

CONTENTS

Preface to the second edition vi

Introduction 1

Acknowledgements 5

Chapter One

The Emerging Landscape 7

Chapter Two

The Great Divide 47

Chapter Three

Beneath the Surface 81

Chapter Four

A Changeable Climate 125

Chapter Five

A World of One's Own 171

Chapter Six

Crossing the Chasm 223

Chapter Seven

States of Mind 259

Chapter Eight

Higher Ground 295

References 337

Bibliography 354

Index 364

REFERENCES

Chapter One

1. George Coombe, *Elements of Phrenology* (MA, Marsh, Capen and Lyon, 1834)
2. Itzhak Fried, 'Electrical current stimulates laughter', *Nature*, 391:6668 (1998), 650
3. Carlyle Jacobsen and John Fulton, Yale University, lecture at the Second International Congress of Neurology, London, 1935
4. Edward Shorter, *A History of Psychiatry; From the Era of the Asylum to the Age of Prozac* (New York, John Wiley, 1997), 228
5. Ibid.
6. H. Mayberg, A. Lozano, V. Voon, H. McNeely, D. Seminowicz, C. Hamani, J. Schwalb, S. Kennedy. *Brain Stimulation for Treatment-Resistant Depression*. *Neuron*, 45 (2005), 651–660
7. B. D. Greenberg, D. A. Malone, G. M. Friehs, A. R. Rezai, C. S. Kubu, P. F. Malloy, S. P. Salloway, M. S. Okun, W. K. Goodman & S. A. Rasmussen. *Three-Year Outcomes in Deep Brain Stimulation for Highly Resistant Obsessive-Compulsive Disorder*. *Neuropsychopharmacology* 31 (2006), 2384–2393
8. M. A. Persinger. *The Neuropsychiatry of Paranormal Experiences*. *The Journal of Neuropsychiatry & Clinical Neurosciences*. 13 (2001), 515–524
9. E. S. Bromberg-Martin & O. Hikosaka. *Midbrain Dopamine Neurons Signal Preference for Advance Information about Upcoming Rewards*. *Neuron*. 63 (2009), 119–126
10. R. Marsh, A. J. Gerber & B. S. Peterson. *Neuroimaging studies of normal brain development and their relevance for understanding childhood neuropsychiatric disorders*. *Journal of the American Academy of Child and Adolescent Psychiatry*. 47 (2008), 1233–1251
11. Daniel Pendick, 'The New Phrenologists', *New Scientist*, 155:2091 (1997), 34–47

12. J. S. Peper, R. M. Brouwer, D. I. Boomsma, R. S. Kahn & H. E. Hulshoff Pol. *Genetic Influences on Human Brain Structure: A Review of Brain Imaging Studies in Twins*. *Human Brain Mapping*. 28 (2007), 464–473
13. F. N. Haque, I. I. Gottesman & A. H. C. Wong. *Not Really Identical: Epigenetic differences in Monozygotic Twins and Implications for Twin Studies in Psychiatry*. *American Journal of Medical Genetics Part C: Seminars in Medical Genetics* 151C (2009), 136–141
14. J.M. Tanner, *Foetus into Man; Physical Growth from Conception to Maturity* (Ware, Castlemead Publications, 1989), 113
15. British Nutrition Foundation, Institute of Food Research report, January 1998
16. G. K. Beauchamp & J. A. Mennella. *Early Flavor Learning and its Impact on Later Feeding Behaviour*. *Journal of Pediatric Gastroenterology and Nutrition*. 48 (2009), 25–30
17. S. Baron-Cohen, S. I. Lutchmaya & R. Knickmeyer. *Prenatal Testosterone in Mind: Amniotic Fluid Studies – the effect of prenatal levels of testosterone on development and behavior up to age 4*. MIT Press, 2006
18. R. Seidl, B. Bidmon, M. Bajo, B. C. Yoo, N. Cairns, E. C. LaCasse & G. Lubec. *Evidence for Apoptosis in the Fetal Down Syndrome*. *Journal of Child Neurology*. 16 (2001), 438–442
19. S. J. M. C. Palmen, H. van Engeland, P. R. Hof & C. Schmitz. *Neuropathological Findings in Autism*. *Brain*. 127 (2004)
20. Joseph LeDoux, *The Emotional Brain* (New York, Simon and Schuster, 1996)
21. Ibid.
22. P. O. McGowan, A. Sasaki, A. C. D. Alessio, S. Dymov, B. Labonte, M. Szyf, G. Turecki & M. J. Meaney. *Epigenetic regulation of the glucocorticoid receptor in human brain associates with childhood abuse*. *Nature Neuroscience*. 12 (2009), 342–348
23. Tanner, *Foetus into Man*
24. A. D. Friederici. *The neural basis of language development and its impairment*. *Neuron*. 52 (2006), 941–952

