

# **The Neurology of Awakening:**

---

## ***Using the New Brain Research to Steady Your Mind***

**Spirit Rock Meditation Center  
January 9, 2011**

**Rick Hanson, Ph.D.**

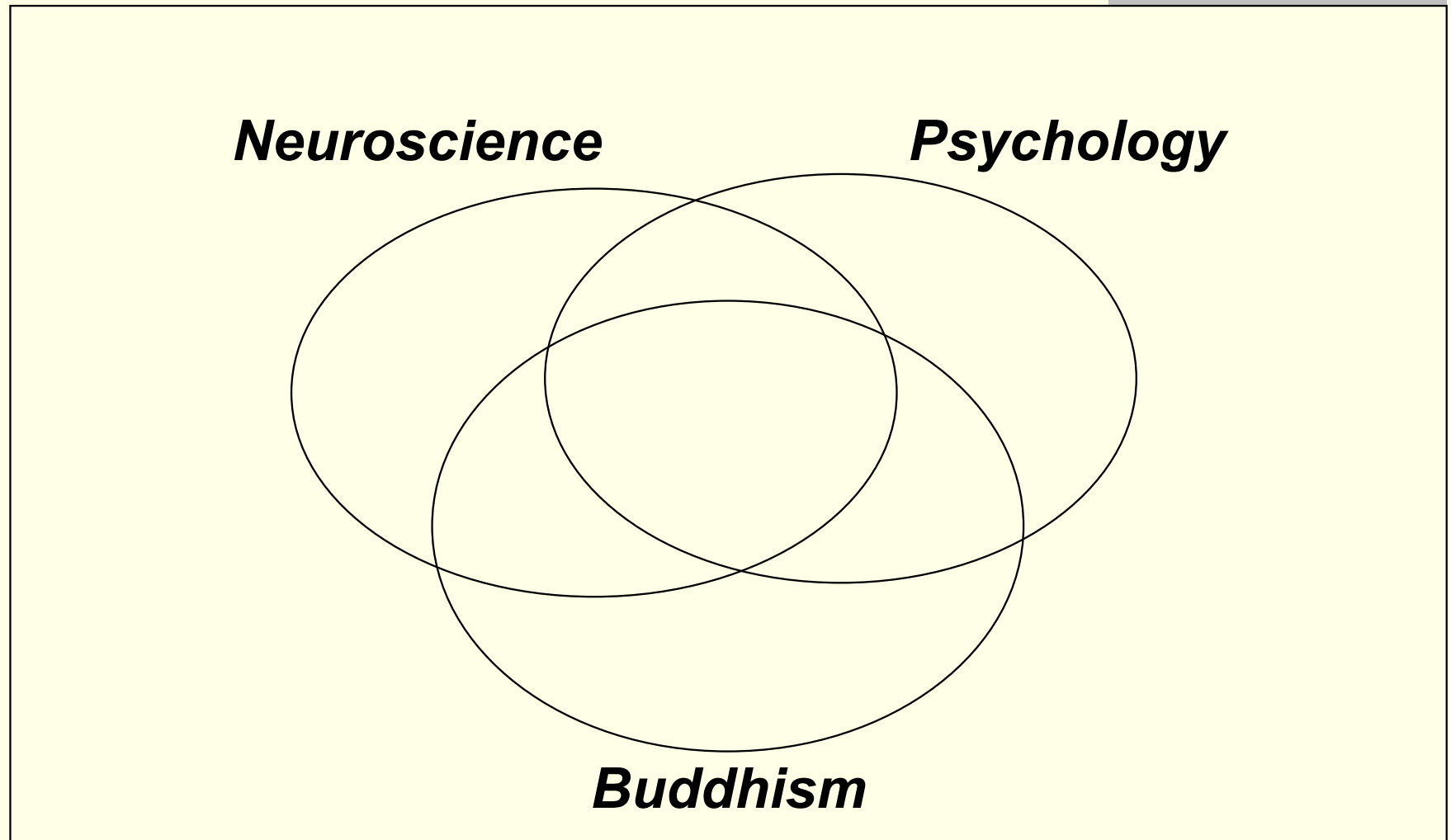
[drh@comcast.net](mailto:drh@comcast.net)

**Richard Mendius, M.D.**

[jrichardmendius@aol.com](mailto:jrichardmendius@aol.com)

© 2011

# Common - and Fertile - Ground



---

***"We ask, 'What is a thought?'"***

***We don't know,***

***yet we are thinking continually."***

- Ven. Tenzin Palmo



# **Foundations of Mindfulness**

# 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
- Relaxing the body
- Feeling cared about
- Feeling safer
- Encouraging positive emotion
- Absorbing the benefits

