Managing Stress: Mindfulness-Based Strategies

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What is Stress?

- **Emotional**
- **Physiological**
- **Environmental**

- Stress is not what happens to you, but how you *react* to what happens
- "…demands exceed personal and social resources the individual is able to mobilize."
  RS Lazarus
- Change can induce a stress response.

See: Life Events Rating Scale at:
http://www.changeforlife.com/holmes_rahe.html

Acute vs. Chronic

Acute

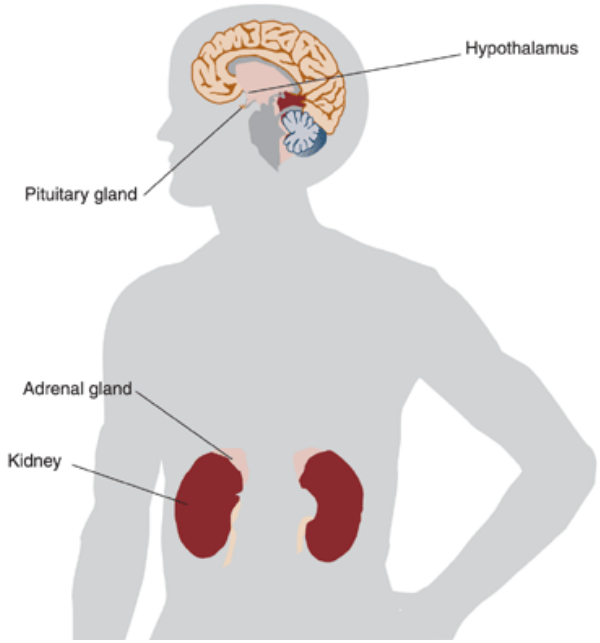
- "Fight or flight"
- Response to physical threat

Chronic

- Psychological
- Interpersonal

Stress Hormones

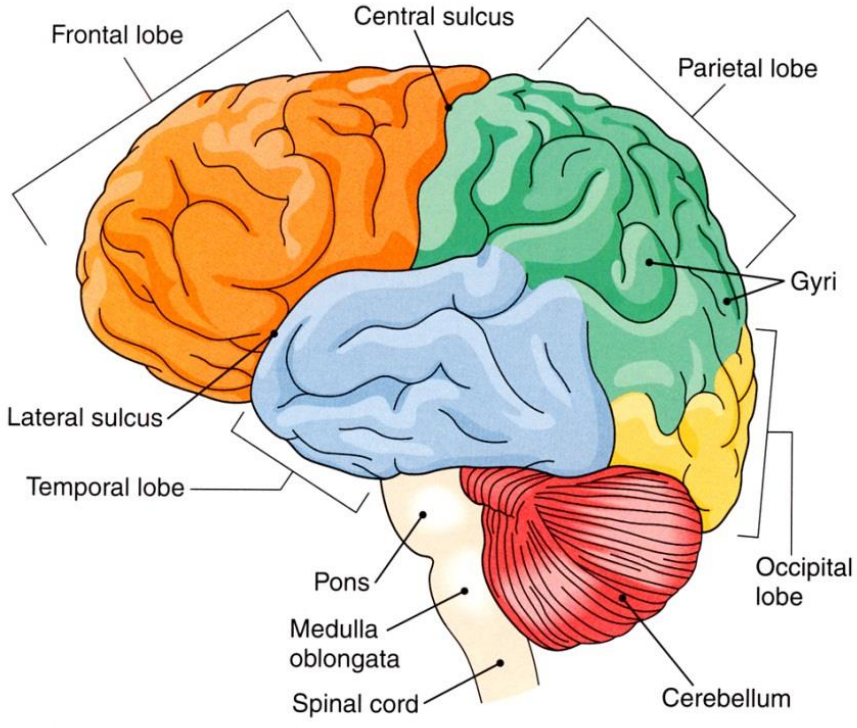
- Adrenaline
- Cortisol

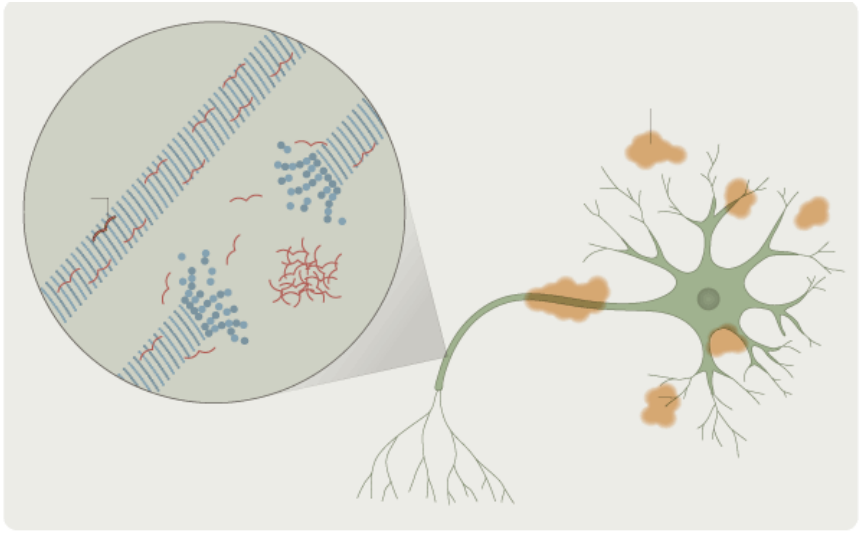


Effects – Chronic Stress

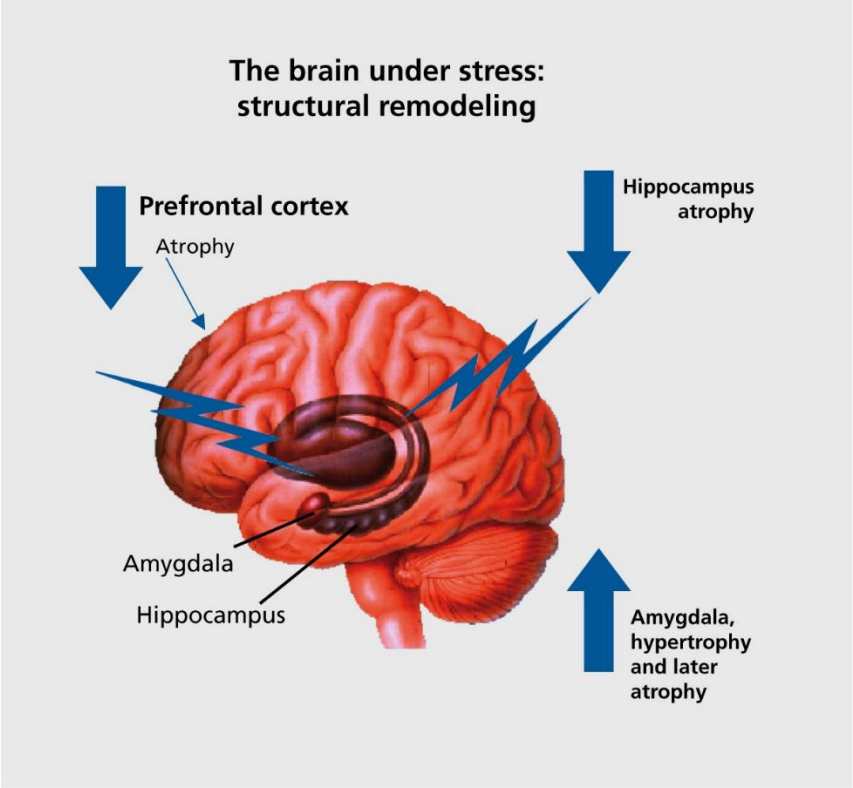
- Nervous System
  - Increased blood pressure, heart rate, platelet activity
- Endocrine - Increased cortisol &
  - Increased blood sugar
  - Increased insulin
  - Increased cholesterol
  - Impaired cognition
- Immune
  - Susceptibility to infection