25. The Edwin Smith Surgical papyrus, discovered in Luxor, 1862
26. M. Beckman. *Crime, Culpability and the Adolescent Brain*. Neuroscience. 305 (2004), 596–599
27. C.D Frith, K.J. Friston, P.F. Liddle, & R.S. J. Frackowiak, Willed action and the prefrontal cortex in man: a study with PET. Proceedings of the Royal Society of London, Series B, 244, (1991) 241–246
28. J & B. Wilgus. Face to Face with Phineas Gage. Journal of the History of the Neurosciences . 18 (2009) 340–345
29. J.M. Harlow, 'Recovery from the passage of an iron bar through the head', Publications of the Massachusetts Medical Society, 1868, cited in Antonio R. Damasio, *Descartes' Error: Emotion, Reason and the Human Brain* (London, Picador, 1995)
30. W. Penfield and P. Perot, 'The brain's record of auditory and visual experience', *Brain*, 86 (1963), 595–696

Chapter Two

1. J. P. Szaflarski, S. K. Holland, V. J. Schmithorst & A. W. Byars. *An fMRI study of language lateralization in children and adults*. Human Brain Mapping. 27 (2006) 202–212
2. Sally P. Springer and Georg Deutsch (eds.), *Left Brain/Right Brain*, 4th edn (New York, W.H. Freeman, 1993)
3. H. W. Huang, C. L. Lee & K. D. Federmeier. *Imagine that! ERPS provide evidence for distinct hemispheric contributions to the processing of concrete and abstract concepts*. Institute of Neuroscience. 49 (2009), 1116–1123
4. Marthe J. Farah, *Visual Agnosia: Disorders of Object Recognition and What They Tell Us About Normal Vision* (Cambridge, MA, MIT Press, 1991)
5. R.C. Gur et al, 'Differences in the distribution of gray and white matter in human cerebral hemispheres', *Science*, 207:4436 (1980), 1226–8
6. M. A. S. Boksem, R. Smolders & D. De Cremer. *Social power and approach-related neural activity*. Social cognitive and affective neuroscience. 10 (2009), 1–5

7. M. Hobbs, 'A randomized controlled trial of psychological debriefing for victims of road traffic accidents', *British Medical Journal*, 313:7070 (1996), 1438–9
8. R. A. Mayou, A. Ehlers & M. Hobbs. *Psychological debriefing for road traffic accident victims. Three-year follow-up of a randomised controlled trial*. *British Journal of Psychiatry*. 176 (2000), 589–93
9. T. Ohnishi, H. Matsuda, T. Asada, M. Arugal, M. Hirakatal, M. Nishikawa, A. Katoh & E Imabayashi. *Functional Anatomy of Musical Perception in Musicians*. *Cerebral Cortex*. 11 (2001), 754–760
10. Michael S. Gazzaniga, *Nature's Mind: The Biological Roots of Thinking, Emotions, Sexuality, Language and Intelligence* (Harmondsworth, Penguin Books, 1992)
11. Richard Nisbett and Timothy Wilson, 'Telling more than we can know – verbal reports on mental processes', *Psychological Review*, 84 (1977), 231–59
12. R.W. Sperry, 'Hemisphere disconnection and unity in conscious awareness', *American Psychologist*, 23 (1968), 723–33
13. Alan J. Parkin, *Explorations in Cognitive Neuropsychology* (Oxford, Blackwell, 1996)
14. Alan J. Parkin, 'The alien hand', in Peter W. Halligan and John C. Marshall (eds.), *Method in Madness: Case Studies in Cognitive Neuropsychiatry* (Hove, Psychology Press, 1996)
15. Parkin in Halligan and Marshall
16. R. Leiguardia, S. Starkstein, M. Nogues, M. Berthier and R. Arbelaz, 1993, cited in Halligan and Marshall
17. Savic et al, *PET and MRI show differences in cerebral asymmetry and functional connectivity between homo- and heterosexual subjects*, *PNAS*, pp.106 (51), (2009)
18. Joseph LeDoux, D.H. Wilson and Michael Gazzaniga, 'A divided mind', *Annals of Neurology*, 2 (1977), 417–21
19. R.W. Sperry, 'Brain bisection and consciousness', in John C. Eccles (ed.), *How the Self Controls Its Brain* (New York, Springer-Verlag, 1966)
20. R.W. Sperry, 'Hemispheric specialization: scope and limits', in F.O. Schmitt and Frederic G. Worden (eds.)
21. P.G. Hepper et al, 'Handedness in the human foetus',