# Neural Basis of Meditation Foundations

---

- **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
- **Absorbing the benefits** - positive implicit memories



# **Self-Directed Neuroplasticity**

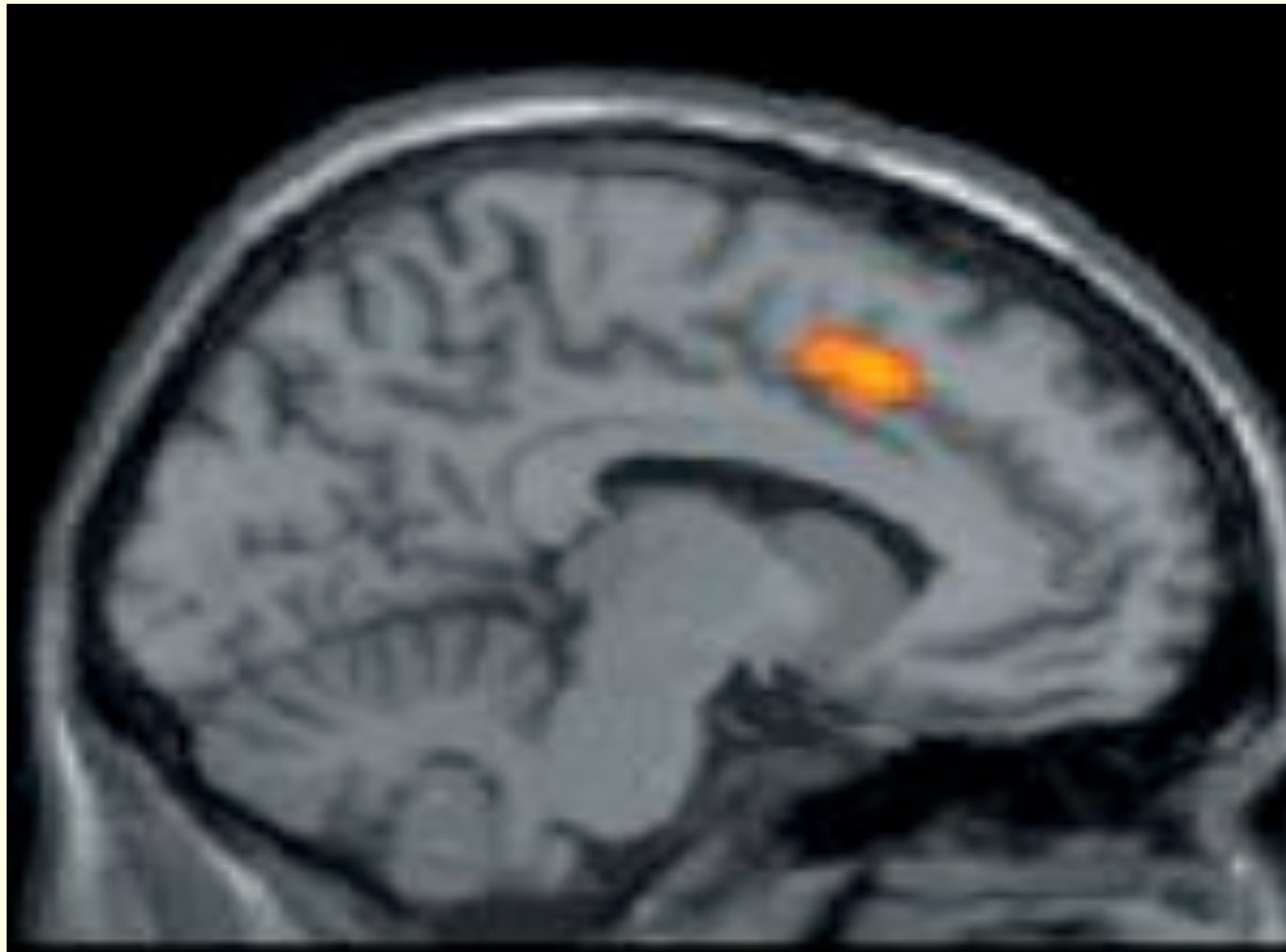
# Mental Activity Sculpts Neural Structure