Basic Neuroscience



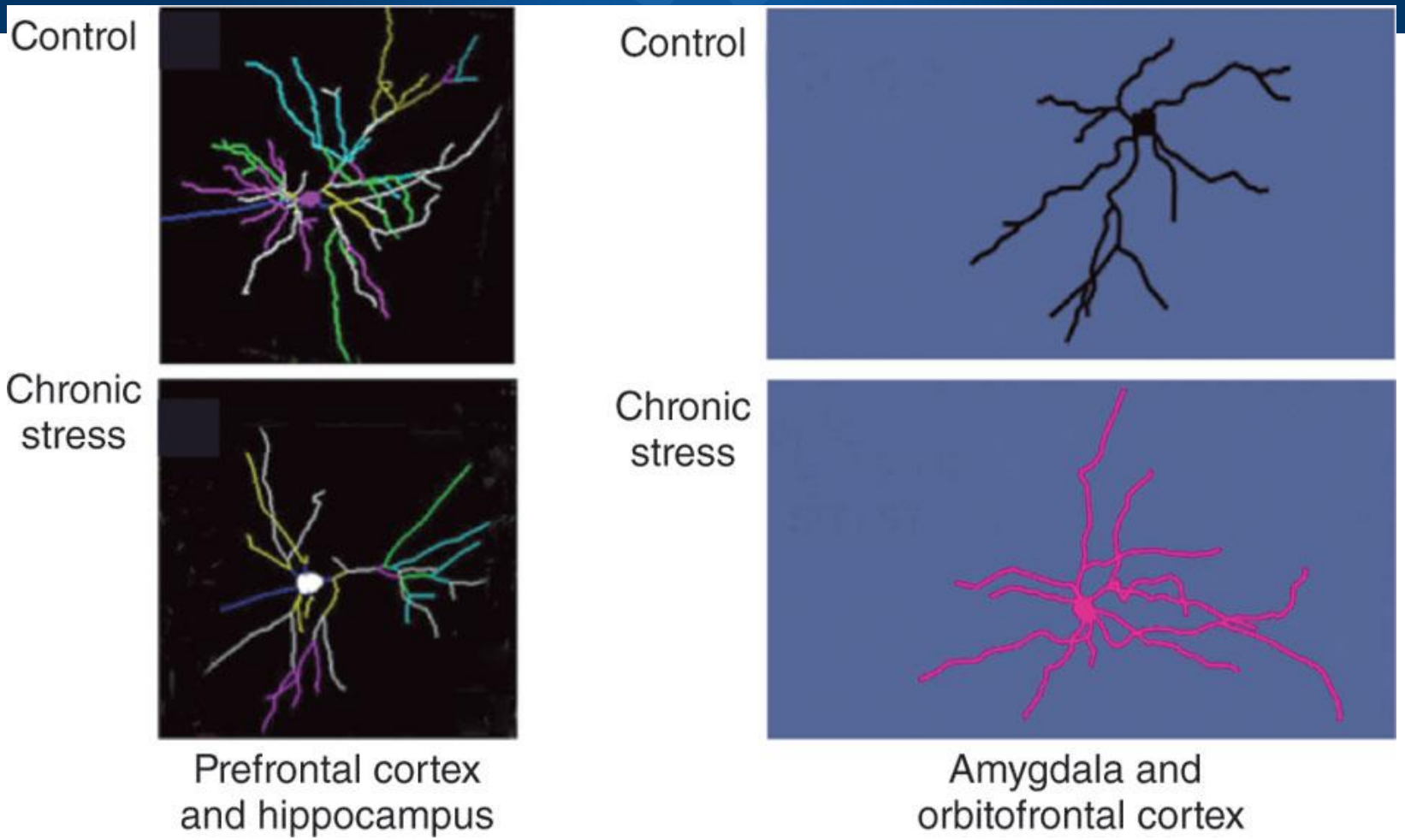


Stress and the Brain



McEwen 2006

Stress and the Brain

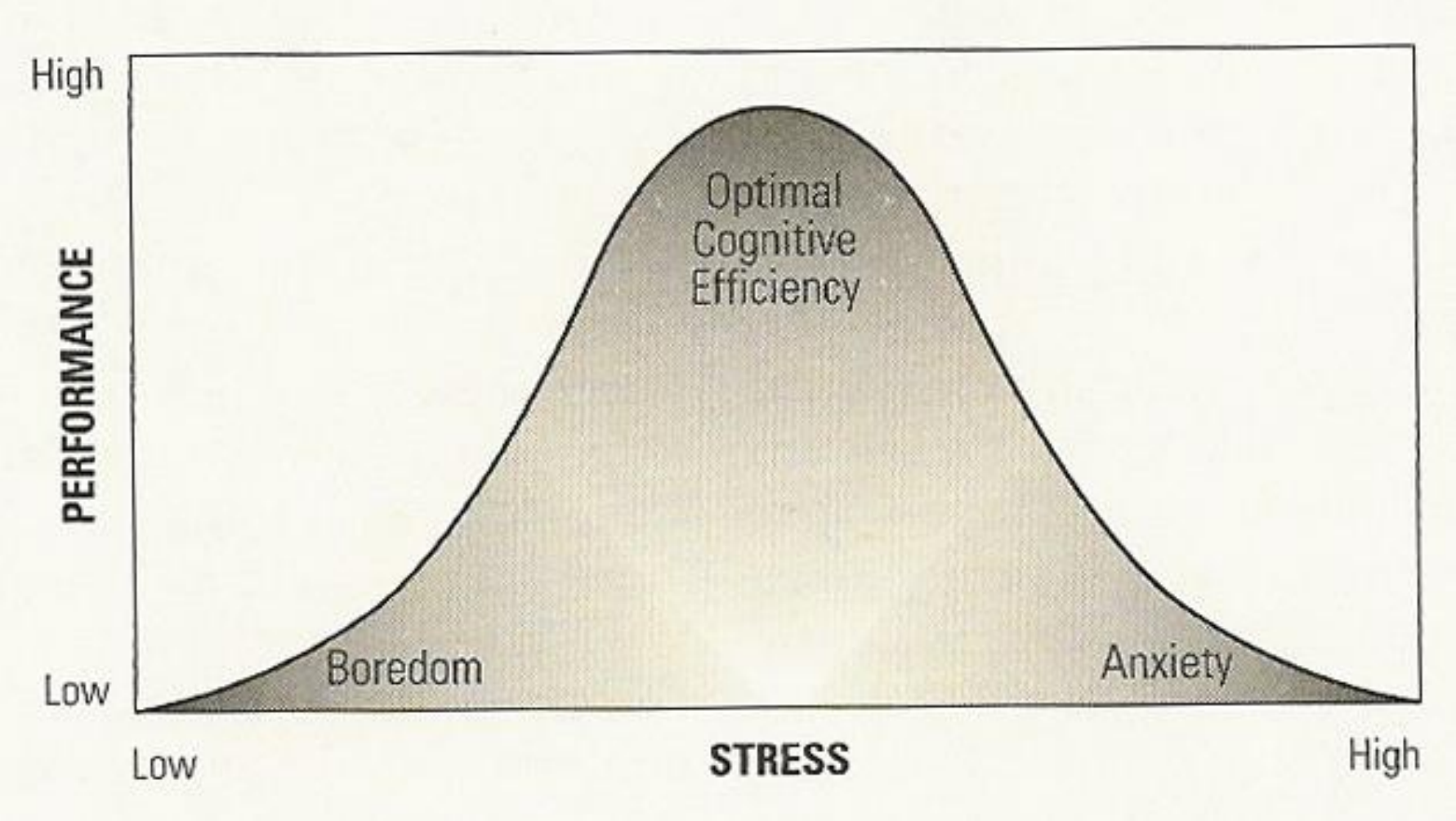


Davidson & McEwen 2012

Some Acknowledgements

- Stress is
  - Unavoidable
  - Uncomfortable
  - Unhealthy
  - Unwanted
- Stress is not
  - Unmanageable
  - Unnecessary
  - Unacceptable
  - Unnatural
- There's also no one "right" or "best" way to deal with stress

