

**CHAPTER 21: TRAINING THE MIND: WHAT THE
COGNITIVE SCIENCES HAVE TO SAY**

1. The account of these meetings gave rise to a book: Goleman, D., and the Dalai Lama, *Destructive Emotions: A Scientific Dialogue with the Dalai Lama*, Bantam Books, 2004.

2. Kaufman, M., Meditation gives brain a charge, study finds, *Washington Post*, January 3, 2005, p. A05.
3. See Ricard, M., *Why Meditate?* Hay House, 2010; *The Art of Meditation*, Atlantic, 2011.
4. Davidson, R. J., & Begley, S., *The Emotional Life of Your Brain: How Its Unique Patterns Affect the Way You Think, Feel, and Live—and How You Can Change Them*, Hudson Street Press, 2012, p. xii.
5. Among the many researchers involved in these studies, we'll cite by way of example: Julie Brefczynski-Lewis, Linda Carlson, Richard Davidson, Gaelle Desbordes, Sona Dimidjian, Brooke Dodson-Lavelle, Paul Ekman, Brent Field, Barbara Fredrickson, Brita Hölzel, Amishi Jha, Jon Kabat-Zinn, Olga Klimecki, Bethany Kok, Sara Lazar, Antoine Lutz, Brendan Ozawa-de Silva, David Perlman, Chuck Raison, Cliff Saron, Tania Singer, Heleen Slagter, John Teasdale, Elen Weng, Mark Williams, Fadel Zeidan, to cite only those with whom I have had the opportunity to interact over the past few years.
6. Brefczynski-Lewis, J. A., Lutz, A., Schaefer, H. S., Levinson, D. B., & Davidson, R. J. (2007). Neural correlates of attentional expertise in long-term meditation practitioners. *Proceedings of the National Academy of Sciences*, 104(27), 11483–11488.
7. Lutz, A., Slagter, H. A., Rawlings, N. B., Francis, A. D., Greischar, L. L., & Davidson, R. J. (2009). Mental training enhances attentional stability: Neural and behavioral evidence. *Journal of Neuroscience*, 29(42), 13418–13427.
8. Gyatso, Tenzin (the XIVth Dalai Lama) & Jinpa, G. T., *The World of Tibetan Buddhism: An Overview of Its Philosophy and Practice*, Wisdom Publications, 1995. Wallace, B. A., *The Attention Revolution: Unlocking the Power of the Focused Mind*, Wisdom Publications, 2006; Ricard, M., *The Art of Meditation*.
9. This stems from the fact that the brain is always involved in dealing with consciously perceived stimulus and does not have enough attentive resources to deal with stimuli that follow. The term “attentional blink” is given to the inability to deal with the images that follow. The most surprising discovery was that experienced meditators, even if they were older (attentional blink increases with age because the mechanisms of attention become slower) had remarkably short attentional blinks. One 65-year-old meditator, in particular, didn't have any at all, and perceived all the stimuli, even though they went by very quickly (unpublished results of research carried out at the

laboratories of Anne Treisman and Jonathan Cohen at Princeton University). Heleen Slagter and Antoine Lutz have also shown that after three months of intensive training in meditation on full awareness, attentional blink was considerably reduced. Slagter, H. A., Lutz, A., Greischar, L. L., Francis, A. D., Nieuwenhuis, S., Davis, J. M., & Davidson, R. J. (2007). Mental training affects distribution of limited brain resources. *PLoS Biology*, 5(6), 138.

10. Gamma waves have rapid oscillation frequencies between 25 and 42 Hz.
11. The first of these articles: Lutz, A., Greischar, L. L., Rawlings, N. B., Ricard, M., & Davidson, R. J. (2004). Long-term meditators self-induce high-amplitude gamma synchrony during mental practice. *Proceedings of the National Academy of Sciences of the United States of America*, 101(46), 16369.
12. Lutz, A., Greischar, L. L., Perlman, D. M., & Davidson, R. J. (2009). BOLD signal in insula is differentially related to cardiac function during compassion meditation in experts vs. novices. *Neuroimage*, 47(3), 1038–1046.
13. Other studies suggest that lesions in the amygdala disturb the emotional aspect of empathy, without affecting its cognitive aspect. See Hurlemann, R., Walter, H., Rehme, A. K., *et al.* (2010). Human amygdala reactivity is diminished by the b-noradrenergic antagonist propanolol. *Psychol. Med*, 40, 1839–1848.
14. Lutz, A., Brefczynski-Lewis, J., Johnstone, T., & Davidson, R. J. (2008). Regulation of the neural circuitry of emotion by compassion meditation: Effects of meditative expertise. *PLoS One*, 3(3), e1897; Klimecki, O. M., Leiberg, S., Ricard, M., & Singer, T. (2013). Differential pattern of functional brain plasticity after compassion and empathy training. *Social Cognitive and Affective Neuroscience*, doi:10.1093/scan/nst060.
15. Fredrickson, B. L., Cohn, M. A., Coffey, K. A., Pek, J., & Finkel, S. M. (2008). Open hearts build lives: Positive emotions, induced through loving-kindness meditation, build consequential personal resources. *Journal of Personality and Social Psychology*, 95(5), 1045. The subjects studied have trained according to the Buddhist meditation on *metta*, the Pali word for altruistic love.
16. Pace, T. W. W., Negi, L. T., Adame, D. D., Cole, S. P., Sivilli, T. I., Brown, T. D., Issa, M. J., *et al.* (2009). Effect of compassion meditation on neuroendocrine, innate immune and behavioral responses to psychosocial stress. *Psychoneuroendocrinology*, 34(1), 87–98.