---

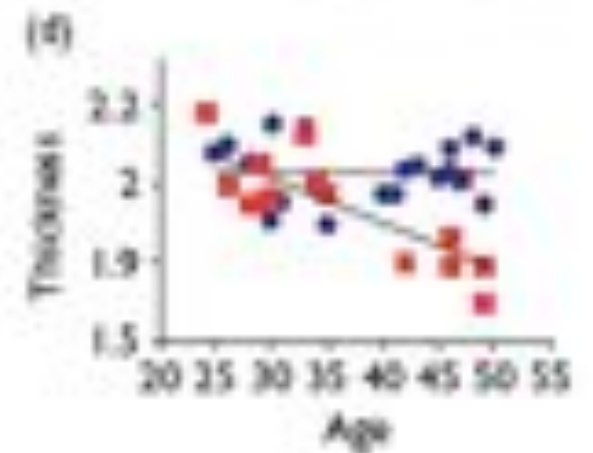
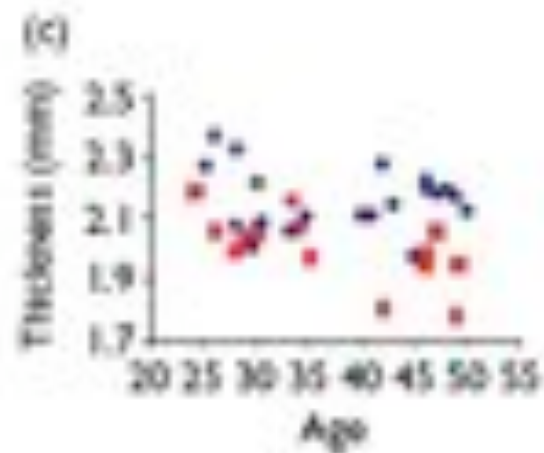
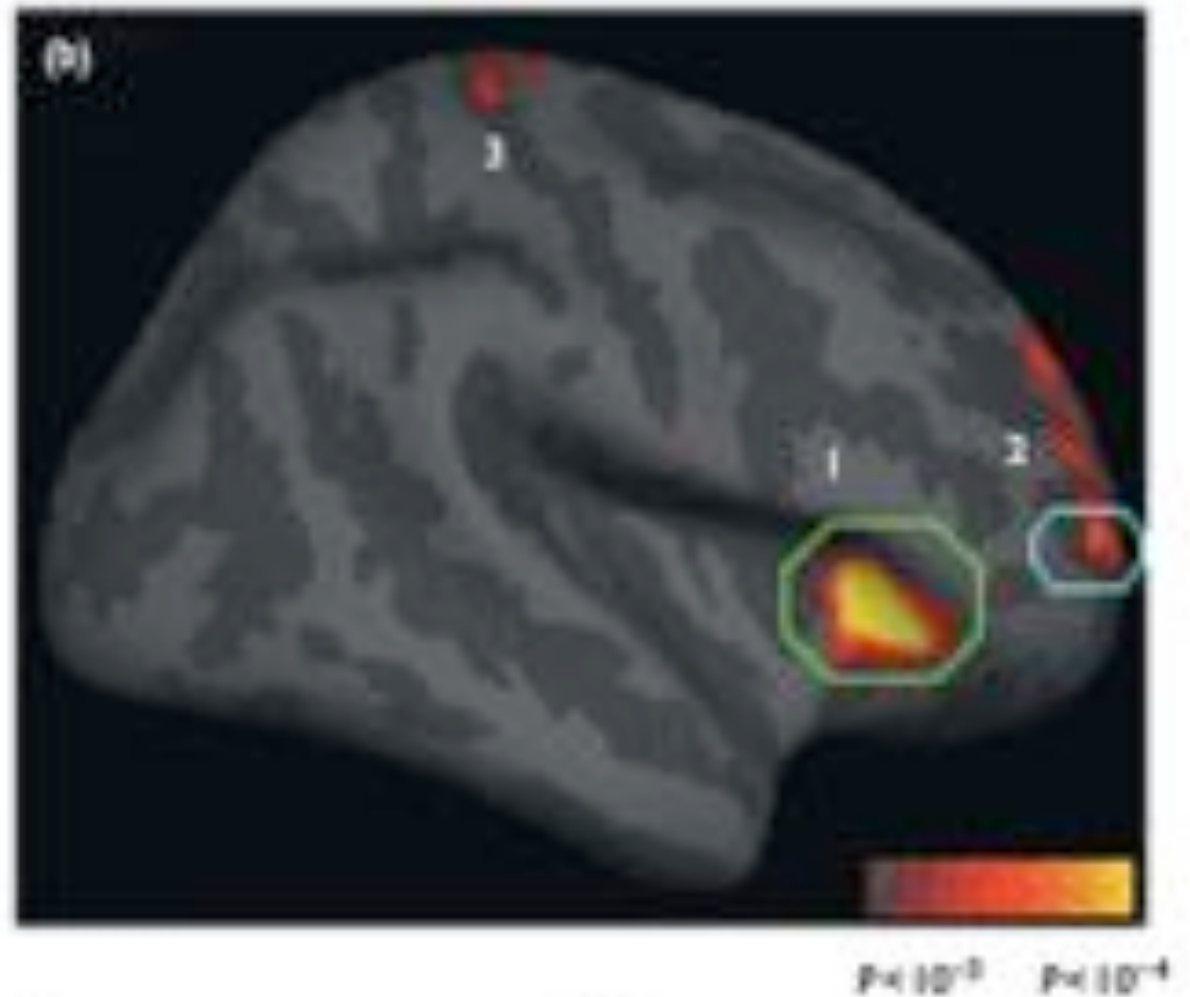
- What flows through your mind sculpts your brain. Immaterial experience leaves material traces behind.
- “Neurons that fire together wire together.”
  - Neuronal “pruning” - Natural selection in the brain
  - Changes in excitability of individual neurons due to activity
  - Increased blood flow
  - 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.