Stress and Cognitive Efficiency



Stress Management Practices

Physical

Yoga, tai chi, running, weights

Spiritual

TM, Qigong, prayer

Meditation

- Concentrative – Mantra, prayers, visualization, qigong, yoga
- Receptive/awareness – Vipassana, mindfulness
- Reflective/analytical – disciplined thinking for insight
- Expressive – dancing, chanting, fast breathing, drumming, calligraphy

Other

- Nature, silence, gratitude, forgiveness

"Could we up the dosage? I still have feelings."

Mindfulness

- Relationship with Eastern meditation practices
  - Not tethered to them
  - Unconstrained to ideologies/beliefs
- Resting of attention in the present moment
- “Here and now” vs “then and there”
- Core components of openness to whatever the present moment contains
  - Non-judgmental
  - Gentleness
  - Curiosity
  - Acceptance
- Engagement over avoidance

Mindfulness

- ‘Doing’ versus ‘Being’
  - Habits versus intentions
  - Passive recipient versus active receiver
  - Avoiding verses approaching
  - Fusion of thoughts and reality versus thoughts being thoughts
  - Striving versus flowing

Mindfulness

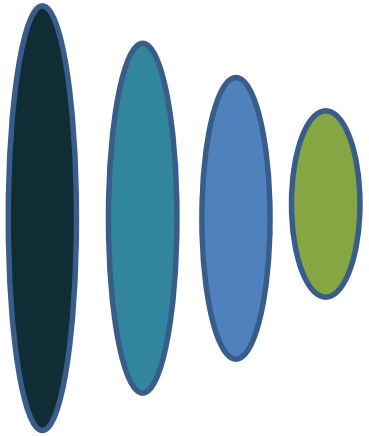
- Is not:
  - Escape
  - A different form of avoidance
  - Emptying the mind of all thoughts
  - Competitive
  - A relaxation technique
  - Exclusive
  - Dogmatic

Mindfulness

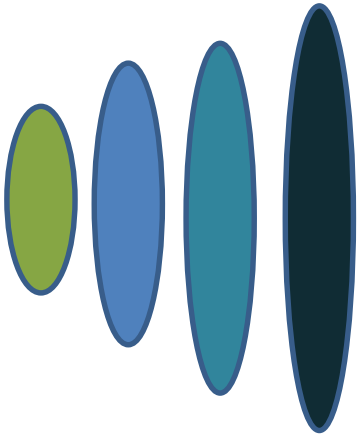
- “Mindfulness means paying attention in a particular way: on purpose, in the present moment, and non-judgmentally.” (Kabat-Zinn, 1994)

- “Life can be found only in the present moment. The past is gone, the future is not yet here, and if we do not go back to ourselves in the present moment, we cannot be in touch with life.” – Thich Nhat Hanh

WHAT WAS
(then and there)



WHAT IS
(here and now)



WHAT IF
(where and when)

Mindfulness

- Core attitudes (Kabat-Zinn, 1990):
  - Non-judging
  - Patience
  - Beginners Mind
  - Trusting
  - Non-striving
  - Acceptance
  - Freedom from attachment

Mindfulness

- Practice, not Mastery
  - Meditation
  - Body Scan
  - Breath
  - Sounds
  - Movement
  - Enhanced awareness
    - Body
    - Mind
    - World

Meditation and Cognition

- Changes in cortical structures
  - White matter
    - Brain stem
    - Putamen
    - Frontal lobes
  - Function
    - Frontal
    - Parietal
  - Default mode network

- Changes in cognitive skills (Chiesa et al., 2011)
  - Processing speed
  - Attention
    - Selective vs. divided
  - Working memory
  - Executive function
    - Mental flexibility