- Neuropsychologia*, 29:11 (1991), 1107–11
22. Luigi Gedda, Director, Gregor Mendel Institute, Rome, quoted by Lawrence Wright in 'Double mystery', *New Yorker*, 7 August 1995
 23. C. Francks. *LRRTM1 on chromosome 2p12 is a maternally suppressed gene that is associated paternally with handedness and schizophrenia*. *Molecular Psychiatry*. 12 (2007), 1129–1139
 24. S. Coren and D.F. Helpfer, 'Left-handedness: a marker for decreased survival fitness', *Psychological Bulletin*, 109 (1991), 90–106
 25. 1. C. S. Ruebeck, J. E. Harrington & R. Moffitt. *Handedness and Earnings*. National Bureau of Economic research Working Paper No. 12387* July 2006

Chapter Three

1. Peter Chadwick, *Schizophrenia – the Positive Perspective* (London, Routledge, 1997)
2. E. Gerard & B. S. Peterson. *Developmental processes and brain imaging studies in Tourette syndrome*. *Journal of Psychosomatic Research*. 55 (2003), 13–22
3. R. S. Baltimore & H. B. Jenson. *Infectious diseases and immunization: Pediatric autoimmune neuropsychiatric disorders associated with streptococci (PANDAS)*. *Current Opinion in Pediatrics*. 21 (2009), 127–130
4. Richard Restak, *Brainscapes: An Introduction to What Neuroscience Has Learned About the Structure, Function and Abilities of the Brain* (New York, Hyperion, 1995), 106
5. Tourette newsgroup posting on the Internet, January 1998
6. Obsessive-compulsive disorder (OCD) newsgroup posting on the Internet, January 1998
7. Restak, *Brainscapes*, 107
8. OCD newsgroup posting on the Internet, January 1998
9. Frederick Toates, *Obsessional Thoughts and Behaviour* (Thorsons, 1990)
10. Phyllida Brown, 'Over and over', *New Scientist*, 155:2093 (1997), 27
11. Kenneth Blum et al, 'Reward deficiency syndrome,

- American Scientist*, 84 (1996)
12. John J. Ratey and Catherine Johnson (eds.), *Shadow Syndromes* (London, Bantam Press, 1997)
 13. C-Y. Li, X. Mao, L. Wei. *Genes and (Common) Pathways Underlying Drug Addiction*. PLoS Computational Biology. 4 (2008), 28–34
 14. WHO Global Obesity forecast, 2005
 15. A. Rothenberger et al, 'What happens to electrical brain activity when anorectic adolescents gain weight', *European Archives of Psychiatry and Clinical Neurosurgery*, 240:3 (1991), 144–7
 16. Wagne et al: *Altered Reward Processing in Women Recovered from Anorexia Nervosa* Am J Psychiatry 164:1842–1849, December 2007
 17. Kaye Weltzin, 'Serotonin activity in anorexia and bulimia', *Journal of Clinical Psychiatry*, 52, supplement (1991), 41–8
 18. Wallin G. van der Ster et al, 'Selective dieting patterns among anorectics and bulimics', *European Eating Disorders Review*, 2 (1994), 221–32
 19. Y. Oomura, S. Aou, Y. Koyama and H. Yoshimatsu, 'Central control of sexual behaviour', *Brain Research Bulletin*, 20 (1988), 863–870
 20. B. R. Komisaruk, C. Beyer & B. Whipple. *Orgasm*. The Psychologist. Volume 21 Part 2 February 2008
 21. B. R. Komisaruk, C. Beyer-Flores & B. Whipple. *The science of orgasm*. Baltimore, MD: Johns Hopkins University Press. (2006)
 22. A. Bartels & S. Zeki. *The Neural Correlates of Maternal and Romantic Love*. Neuroimage. 21 (2004), 1155–1166
 23. Jerome Goodman, Columbia University, quoted by Michael S. Gazzaniga, *Nature's Mind: The Biological Roots of Thinking, Emotions, Sexuality, Language and Intelligence* (Harmondsworth, Penguin Books, 1992), 155
 24. Simon LeVay, *The Sexual Brain* (Cambridge, MA, MIT Press, 1994), 102
 25. Ibid.
 26. Savic et al PET and MRI show differences in cerebral asymmetry and functional connectivity between homo- and heterosexual subjects PNAS July 8, 2008 vol. 105 no. 27 9403–9408