# “Ardent, Resolute, Diligent, and Mindful”

---



Lazar, et al. 2005.  
Meditation  
experience is  
associated  
with increased  
cortical thickness.  
*Neuroreport*, 16,  
1893-1897.





# **Concentration in Contemplative Practice**

# 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 true nature 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.

# Distinctions . . .

---

- **Awareness** is the field in which neural activity (mysteriously) becomes conscious experience.
- **Attention** is a heightened focus - a spotlight - on a particular content of awareness.
- **Mindfulness** is sustained attentiveness, typically with a metacognitive awareness of being aware.
- **Concentration** is deep absorption in an object of attention - sometimes to the point of non-ordinary states of consciousness.

---

*Know the mind.*

*Shape the mind.*

*Free the mind.*

# 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

# 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.

# Right 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.*

# 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.*

# 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.*

---

*Penetrative insight*

*joined with calm abiding*

*utterly eradicates*

*afflicted states.*

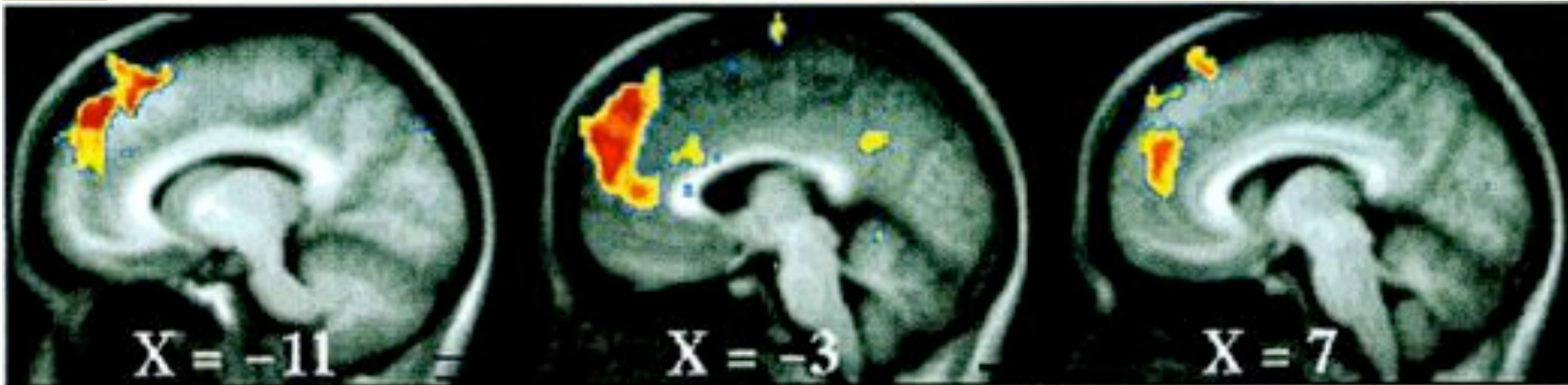
Shantideva



# **Lateral Networks of Spacious Awareness**

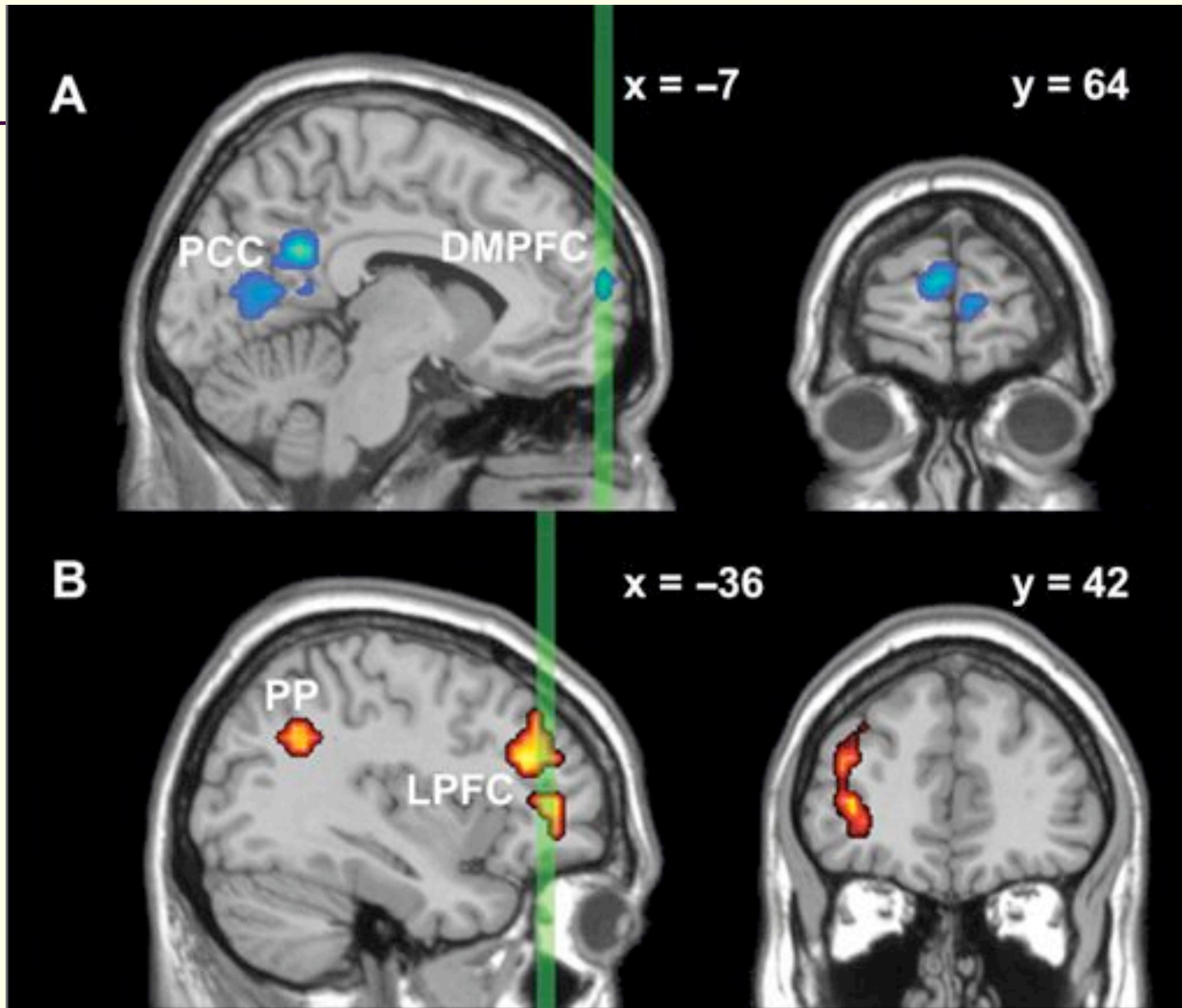
# Increased Medial PFC Activation Related to Self-Referencing Thought