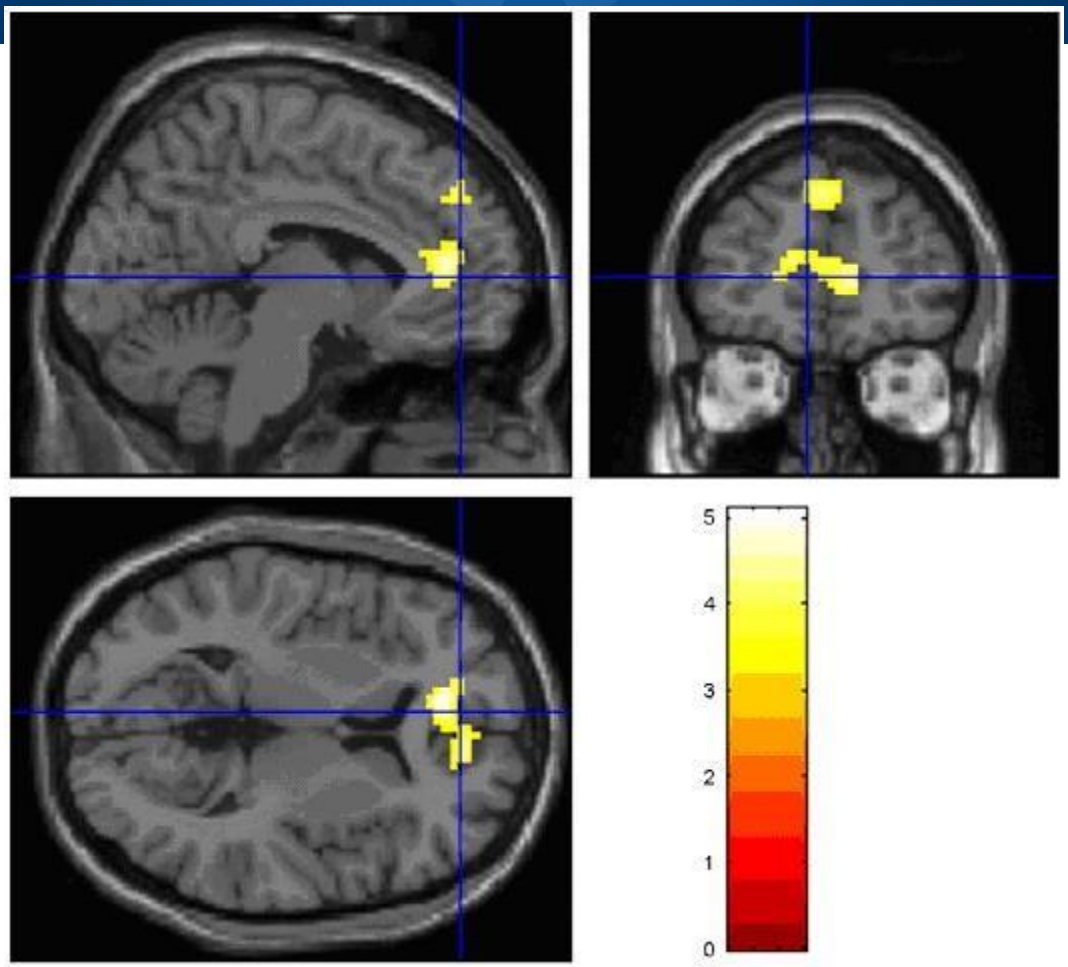
Meditation and the Brain

Study	Intervention	*n*	Mean age ± SD	Experience with meditation	Loci with increased cortical thickness	Interpretation
Lazar et al. (2005)	Various	20	38.2	9.1 ± 7.1 years, 6.2 ± 4 h per week	Anterior insula, parts of frontal lobe, auditory cortex in temporal lobe	Somato-sensory, auditory, and interceptive processes
Pagnoni and Cekic (2007)	Zen	13	37.2 ± 6.9	>3 years per day	Putamen	Attention
Holzel et al. (2008)	Vipassana	20	34.1 ± 4.7	8.6 years, 2 h daily	Anterior insula, right hippocampus, left inferior temporal gyrus	Anterior insula – awareness of internal experience
Vestergaard-Poulsen et al. (2009)	Tibetan buddhism	10	55 ± 6.2	16.5 ± 5.1 years	Medulla oblongata, anterior cerebellum, superior, and inferior frontal gyrus	Breath control, resistance to stress, attention, calmness
Luders et al. (2009)	Various	22	53 ± 11.5	24 ± 12 years	Orbito-frontal cortex, right talamus, left inferior temporal gyrus	Regulation of emotions and sensory functions
Grant et al. (2010)	Zen	17	37.6 ± 10.9	>1000 h	Anterior cingulate cortex, secondary somato-sensory cortex	Anterior cingulate cortex – adaptive control of behavior
Holzel et al. (2011)	MBSR	16	39 ± 4	0	Left hippocampus, posterior cingulate cortex, temporo-parietal junction, cerebellum	Learning, memory, regulation of emotions, empathy
Luders et al. (2013b)	Various	50	51.4 ± 12.8	20 years	Hippocampus, especially subiculum	Subiculum – regulation of stress
Grant et al. (2013)	Zen	18	37.1 ± 10.9	>1000 h	Cingulo-fronto-parietal network	Attention

n, number of subjects, SD, standard deviation, MBSR, mindfulness-based stress reduction, IBMT, integrative body mind training.

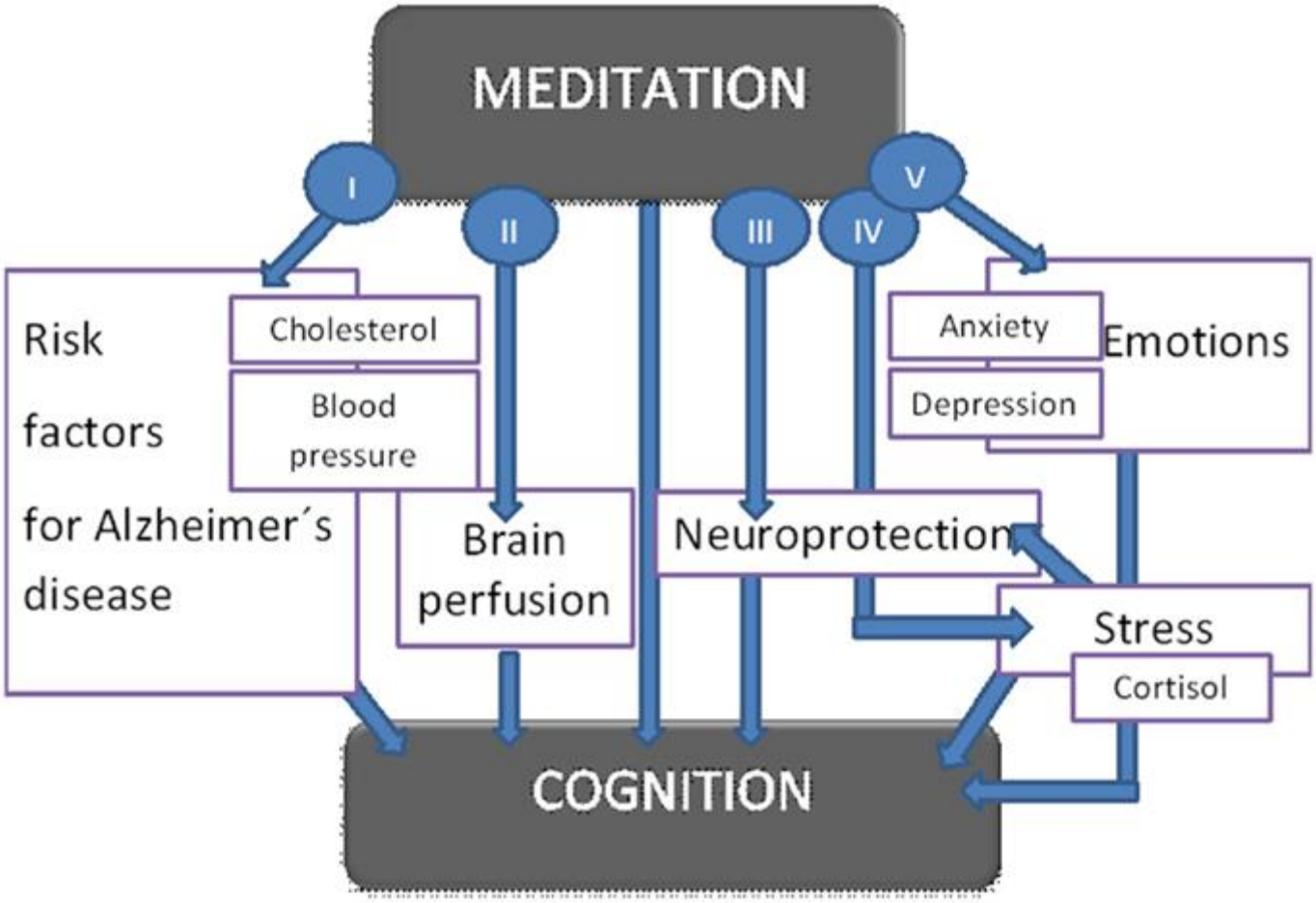
Marciniak et al., 2014

Meditation and the Brain



Hölzel et al., 2007

Meditation and the Brain



Marciniak et al., 2014

Summary

- Validated, longstanding practice
- Non-denominational / trans-theoretical adjunct
- Likely multifactorial direct and indirect impact
  - Risk factors
  - Direct cortical effects
  - Direct functional effects
- Not a cure-all
- Requires effort
- Addresses multiple domains
  - Including quality of life

The Importance of Self-Compassion

- Self-kindness
  - Not self-pity
- Self-acceptance
  - Not self-esteem
- Self-compassion
  - Not self-indulgence or self-flagellation

- Importance of connection to a larger, common human condition
  - Versus isolation

- Importance of mindful awareness and engagement
  - Versus over-identification or fusing thoughts and reality

A Few Final Words on Acceptance

Acceptance is:

the nonjudgmental acknowledgement of “what is.”

Acceptance is not:

giving up, throwing in the towel, or quitting

Acceptance is also not:

the gnashing of teeth, beating of one’s head against the same wall over and over or swearing at the universe

Perhaps the Final Word on Acceptance?