17. Hofmann, S. G., Grossman, P., & Hinton, D. E. (2011). Loving-kindness and compassion meditation. Potential for psychological interventions. *Clinical Psychology Review*, *31*(7), 1126–1132.
18. Lazar, S. W., Kerr, C. E., Wasserman, R. H., Gray, J. R., Greve, D. N., Treadway, M. T., . . . Fischl, B. (2005). Meditation experience is associated with increased cortical thickness. *Neuroreport*, *16*(17), 1893. This growth in volume is caused by an increase of areas of gray matter that contain inter-neural connections and are linked to the process of learning. The number and size of synapses and dendritic ramifications increase phenomena also observed in other forms of training and learning. The term “neuropil” is given to the areas of gray matter situated between neuronal cell bodies, glial cell bodies, and blood vessels. Neuropil is constituted by a complex web of a multiplicity of neuronal cytoplasmic continuations (axons and dendrites) and glials, of varying caliber.
19. Especially in regions associated with sensory perception, emotional and cognitive regulation, and production of neurotransmitters that affect moods, the posterior cingulate cortex, the insula, the temporal parietal junction, the cerebellum, and the brainstem (which produces noradrenaline). See Hölzel, B., *et al.* (2011); Hölzel, B. K., Carmody, J., Evans, K. C., Hoge, E. A., Dusek, J. A., Morgan, L., Pitman, R. K., *et al.* (2010). Stress reduction correlates with structural changes in the amygdala. *Social Cognitive and Affective Neuroscience*, *5*(1), 11–17; Hölzel, B. K., Carmody, J., Vangel, M., Congleton, C., Yerramsetti, S. M., Gard, T., & Lazar, S. W. (2011). Mindfulness practice leads to increases in regional brain gray matter density. *Psychiatry Research: Neuroimaging*, *191*(1), 36–43.
20. Goleman, D., and the Dalai Lama, *Destructive Emotions: A Scientific Dialogue with the Dalai Lama*, pp. 14–15.
21. Weng, H. Y., Fox, A. S., Shackman, A. J., Stodola, D. E., Caldwell, J. Z. K., Olson, M. C., Rogers, G., & Davidson R. J. (in press). Compassion training alters altruism and neural responses to suffering. *Psychological Science*. NIHMSID: 440274. One can predict the degree of prosocial behavior by simply observing differences of brain activity in the amygdala.
22. Leiber, S., Klimecki, O., & Singer, T. (2011). Short-term compassion training increases prosocial behavior in a newly developed prosocial game. *PloS One*, *6*(3), e17798.
23. Condon, P., Desbordes, G., Miller, W., DeSteno, D., Hospital, M. G., & DeSteno, D. (n.d.). Meditation increases compassionate responses

- to suffering, *Psychological Science*. Retrieved from <http://daviddesteno.com/page5/files/Condon.etal.2013.pdf>.
24. Rudman, L. A., Ashmore, R. D., & Gary, M. L. (2001). "Unlearning" automatic biases: The malleability of implicit prejudice and stereotypes. *Journal of Personality and Social Psychology*, *81*(5), 856–868.
 25. Dasgupta, N., & Greenwald, A. G. (2001). On the malleability of automatic attitudes: Combating automatic prejudice with images of admired and disliked individuals. *Journal of Personality and Social Psychology*, *81*(5), 800–814.
 26. Hutcherson, C. A., Seppala, E. M., & Gross, J. J. (2008). Loving-kindness meditation increases social connectedness. *Emotion*, *8*(5), 720–724.
 27. Kang, Y., Gray, J. R., & Dovidio, J. F. (2013). The nondiscriminating heart: Lovingkindness meditation training decreases implicit bias against stigmatized outgroups. *Journal of Experimental Psychology*; doi:10.1037/a0034150.
 28. The activity of the amygdala and the anterior insulate cortex is markedly weaker among meditators than novices.
 29. Lutz, A., McFarlin, D. R., Perlman, D. M., Salomons, T. V., & Davidson, R. J. (2012). Altered anterior insula activation during anticipation and experience of painful stimuli in expert meditators. *NeuroImage*; Perlman, D. M., Salomons, T. V., Davidson, R. J., & Lutz, A. (2010). Differential effects on pain intensity and unpleasantness of two meditation practices. *Emotion*, *10*(1), 65.
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35. Goleman, D., and the Dalai Lama, *Destructive Emotions, op. cit.*, pp. 26–27.