---



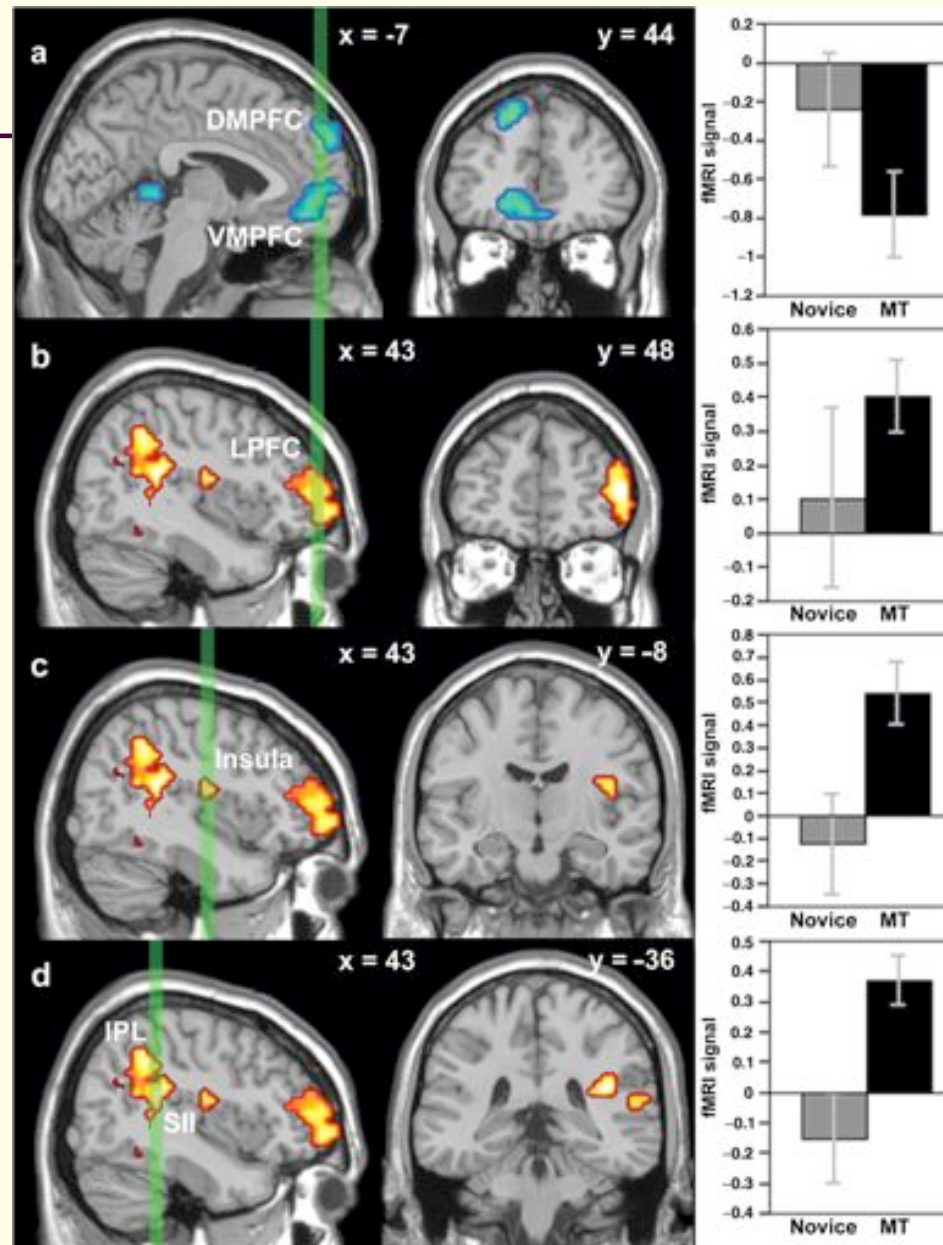
Gusnard D. A., et.al. 2001. *PNAS*, 98:4259-4264

# Self-Focused (blue) and Open Awareness (red) Conditions (in the novice, pre MT group)



Farb, et al. 2007. *Social Cognitive Affective Neuroscience*, 2:313-322

# Self-Focused (blue) and Open Awareness (red) Conditions (following 8 weeks of MT)



# Ways to Activate Lateral Networks

---

- 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.”

# Whole Body Awareness

---

- Involves insula and middle parietal lobes, which integrate sensory maps of the body, plus right hemisphere, for holistic (gestalt) perception
- Practice
  - Sense the breath in one area (e.g., chest, upper lip)
  - Sense the breath as a whole: one gestalt, percept
  - Sense the body as a whole, a whole body breathing
  - Sense experience as a whole: sensations, sounds, thoughts . . . all arising together as one unified thing
- This sense of the whole may be present for a second or two, then crumble; just open up to it again.

# Panoramic Awareness

---

- Recall a bird's-eye view (e.g., mountain, airplane).
- Be aware of sounds coming and going in an open space of awareness, without any edges: boundless.
- Open to other contents of mind, coming and going like clouds moving across the sky.
- Pleasant or unpleasant, no matter: just more clouds
- No cloud ever harms or taints the sky.

*Trust in awareness, in being awake,  
rather than in transient and unstable conditions.*

Ajahn Sumedho



# **A Road Map from the Buddha**

# 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

# Steadied Internally

---

A stable

stability of attention . . .