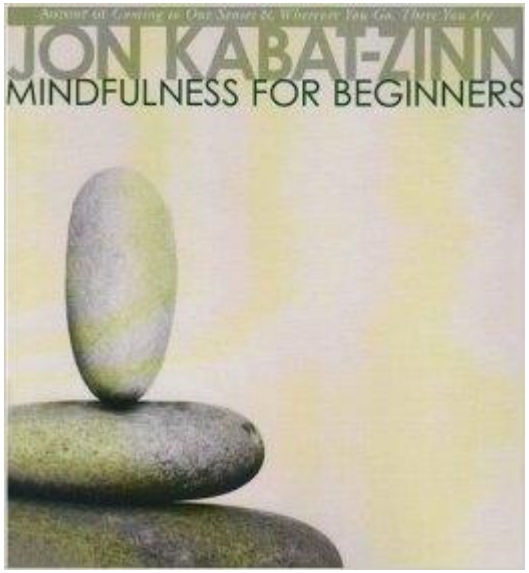
“I can’t fight this, so I might as well dance with it and lead as much as possible.”

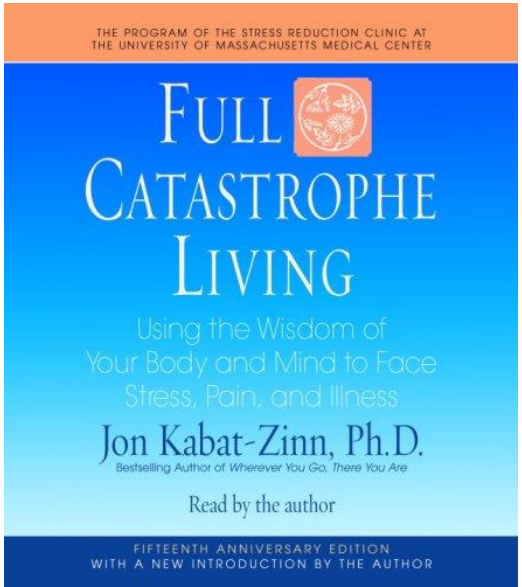
Resources

- Mindfulness Northwest
- http://www.mindfulnessnorthwest.com/

- Seattle Mindfulness Center
- http://seattlemindfulnesscenter.com/

- Mindfulness for Beginners/Full Catastrophe Living (Kabat-Zinn)





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References/Resources

- Beaudreau, S. A., and O'Hara, R. (2008). Late-life anxiety and cognitive impairment: a review. Am. J. Geriatr. Psychiatry 16, 790–803
- Benson, H., Greenwood, M. M., and Klemchuk, H. (1975). The relaxation response: psychophysiologic aspects and clinical applications. Int. J. Psychiatry Med. 6, 87–98
- Brookmeyer, R., Johnson, E., Ziegler-Graham, K., and Arrighi, H. M. (2007). Forecasting the global burden of Alzheimer's disease. Alzheimers Dement. 3, 186–191
- Chien, L. Y., Chu, H., Guo, J. L., Liao, Y. M., Chang, L. I., Chen, C. H., et al. (2011). Caregiver support groups in patients with dementia: a meta-analysis. Int. J. Geriatr. Psychiatry 26, 1089–1098.
- Chiesa, A., Calati, R., and Serretti, A. (2011). Does mindfulness training improve cognitive abilities? A systematic review of neuropsychological findings. Clin. Psychol. Rev. 31, 449–464.
- Davidson, R.J. & McEwen, B.S. (2012) Social influences on neuroplasticity: stress and interventions to promote well-being. Nature Neuroscience 15, 689–695
- Dopson, L. (2005). Spirituality and Alzheimer's. Nurs. Older People 17, 39.
- Epel, E., Daubenmier, J., Moskowitz, J. T., Folkman, S., and Blackburn, E. (2009). Can meditation slow rate of cellular aging? Cognitive stress, mindfulness, and telomeres. Ann. N. Y. Acad. Sci. 1172, 34–53.
- Forette, F., Seux, M. L., Staessen, J. A., Thijs, L., Birkenhager, W. H., Babarskiene, M. R., et al. (1998). Prevention of dementia in randomised double-blind placebo-controlled systolic hypertension in Europe (Syst-Eur) trial. Lancet 352, 1347–1351.
- Gauthier, S., Cummings, J., Ballard, C., Brodaty, H., Grossberg, G., Robert, P., et al. (2010). Management of behavioral problems in Alzheimer's disease. Int. Psychogeriatr. 22, 346–372.
- Germer, C. K., Siegel, R. D., and Fulton, P. R. (2005). Mindfulness and Psychotherapy. New York: Guilford Press.
- Grant, J. A., Courtemanche, J., Duerden, E. G., Duncan, G. H., and Rainville, P. (2010). Cortical thickness and pain sensitivity in Zen meditators. Emotion 10, 43–53.
- Grant, J. A., Duerden, E. G., Courtemanche, J., Cherkasova, M., Duncan, G. H., and Rainville, P. (2013). Cortical thickness, mental absorption and meditative practice: possible implications for disorders of attention. Biol. Psychol. 92, 275–281.
- Grossman, P., Niemann, L., Schmidt, S., and Walach, H. (2004). Mindfulness-based stress reduction and health benefits. A meta-analysis. J. Psychosom. Res. 57, 35–43.

References/Resources

- Hoge, E. A., Chen, M. M., Orr, E., Metcalf, C. A., Fischer, L. E., Pollack, M. H., et al. (2013). Loving-Kindness Meditation practice associated with longer telomeres in women. Brain Behav. Immun. 32, 159–163.
- Holzel, B. K., Carmody, J., Vangel, M., Congleton, C., Yerramsetti, S. M., Gard, T., et al. (2011). Mindfulness practice leads to increases in regional brain gray matter density. Psychiatry Res. 191, 36–43.
- Holzel, B. K., Ott, U., Gard, T., Hempel, H., Weygandt, M., Morgen, K., et al. (2008). Investigation of mindfulness meditation practitioners with voxel-based morphometry. Soc. Cogn. Affect. Neurosci. 3, 55–61.
- Horrigan, B. J. (2007). New studies support the therapeutic value of meditation. Explore (NY) 3, 449–450.
- Hulme, C., Wright, J., Crocker, T., Oluboyede, Y., and House, A. (2010). Non-pharmacological approaches for dementia that informal carers might try or access: a systematic review. Int. J. Geriatr. Psychiatry 25, 756–763.
- Innes, K. E., Selfe, T. K., Brown, C. J., Rose, K. M., and Thompson-Heisterman, A. (2012). The effects of meditation on perceived stress and related indices of psychological status and sympathetic activation in persons with Alzheimer's disease and their caregivers: a pilot study. Evid. Based Complement. Altern. Med. 2012, 927509.
- Jacobs, T. L., Epel, E. S., Lin, J., Blackburn, E. H., Wolkowitz, O. M., Bridwell, D. A., et al. (2011). Intensive meditation training, immune cell telomerase activity, and psychological mediators. Psychoneuroendocrinology 36, 664–681.
- Jacobs, T. L., Shaver, P. R., Epel, E. S., Zanesco, A. P., Aichele, S. R., Bridwell, D. A., et al. (2013). Self-reported mindfulness and cortisol during a Shamatha meditation retreat. Health Psychol. 32, 1104–1109.
- Kaufman, Y., Anaki, D., Binns, M., and Freedman, M. (2007). Cognitive decline in Alzheimer disease: impact of spirituality, religiosity, and QOL. Neurology 68, 1509–1514.
- Khalsa, D. S., Amen, D., Hanks, C., Money, N., and Newberg, A. (2009). Cerebral blood flow changes during chanting meditation. Nucl. Med. Commun. 30, 956–961.
- Khanna, S., and Greeson, J. M. (2013). A narrative review of yoga and mindfulness as complementary therapies for addiction. Complement. Ther. Med. 21, 244–252.
- Khatri, D., Mathur, K. C., Gahlot, S., Jain, S., and Agrawal, R. P. (2007). Effects of yoga and meditation on clinical and biochemical parameters of metabolic syndrome. Diabetes Res. Clin. Pract. 78, e9–e10.

