mind:
  - Much more influence
  - Changes are with us wherever we go
Your Brain: Technical Specs
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
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.
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A Profoundly Complex System

Your brain is the most complex object known in the universe.
Sources of Individuality

- **Genetic Variation**, such as:
  - Receptors for neurotransmitters
  - The numbers of neurons and their connections

- **Gender:**
  - Similarities outweigh the subtle differences

- **Variation in synaptic connections** for exactly the same reflex . . . or concept

- **History:**
  - Fetal
  - Lifespan
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.
Self-Directed Neuroplasticity
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 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.
Within the Frame of Western Science

Our focus is on how to use the mind to change the brain to benefit the mind.

There could be Transcendental factors at work in the brain and the mind.

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

Bowing to the possibility of the Transcendental, I’ll stay within the frame of Western science.
Fact #1

As your brain changes, your mind changes.
Ways That Brain Can Change Mind 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
Key Brain Areas for Consciousness

(adapted from) M. T. Alkire et al., Science 322, 876-880 (2008)
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
The Rewards of Love
Christian Nuns, Recalling Profound Spiritual Experiences

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”
Physical Effects of Meditation

- Thickens and strengthens anterior (frontal) cingulate cortex and insula. Results include improved attention, empathy, and compassion.

- Less cortical thinning with aging

- Increases activation of left frontal regions, which lifts mood

- Increases power and reach of gamma-range brainwaves

- Decreases stress-related cortisol

- Stronger immune system
The principal activities of brains are making changes in themselves.

Marvin L. Minsky
Honoring Experience

One’s experience *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?*
Self-Goodwill

- All the great teachers have told us to be compassionate and kind toward all beings. And that whatever we do to the world affects us, and whatever we do to ourselves affects the world.

- You are one of the “all beings!” And kindness to yourself benefits the world, while hurting yourself harms the world.

- It’s a general moral principle that the more power you have over someone, the greater your duty is to use that power wisely. Well, who is the one person in the world you have the greatest power over? It’s your future self. You hold that life in your hands, and what it will be depends on how you care for it.

- Consider yourself as an innocent child, as deserving of care and happiness as any other.
“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 Brain: So What?
Neuroplasticity in Context

- Neuroplasticity is not breaking news. It’s been long presumed that mental activity changed neural structure: what else is learning?

- The news is in how the mind changes the brain.

- Most neuroplasticity is incremental, not dramatic.

- Neuroplasticity is ethically neutral.
Grounding in the Brain - Benefits

- **Organizing framework**
  - Evolutionary neuropsychology
  - Common ground across theories and methods

- **Motivating to clients, clinicians, policy-makers**
  - Concrete, in the body, *physical*
  - Status of medicine, hard science

- **Highlighting key principles and practices**
  - Implicit memory
  - Nonverbal processes

- **Innovating with truly new methods**
  - Neurofeedback
  - Fear extinction
Grounding in the Brain - Pitfalls

- Adding little new meaning
  - Replacing psych terms with neuro ("amygdala made me do it")

- Over-simplifying
  - Over-localizing function (e.g., empathy = mirror neurons)
  - Exaggerated terms ("God-gene," "female brain")
  - Materialistic reductionism, though brain and mind co-arise

- Claiming authority
  - Using neuro data to argue a political or cultural case
  - Using the secular religion of science to elevate status

- Underestimating the mind
  - Most big changes in psyche involve tiny changes in soma; mental plasticity holds more promise than neural plasticity.
  - Overlooking the insights and effectiveness of psychology
  - Ducking existential choices in values
Your Brain Makes You Suffer
The Evolution of Suffering

Animals survive through three fundamental strategies. When these run into trouble, unpleasant alarm signals pulse through the nervous system.

But trouble comes constantly: each strategy contains inherent contradictions, as the animal keeps trying:

- To *separate what is actually connected* – in order to create a boundary between itself and the world

- To *stabilize what keeps changing* – in order to maintain its internal systems within tight ranges

- To *hold onto fleeting pleasures and escape inevitable pains* – in order to approach opportunities and avoid threats
The Three Marks of Existence

These survival strategies fly in the face of three observations the Buddha made about the nature of existence:

- Everything is connected to everything else, so nothing has an absolute, independent self-nature
- Everything is impermanent, constantly changing
- Suffering arises when we crave the lasting of pleasure and the ending of pain.
A Harvest of Suffering

The unfortunate result of our highly evolved brain is that it’s fertile ground for a harvest of suffering.

Only humans worry about the future, regret the past, and blame themselves for the present. We get frustrated when we can’t have what we want and disappointed when what we like ends. We suffer *that* we suffer. We get upset about being in pain, angry about dying, sad about waking up sad yet another day.