# Quiet

---

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

# Singleness of Mind

---

- Great collectedness: integrated, inclusive awareness: all one percept
- Largely absorbed in the object of attention; withdrawn from most everything else
- Only wispy, peripheral thoughts
- Growing equanimity: impartiality toward experience
- Little sense of self: breathing without a breather

# Concentrated

---

- Profound absorption in non-ordinary state of consciousness: e.g., the “form” and “formless” jhanas; samadhi; mystical transport
- Pervading sense of rapture, bliss, happiness, contentment, tranquillity, equanimity
- Penetrating clarity into fine-grained details of experience, e.g., transience, interdependence, selflessness

---

*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.*



# The Jhana Factors

# The Jhana Factors

---

- 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

# Rapture

---

- Experience
  - Feelings of pleasure, even bliss, in the body; pulses, waves of energy; rising quality
  - Range of capacity for rapture
  - Can come to feel a little overwhelming
- Neurology
  - Intensifies dopamine, closing the gate to working memory
  - Intensifies norepinephrine and alertness (“brightening the mind”)
  - Both neurotransmitters promote synaptic formation, thus learning.
  - Intensifies natural opioids
- Practice
  - Softly think: “May rapture (*piti*) arise.”
  - Perhaps gently arouse the body: strong inhale; pulse muscles at base of spine.
  - If rapture doesn’t come, return to the breath.

# Joy

---

- Experience
  - Spectrum of happiness, contentment, and tranquility
  - Happiness - Gratitude, gladness, delight
  - Contentment - Well-being plus no wish at all that the moment be any different (hint of equanimity)
  - Tranquility - Deep peace; a still pond
  - Feelings can be subtle, and still pervade the mind.
- Neurology
  - Stable dopamine, lessening norepinephrine and opioids
  - Internal stimulation reduces basal ganglia need for external stim.
- Practice
  - Settle down from rapture.
  - Softly think: “May joy (*sukha*) arise.”
  - OK to think of cues to joy.
  - Explore the spectrum of joy; know each state.

# Cultivating Singleness

---

## ■ Experience

- A sense of all contents of experience appearing as a unified whole, as a single gestalt, moment by moment
- Great collectedness; minimal thought; deep, nearly effortless engagement with the object of attention; non-reactivity; little sense of self

## ■ Neurology

- Fast gamma wave entrainment
- Less “effortful control” by the ACC

## ■ Practice

- Relax into whole body awareness
- Softly think: “May singleness (*ekaggata* ) arise.”
- Open up to the “ka-woosh” of it all coming together

---

*Penetrative insight*

*joined with calm abiding*

*utterly eradicates*

*afflicted states.*

Shantideva



# 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.





# Neurological Diversity

# 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

# Individual Differences in Attention

	<b><u>Holding Information</u></b>	<b><u>Updating Awareness</u></b>	<b><u>Seeking Stimulation</u></b>
<b>High</b>	Obsession Over-focusing	Porous filters Distractible Overload	Hyperactive Thrill-seeking
<b>Mod</b>	Concentrates Divides attention	Flexible Assimilation Accommodation	Enthusiastic Adaptive
<b>Low</b>	Fatigues w/Conc. Small WM	Fixed views Oblivious Low learning	Stuck in a rut Apathetic Lethargic



**What is your own profile of attentional capabilities?**



## **Resources for Issues with Concentration**

# General: Regenerate Intention

---

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

# Hold the Object of Attention

---

- 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 and energy
  - Deepens engagement

# Filter out Distractions

---

- Sate on stimuli: Recurring, safe to ignore.
- Use frontal lobe intentionality to set "high filtering."
- Bat away other stimuli before they take root.
- Postpone planning, worrying, thinking, getting upset, etc., to later.
- If necessary, focus on the intrusive stimulus.

# Increase General Stimulation

---

- Enjoy “the beautiful breath.”
- Evoke feelings of sufficiency, contentment, fullness.
- Activate oxytocin, giving yourself a mental hug.
- Savor the pleasant sense of absorption itself.

# Increase the Stimulation of the Object of Attention

---

- 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
- Walking meditation

# Be Satisfied with Less

---

- Mindfulness thickens cortical layers, so less stimuli are still rewarding.
- Practice focusing on neutral - neither pleasant nor unpleasant - experiences. (*“The neutral is actually very close to peace and ease. It’s a real doorway to resting in the eventless.”* Christina Feldman)
- 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.