References/Resources

- Kivipelto, M., Helkala, E. L., Laakso, M. P., Hanninen, T., Hallikainen, M., Alhainen, K., et al. (2001). Midlife vascular risk factors and Alzheimer's disease in later life: longitudinal, population based study. BMJ 322, 1447–1451.
- Kivipelto, M., Ngandu, T., Fratiglioni, L., Viitanen, M., Kareholt, I., Winblad, B., et al. (2005). Obesity and vascular risk factors at midlife and the risk of dementia and Alzheimer disease. Arch. Neurol. 62, 1556–1560.
- Lakhan, S. E., and Schofield, K. L. (2013). Mindfulness-based therapies in the treatment of somatization disorders: a systematic review and meta-analysis. PLoS ONE 8:e71834.
- Lavretsky, H., Epel, E. S., Siddarth, P., Nazarian, N., Cyr, N. S., Khalsa, D. S., et al. (2013). A pilot study of yogic meditation for family dementia caregivers with depressive symptoms: effects on mental health, cognition, and telomerase activity. Int. J. Geriatr. Psychiatry 28, 57–65.
- Lazar, S. W., Kerr, C. E., Wasserman, R. H., Gray, J. R., Greve, D. N., Treadway, M. T., et al. (2005). Meditation experience is associated with increased cortical thickness. Neuroreport 16, 1893–1897.
- Lindberg, D. A. (2005). Integrative review of research related to meditation, spirituality, and the elderly. Geriatr. Nurs. 26, 372–377.
- Luders, E., Clark, K., Narr, K. L., and Toga, A. W. (2011). Enhanced brain connectivity in long-term meditation practitioners. Neuroimage 57, 1308–1316
- Luders, E., Thompson, P. M., Kurth, F., Hong, J. Y., Phillips, O. R., Wang, Y., et al. (2013a). Global and regional alterations of hippocampal anatomy in long-term meditation practitioners. Hum. Brain Mapp. 34, 3369–3375.
- Luders, E., Kurth, F., Toga, A. W., Narr, K. L., and Gaser, C. (2013b). Meditation effects within the hippocampal complex revealed by voxel-based morphometry and cytoarchitectonic probabilistic mapping. Front. Psychol. 4:398.
- Luders, E., Toga, A. W., Lepore, N., and Gaser, C. (2009). The underlying anatomical correlates of long-term meditation: larger hippocampal and frontal volumes of gray matter. Neuroimage 45, 672–678.
- Lutz, A., Slagter, H. A., Dunne, J. D., and Davidson, R. J. (2008). Attention regulation and monitoring in meditation. Trends Cogn. Sci. 12, 163–169.

References/Resources

- Marciniak, R., Sheardova, K., Čermáková, P., Hudeček, D., Šumec, R., & Hort, J. (2014). Effect of meditation on cognitive functions in context of aging and neurodegenerative diseases. Frontiers in Behavioral Neuroscience, 8.
- McEwen, B.S. (2006). Protective and damaging effects of stress mediators: central role of the brain. Dialogues Clin Neurosci. 2006;8:367-381.
- Moss, A. S., Wintering, N., Roggenkamp, H., Khalsa, D. S., Waldman, M. R., Monti, D., et al. (2012). Effects of an 8-week meditation program on mood and anxiety in patients with memory loss. J. Altern. Complement. Med. 18, 48–53.
- Newberg, A., Alavi, A., Baime, M., Pourdehnad, M., Santanna, J., and d'Aquili, E. (2001). The measurement of regional cerebral blood flow during the complex cognitive task of meditation: a preliminary SPECT study. Psychiatry Res. 106, 113–122.
- Newberg, A. B., Serruya, M., Wintering, N., Moss, A. S., Reibel, D., and Monti, D. A. (2013). Meditation and neurodegenerative diseases. Ann. N. Y. Acad. Sci. 1307, 112–123.
- Newberg, A. B., Wintering, N., Khalsa, D. S., Roggenkamp, H., and Waldman, M. R. (2010a). Meditation effects on cognitive function and cerebral blood flow in subjects with memory loss: a preliminary study. J. Alzheimers Dis. 20, 517–526.
- Newberg, A. B., Wintering, N., Waldman, M. R., Amen, D., Khalsa, D. S., and Alavi, A. (2010b). Cerebral blood flow differences between long-term meditators and non-meditators. Conscious. Cogn. 19, 899–905.
- Olazaran, J., Reisberg, B., Clare, L., Cruz, I., Pena-Casanova, J., Del Ser, T., et al. (2010). Nonpharmacological therapies in Alzheimer's disease: a systematic review of efficacy. Dement. Geriatr. Cogn. Disord. 30, 161–178.
- Pagnoni, G., and Cekic, M. (2007). Age effects on gray matter volume and attentional performance in Zen meditation. Neurobiol. Aging 28, 1623–1627.
- Prakash, R., Rastogi, P., Dubey, I., Abhishek, P., Chaudhury, S., and Small, B. J. (2012). Long-term concentrative meditation and cognitive performance among older adults. Neuropsychol Dev Cogn B Aging Neuropsychol Cogn. 19, 479–494
- Prince, M., Bryce, R., Albanese, E., Wimo, A., Ribeiro, W., and Ferri, C. P. (2013). The global prevalence of dementia: a systematic review and metaanalysis. Alzheimers Dement. 9, 63e–75e.

References/Resources

- Reitz, C. (2013). Dyslipidemia and the risk of Alzheimer's disease. Curr. Atheroscler. Rep. 15, 307.
- Rocca, W. A., Petersen, R. C., Knopman, D. S., Hebert, L. E., Evans, D. A., Hall, K. S., et al. (2011). Trends in the incidence and prevalence of Alzheimer's disease, dementia, and cognitive impairment in the United States. Alzheimers Dement. 7, 80–93.
- Roher, A. E., Debbins, J. P., Malek-Ahmadi, M., Chen, K., Pipe, J. G., Maze, S., et al. (2012). Cerebral blood flow in Alzheimer's disease. Vasc. Health Risk Manag. 8, 599–611.
- Salthouse, T. A. (2011). Neuroanatomical substrates of age-related cognitive decline. Psychol. Bull. 137, 753.
- Schwartz, G. E., Davidson, R. J., and Goleman, D. J. (1978). Patterning of cognitive and somatic processes in the self-regulation of anxiety: effects of meditation versus exercise. Psychosom. Med. 40, 321–328.
- Tang, Y. Y., Lu, Q., Geng, X., Stein, E. A., Yang, Y., and Posner, M. I. (2010). Short-term meditation induces white matter changes in the anterior cingulate. Proc. Natl. Acad. Sci. U.S.A. 107, 15649–15652.
- Vestergaard-Poulsen, P., van Beek, M., Skewes, J., Bjarkam, C. R., Stubberup, M., Bertelsen, J., et al. (2009). Long-term meditation is associated with increased gray matter density in the brain stem. Neuroreport 20, 170–174.
- Wachholtz, A. B., and Pargament, K. I. (2005). Is spirituality a critical ingredient of meditation? Comparing the effects of spiritual meditation, secular meditation, and relaxation on spiritual, psychological, cardiac, and pain outcomes. J. Behav. Med. 28, 369–384.
- Waelde, L. C., Thompson, L., and Gallagher-Thompson, D. (2004). A pilot study of a yoga and meditation intervention for dementia caregiver stress. J. Clin. Psychol. 60, 677–687.
- Walton, K. G., Schneider, R. H., and Nidich, S. (2004). Review of controlled research on the transcendental meditation program and cardiovascular disease. Risk factors, morbidity, and mortality. Cardiol. Rev. 12, 262–266.
- Wang, D. J., Rao, H., Korczykowski, M., Wintering, N., Pluta, J., Khalsa, D. S., et al. (2011). Cerebral blood flow changes associated with different meditation practices and perceived depth of meditation. Psychiatry Res. 191, 60–67.
- Wells RE1, Yeh GY, Kerr CE, Wolkin J, Davis RB, Tan Y, Spaeth R, Wall RB, Walsh J, Kaptchuk TJ, Press D, Phillips RS, Kong J. Meditation's impact on default mode network and hippocampus in mild cognitive impairment: a pilot study. Neurosci Lett. 2013 Nov 27;556:15-9.
- Xiong, G. L., and Doraiswamy, P. M. (2009). Does meditation enhance cognition and brain plasticity? Ann. N. Y. Acad. Sci. 1172, 63–69.