This kind of suffering – which encompasses most of our unhappiness and dissatisfaction – is constructed by the brain. It is made up. Which is ironic, poignant, and supremely hopeful.

*If the brain is the cause of your suffering, it can also be its cure.*
Cultivating Inner Resources
The Importance of Inner Resources

Examples:
- Character virtues
- Positive introjects
- Corrective emotional experiences in psychotherapy
- Learned optimism
- Brahmaviharas; Paramittas; awakening factors

Benefits
- Increase positive emotions: physical and mental health
- Improve self-soothing
- Improve outlook on world, self, and future
- Increase resilience, determination
- Promote prosocial behaviors
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 of Neuroplasticity

Physiological:
- Norepinephrine (moderate)
- Dopamine
- Acetylcholine
- Brain-derived neurotrophic factor (BDNF)
- Natural opioids (?) (e.g., endorphins)
- Neurogenesis (promoted by exercise)

Mental:
- Priming memory through intention
- Target material:
  - Is within awareness
  - Receives focused attention
  - Is sustained, multimodal, and intense
Attention is like a spotlight, illuminating what it rests upon.

Because neuroplasticity is heightened for what’s in the field of focused awareness, attention is also like a vacuum cleaner, sucking its contents into the brain.

Directing attention skillfully is therefore a fundamental way to shape the brain - and one’s life over time.

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

William James
Mindfulness, Virtue, Wisdom

- **Mindfulness** (or “concentration”), **virtue**, and **wisdom** are identified in Buddhism and other contemplative traditions as the pillars of practice.

- In Western psychology, these are the foundations of mental health and well-being.

- These three pillars map to three core functions of the nervous system:
  - Receiving/learning
  - Regulating
  - Prioritizing/selecting
“Know the Mind, Shape the Mind, Free the Mind”

- **Mindfulness**, **virtue**, and **wisdom** - and their neural correlates - also map to three phases of practice:
  - Be aware of the garden, pull weeds, plant flowers.
  - Be mindful of, release, replace.
  - Let be, let go, let in.

- People vary in their inclinations and strengths with the phases.

- Sometimes we need to take in resources in the third phase in order to bear our own experience.

- **Mindfulness** is key to the second and third phase, sometimes curative on its own, and always beneficial in strengthening its neural substrates. But often it is not enough by itself.
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.

That’s where sustained mindfulness comes in - making the brain like Velcro for **positive** experiences, but Teflon for negative ones.
Compassion

The root of Buddhism is compassion,

and the root of compassion is compassion for oneself.

Pema Chodren
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.”
Natural Happiness
Reverse Engineering the Brain

What’s the nature of the brain when a person is:

- In peak states of productivity or “flow?”
- Experiencing inner peace?
- Self-actualizing?
- Enlightened (or close to it)?
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, our closest relative among the “great apes” (gorillas, orangutans, chimpanzees, bonobos, humans)
- 2.5 million years of tool-making (starting with brains 1/3 our size)
- ~ 150,000 years of *homo sapiens*
- ~ 50,000 years of modern humans
- ~ 5000 years of blue, green, hazel eyes
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”
Three Motivational Systems

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

[Diagram showing a triangle with 'Approach' on one side, 'Gratitude' on another, and 'Avoid' on the third, with 'Wisdom' at the top, 'Contentment' in the middle, 'Love' on one side, and 'Affiliate' at the base of the triangle.]
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
Some Benefits of Responsive Mode

- Recovery from “mobilizations” for survival:
  - Refueling after depleting outpourings
  - Restoring equilibrium to perturbed systems
  - Reinterpreting negative events in a positive frame
  - Reconciling after separations and conflicts

- Promotes prosocial behaviors:
  - Experiencing safety decreases aggression.
  - Experiencing sufficiency decreases envy.
  - Experiencing connection decreases jealousy.
  - We’re more generous when our own cup runneth over.
But to Survive, We Leave Home . . .

- **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

Approach
"Greed"

Affiliate

Ignorance
Suffering

Avoid
"Hatred"

Heartache
Reactive Dysfunctions in Each System

- **Approach** - Addiction; over-drinking, -eating, -gambling; compulsion; hoarding; driving for goals at great cost; spiritual materialism

- **Avoid** - Anxiety disorders; PTSD; panic, terror; rage; violence

- **Attach** - Borderline, narcissistic, antisocial PD; symbiosis; *folie a deux*; “looking for love in all the wrong places”
Choices . . .

Reactive Mode

Responsive Mode

Or?
Coming Home . . .

Gladness

Love

Peace
Ways to “Take the Fruit as the Path”

**General factors:** See clearly. Have compassion for yourself. Take life less personally. Take in the good. Deepen equanimity.

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

**Attach 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.
Know the mind.

Shape the mind.

Free the mind.
Great Books

See [www.RickHanson.net](http://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.
Key Papers - 3


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