# Great Books

---

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

- Austin, J. 2009. *Selfless Insight*. MIT Press.
- Begley, S. 2007. *Train Your Mind, Change Your Brain*. Ballantine.
- Carter, C. 2010. *Raising Happiness*. Ballantine.
- Hanson, R. (with R. Mendius). 2009. *Buddha's Brain: The Practical Neuroscience of Happiness, Love, and Wisdom*. New Harbinger.
- Johnson, S. 2005. *Mind Wide Open*. Scribner.
- Keltner, D. 2009. *Born to Be Good*. Norton.
- Kornfield, J. 2009. *The Wise Heart*. Bantam.
- LeDoux, J. 2003. *Synaptic Self*. Penguin.
- Linden, D. 2008. *The Accidental Mind*. Belknap.
- Sapolsky, R. 2004. *Why Zebras Don't Get Ulcers*. Holt.
- Siegel, D. 2007. *The Mindful Brain*. Norton.
- Thompson, E. 2007. *Mind in Life*. Belknap.

# Key Papers - 1

---

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.
- Baumeister, R., Bratlavsky, E., Finkenauer, C. & Vohs, K. 2001. Bad is stronger than good. *Review of General Psychology*, 5:323-370.
- Braver, T. & Cohen, J. 2000. On the control of control: The role of dopamine in regulating prefrontal function and working memory; in *Control of Cognitive Processes: Attention and Performance XVIII*. Monsel, S. & Driver, J. (eds.). MIT Press.
- 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

---

- Davidson, R.J. 2004. Well-being and affective style: neural substrates and biobehavioural correlates. *Philosophical Transactions of the Royal Society*. 359:1395-1411.
- Farb, N.A.S., Segal, Z.V., Mayberg, H., Bean, J., McKeon, D., Fatima, Z., and Anderson, A.K. 2007. Attending to the present: Mindfulness meditation reveals distinct neural modes of self-reflection. *SCAN*, 2, 313-322.
- Gillihan, S.J. & Farah, M.J. 2005. Is self special? A critical review of evidence from experimental psychology and cognitive neuroscience. *Psychological Bulletin*, 131:76-97.
- Hagmann, P., Cammoun, L., Gigandet, X., Meuli, R., Honey, C.J., Wedeen, V.J., & Sporns, O. 2008. Mapping the structural core of human cerebral cortex. *PLoS Biology*. 6:1479-1493.
- 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. 65

# Key Papers - 3

---

- 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.
- Lieberman, M.D. & Eisenberger, N.I. 2009. Pains and pleasures of social life. *Science*. 323:890-891.
- 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.
- Lutz, A., Slager, H.A., Dunne, J.D., & Davidson, R. J. 2008. Attention regulation and monitoring in meditation. *Trends in Cognitive Sciences*. 12:163-169.

# Key Papers - 4

---

- Rozin, P. & Royzman, E.B. 2001. Negativity bias, negativity dominance, and contagion. *Personality and Social Psychology Review*, 5:296-320.
- 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.
- Thompson, E. & Varela F.J. 2001. Radical embodiment: Neural dynamics and consciousness. *Trends in Cognitive Sciences*, 5:418-425.
- Walsh, R. & Shapiro, S. L. 2006. The meeting of meditative disciplines and Western psychology: A mutually enriching dialogue. *American Psychologist*, 61:227-239.

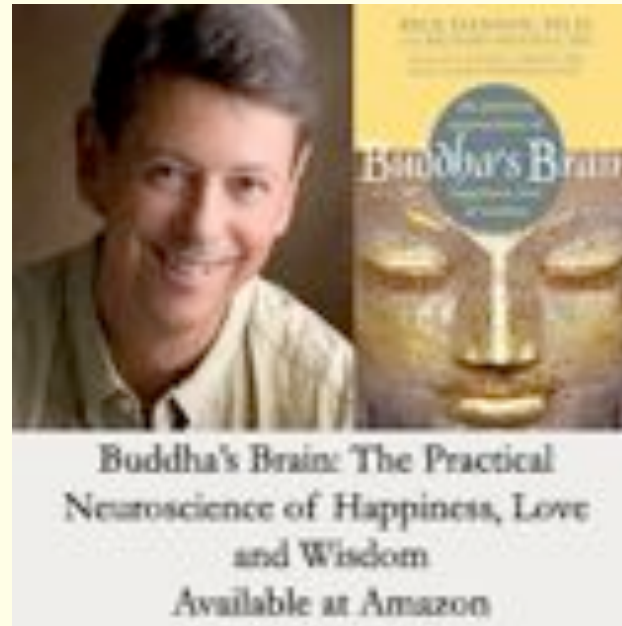
## *Where to Find Rick Hanson Online*

---



<http://www.youtube.com/BuddhasBrain>

<http://www.facebook.com/BuddhasBrain>



[www.RickHanson.net](http://www.RickHanson.net)

[www.WiseBrain.org](http://www.WiseBrain.org)