References/Resources

- Beaudreau, S. A., and O'Hara, R. (2008). Late-life anxiety and cognitive impairment: a review. Am. J. Geriatr. Psychiatry 16, 790–803
- Benson, H., Greenwood, M. M., and Klemchuk, H. (1975). The relaxation response: psychophysiologic aspects and clinical applications. Int. J. Psychiatry Med. 6, 87–98
- Brookmeyer, R., Johnson, E., Ziegler-Graham, K., and Arrighi, H. M. (2007). Forecasting the global burden of Alzheimer's disease. Alzheimers Dement. 3, 186–191
- Chien, L. Y., Chu, H., Guo, J. L., Liao, Y. M., Chang, L. I., Chen, C. H., et al. (2011). Caregiver support groups in patients with dementia: a meta-analysis. Int. J. Geriatr. Psychiatry 26, 1089–1098.
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- Dopson, L. (2005). Spirituality and Alzheimer's. Nurs. Older People 17, 39.
- Epel, E., Daubenmier, J., Moskowitz, J. T., Folkman, S., and Blackburn, E. (2009). Can meditation slow rate of cellular aging? Cognitive stress, mindfulness, and telomeres. Ann. N. Y. Acad. Sci. 1172, 34–53.
- Forette, F., Seux, M. L., Staessen, J. A., Thijs, L., Birkenhager, W. H., Babarskiene, M. R., et al. (1998). Prevention of dementia in randomised double-blind placebo-controlled systolic hypertension in Europe (Syst-Eur) trial. Lancet 352, 1347–1351.
- Gauthier, S., Cummings, J., Ballard, C., Brodaty, H., Grossberg, G., Robert, P., et al. (2010). Management of behavioral problems in Alzheimer's disease. Int. Psychogeriatr. 22, 346–372.
- Germer, C. K., Siegel, R. D., and Fulton, P. R. (2005). Mindfulness and Psychotherapy. New York: Guilford Press.
- Grant, J. A., Courtemanche, J., Duerden, E. G., Duncan, G. H., and Rainville, P. (2010). Cortical thickness and pain sensitivity in Zen meditators. Emotion 10, 43–53.
- Grant, J. A., Duerden, E. G., Courtemanche, J., Cherkasova, M., Duncan, G. H., and Rainville, P. (2013). Cortical thickness, mental absorption and meditative practice: possible implications for disorders of attention. Biol. Psychol. 92, 275–281.
- Grossman, P., Niemann, L., Schmidt, S., and Walach, H. (2004). Mindfulness-based stress reduction and health benefits. A meta-analysis. J. Psychosom. Res. 57, 35–43.

References/Resources

- Hoge, E. A., Chen, M. M., Orr, E., Metcalf, C. A., Fischer, L. E., Pollack, M. H., et al. (2013). Loving-Kindness Meditation practice associated with longer telomeres in women. Brain Behav. Immun. 32, 159–163.
- Holzel, B. K., Carmody, J., Vangel, M., Congleton, C., Yerramsetti, S. M., Gard, T., et al. (2011). Mindfulness practice leads to increases in regional brain gray matter density. Psychiatry Res. 191, 36–43.
- Holzel, B. K., Ott, U., Gard, T., Hempel, H., Weygandt, M., Morgen, K., et al. (2008). Investigation of mindfulness meditation practitioners with voxel-based morphometry. Soc. Cogn. Affect. Neurosci. 3, 55–61.
- Horrigan, B. J. (2007). New studies support the therapeutic value of meditation. Explore (NY) 3, 449–450.
- Hulme, C., Wright, J., Crocker, T., Oluboyede, Y., and House, A. (2010). Non-pharmacological approaches for dementia that informal carers might try or access: a systematic review. Int. J. Geriatr. Psychiatry 25, 756–763.
- Innes, K. E., Selfe, T. K., Brown, C. J., Rose, K. M., and Thompson-Heisterman, A. (2012). The effects of meditation on perceived stress and related indices of psychological status and sympathetic activation in persons with Alzheimer's disease and their caregivers: a pilot study. Evid. Based Complement. Altern. Med. 2012, 927509.
- Jacobs, T. L., Epel, E. S., Lin, J., Blackburn, E. H., Wolkowitz, O. M., Bridwell, D. A., et al. (2011). Intensive meditation training, immune cell telomerase activity, and psychological mediators. Psychoneuroendocrinology 36, 664–681.
- Jacobs, T. L., Shaver, P. R., Epel, E. S., Zanesco, A. P., Aichele, S. R., Bridwell, D. A., et al. (2013). Self-reported mindfulness and cortisol during a Shamatha meditation retreat. Health Psychol. 32, 1104–1109.
- Kaufman, Y., Anaki, D., Binns, M., and Freedman, M. (2007). Cognitive decline in Alzheimer disease: impact of spirituality, religiosity, and QOL. Neurology 68, 1509–1514.
- Khalsa, D. S., Amen, D., Hanks, C., Money, N., and Newberg, A. (2009). Cerebral blood flow changes during chanting meditation. Nucl. Med. Commun. 30, 956–961.
- Khanna, S., and Greeson, J. M. (2013). A narrative review of yoga and mindfulness as complementary therapies for addiction. Complement. Ther. Med. 21, 244–252.
- Khatri, D., Mathur, K. C., Gahlot, S., Jain, S., and Agrawal, R. P. (2007). Effects of yoga and meditation on clinical and biochemical parameters of metabolic syndrome. Diabetes Res. Clin. Pract. 78, e9–e10.

References/Resources

- Kivipelto, M., Helkala, E. L., Laakso, M. P., Hanninen, T., Hallikainen, M., Alhainen, K., et al. (2001). Midlife vascular risk factors and Alzheimer's disease in later life: longitudinal, population based study. BMJ 322, 1447–1451.
- Kivipelto, M., Ngandu, T., Fratiglioni, L., Viitanen, M., Kareholt, I., Winblad, B., et al. (2005). Obesity and vascular risk factors at midlife and the risk of dementia and Alzheimer disease. Arch. Neurol. 62, 1556–1560.
- Lakhan, S. E., and Schofield, K. L. (2013). Mindfulness-based therapies in the treatment of somatization disorders: a systematic review and meta-analysis. PLoS ONE 8:e71834.
- Lavretsky, H., Epel, E. S., Siddarth, P., Nazarian, N., Cyr, N. S., Khalsa, D. S., et al. (2013). A pilot study of yogic meditation for family dementia caregivers with depressive symptoms: effects on mental health, cognition, and telomerase activity. Int. J. Geriatr. Psychiatry 28, 57–65.
- Lazar, S. W., Kerr, C. E., Wasserman, R. H., Gray, J. R., Greve, D. N., Treadway, M. T., et al. (2005). Meditation experience is associated with increased cortical thickness. Neuroreport 16, 1893–1897.
- Lindberg, D. A. (2005). Integrative review of research related to meditation, spirituality, and the elderly. Geriatr. Nurs. 26, 372–377.
- Luders, E., Clark, K., Narr, K. L., and Toga, A. W. (2011). Enhanced brain connectivity in long-term meditation practitioners. Neuroimage 57, 1308–1316
- Luders, E., Thompson, P. M., Kurth, F., Hong, J. Y., Phillips, O. R., Wang, Y., et al. (2013a). Global and regional alterations of hippocampal anatomy in long-term meditation practitioners. Hum. Brain Mapp. 34, 3369–3375.
- Luders, E., Kurth, F., Toga, A. W., Narr, K. L., and Gaser, C. (2013b). Meditation effects within the hippocampal complex revealed by voxel-based morphometry and cytoarchitectonic probabilistic mapping. Front. Psychol. 4:398.
- Luders, E., Toga, A. W., Lepore, N., and Gaser, C. (2009). The underlying anatomical correlates of long-term meditation: larger hippocampal and frontal volumes of gray matter. Neuroimage 45, 672–678.
- Lutz, A., Slagter, H. A., Dunne, J. D., and Davidson, R. J. (2008). Attention regulation and monitoring in meditation. Trends Cogn. Sci. 12, 163–169.

References/Resources

- Marciniak, R., Sheardova, K., Čermáková, P., Hudeček, D., Šumec, R., & Hort, J. (2014). Effect of meditation on cognitive functions in context of aging and neurodegenerative diseases. Frontiers in Behavioral Neuroscience, 8.
- McEwen, B.S. (2006). Protective and damaging effects of stress mediators: central role of the brain. Dialogues Clin Neurosci. 2006;8:367-381.
- Moss, A. S., Wintering, N., Roggenkamp, H., Khalsa, D. S., Waldman, M. R., Monti, D., et al. (2012). Effects of an 8-week meditation program on mood and anxiety in patients with memory loss. J. Altern. Complement. Med. 18, 48–53.
- Newberg, A., Alavi, A., Baime, M., Pourdehnad, M., Santanna, J., and d'Aquili, E. (2001). The measurement of regional cerebral blood flow during the complex cognitive task of meditation: a preliminary SPECT study. Psychiatry Res. 106, 113–122.
- Newberg, A. B., Serruya, M., Wintering, N., Moss, A. S., Reibel, D., and Monti, D. A. (2013). Meditation and neurodegenerative diseases. Ann. N. Y. Acad. Sci. 1307, 112–123.
- Newberg, A. B., Wintering, N., Khalsa, D. S., Roggenkamp, H., and Waldman, M. R. (2010a). Meditation effects on cognitive function and cerebral blood flow in subjects with memory loss: a preliminary study. J. Alzheimers Dis. 20, 517–526.
- Newberg, A. B., Wintering, N., Waldman, M. R., Amen, D., Khalsa, D. S., and Alavi, A. (2010b). Cerebral blood flow differences between long-term meditators and non-meditators. Conscious. Cogn. 19, 899–905.
- Olazaran, J., Reisberg, B., Clare, L., Cruz, I., Pena-Casanova, J., Del Ser, T., et al. (2010). Nonpharmacological therapies in Alzheimer's disease: a systematic review of efficacy. Dement. Geriatr. Cogn. Disord. 30, 161–178.
- Pagnoni, G., and Cekic, M. (2007). Age effects on gray matter volume and attentional performance in Zen meditation. Neurobiol. Aging 28, 1623–1627.
- Prakash, R., Rastogi, P., Dubey, I., Abhishek, P., Chaudhury, S., and Small, B. J. (2012). Long-term concentrative meditation and cognitive performance among older adults. Neuropsychol Dev Cogn B Aging Neuropsychol Cogn. 19, 479–494
- Prince, M., Bryce, R., Albanese, E., Wimo, A., Ribeiro, W., and Ferri, C. P. (2013). The global prevalence of dementia: a systematic review and metaanalysis. Alzheimers Dement. 9, 63e–75e.

References/Resources

- Reitz, C. (2013). Dyslipidemia and the risk of Alzheimer's disease. Curr. Atheroscler. Rep. 15, 307.
- Rocca, W. A., Petersen, R. C., Knopman, D. S., Hebert, L. E., Evans, D. A., Hall, K. S., et al. (2011). Trends in the incidence and prevalence of Alzheimer's disease, dementia, and cognitive impairment in the United States. Alzheimers Dement. 7, 80–93.
- Roher, A. E., Debbins, J. P., Malek-Ahmadi, M., Chen, K., Pipe, J. G., Maze, S., et al. (2012). Cerebral blood flow in Alzheimer's disease. Vasc. Health Risk Manag. 8, 599–611.
- Salthouse, T. A. (2011). Neuroanatomical substrates of age-related cognitive decline. Psychol. Bull. 137, 753.
- Schwartz, G. E., Davidson, R. J., and Goleman, D. J. (1978). Patterning of cognitive and somatic processes in the self-regulation of anxiety: effects of meditation versus exercise. Psychosom. Med. 40, 321–328.
- Tang, Y. Y., Lu, Q., Geng, X., Stein, E. A., Yang, Y., and Posner, M. I. (2010). Short-term meditation induces white matter changes in the anterior cingulate. Proc. Natl. Acad. Sci. U.S.A. 107, 15649–15652.
- Vestergaard-Poulsen, P., van Beek, M., Skewes, J., Bjarkam, C. R., Stubberup, M., Bertelsen, J., et al. (2009). Long-term meditation is associated with increased gray matter density in the brain stem. Neuroreport 20, 170–174.
- Wachholtz, A. B., and Pargament, K. I. (2005). Is spirituality a critical ingredient of meditation? Comparing the effects of spiritual meditation, secular meditation, and relaxation on spiritual, psychological, cardiac, and pain outcomes. J. Behav. Med. 28, 369–384.
- Waelde, L. C., Thompson, L., and Gallagher-Thompson, D. (2004). A pilot study of a yoga and meditation intervention for dementia caregiver stress. J. Clin. Psychol. 60, 677–687.
- Walton, K. G., Schneider, R. H., and Nidich, S. (2004). Review of controlled research on the transcendental meditation program and cardiovascular disease. Risk factors, morbidity, and mortality. Cardiol. Rev. 12, 262–266.
- Wang, D. J., Rao, H., Korczykowski, M., Wintering, N., Pluta, J., Khalsa, D. S., et al. (2011). Cerebral blood flow changes associated with different meditation practices and perceived depth of meditation. Psychiatry Res. 191, 60–67.
- Wells RE1, Yeh GY, Kerr CE, Wolkin J, Davis RB, Tan Y, Spaeth R, Wall RB, Walsh J, Kaptchuk TJ, Press D, Phillips RS, Kong J. Meditation's impact on default mode network and hippocampus in mild cognitive impairment: a pilot study. Neurosci Lett. 2013 Nov 27;556:15-9.
- Xiong, G. L., and Doraiswamy, P. M. (2009). Does meditation enhance cognition and brain plasticity? Ann. N. Y. Acad. Sci. 1172, 63–69.