27. J. R. Georgiadis, R. Kortekaas, R. Kuipers, A. Nieuwenburg, J. Pruim, A. A. T. S. Reinders & G. Holstege. *Regional cerebral blood flow changes associated with clitorally induced orgasm in healthy women*. *European Journal of Neuroscience*. 24 (2006), 3305–3316
28. D. L. Cohen & J. Belsky. *Avoidant romantic attachment and female orgasm: testing an emotion-regulation hypothesis*. *Attachment & human development*. 10 (2008), 1–10
29. Louis R. Franzini and John Grossberg (eds.), *Eccentric and Bizarre Behaviours* (New York, John Wiley, 1995)
30. F.R. Farnham, 'Pathology of love', *The Lancet*, 350:9079 (1997), 710
31. R. Swerdlow & J. Burns. University of Virginia in Charlottesville, USA case report to American Neurology Association meeting New York, October 2002
32. Susan Greenfield (ed.), *The Human Mind Explained: The Control Centre of the Living Machine* (London, Cassell, 1996)
33. A. Nystrand, 'New discoveries on sex differences in the brain', *National Institute of Ageing, NIH Bethesda, Lakartidningen* 93:21 (1996), 2071–3

Chapter Four

1. Antonio R. Damasio, *Descartes' Error: Emotion, Reason and the Human Brain* (London, Picador, 1995)
2. J. Coid, *Prevalence and correlates of psychopathic traits in the household population of Great Britain*, *International Journal of Law and Psychiatry*, Volume 32, Issue 2, pp. 65–73 (2009)
3. D. Pitcher, L. Garrido, V. Walsh, and B. C. Duchaine, *Transcranial Magnetic Stimulation Disrupts the Perception and Embodiment of Facial Expressions*, *The Journal of Neuroscience*, (September 3, 2008), 28(36):8929–8933
4. Jackson et al, *How do we perceive the pain of others? A window into the neural processes involved in empathy*, *NeuroImage*, Volume 24, Issue 3, pp. 771–779 (2005)
5. Tamietto et al. *Proc. Natl Acad. Sci. USA* <http://dx.doi:10.1073/pnas.0908994106> (2009)

6. Paul Ekman, quoted in *New Scientist* 'Emotions' supplement, 150:2027 (1996), 11
7. Paul Frank and Paul Ekman, 'Behavioural markers and recognizability of smile of enjoyment', *Journal of Personality and Social Psychology*, 64:1 (1993), 83–93
8. B. Kolb et al, 'Developmental changes in the recognition and comprehension of facial expression: implications for frontal lobe function', *Brain and Cognition*, 20 (1992), 74–84
9. J.S. Morris et al, 'A differential neural response in the human amygdala to fearful and happy facial expressions', letter to *Nature*, 383:6603 (1997), 812–15
10. Tranel, Gullickson, Koch, Adolphs, Cogn Neuropsychiatry (3), pp.219–32, University of Iowa College of Medicine, daniel-tranel@uiowa.edu (2006)
11. Prosopagnosia newsgroup posting on the Internet, January 1998
12. Ekman, *New Scientist*
13. Ibid.
14. U. Hess et al, 'The facilitative effect of facial expression on the self-generation of emotion', *International Journal of Psychophysiology*, 12:3 (1992), 251–65
15. Interview on *Woman's Hour*, BBC Radio 4, 25 February 1998
16. Ibid.
17. A. Raine, *From Genes to Brain to Antisocial Behaviour*, Current Directions in Psychological Science, volume 17, no 5, pp 323–328
18. *Can you be blamed for sleepwalking crimes?*, *New Scientist*, 24 November 2009
19. Claudio Bassetti, *The Lancet*, *SPECT during sleepwalking*, Vol. 356, Issue 9228, pages 484–485, (August 2000)
20. E. A. Murray, *The amygdala, reward and emotion*, Trends in Cognitive Sciences
Volume 11, Issue 11, pp. 489–497, (2007)
21. Milad et al, *Fear extinction in rats: Implications for human brain imaging and anxiety disorders*, *Biological Psychology*, Volume 73, Issue 1, pp. 61–71 (2006)
22. Andrew Young and Kate Leafhead, 'Cotard's delusion' in Peter W. Halligan and John C. Marshall (eds.), *Method in*

- Madness: Case Studies in Cognitive Neuropsychiatry* (Hove, Psychology Press, 1996)
23. H. Forstl and B. Beats, 'Charles Bonnet's description of Cotard's delusion and reduplicative paramnesia in an elderly patient (1788)', *British Journal of Psychiatry*, 160 (1992), 416–18
 24. Drevets et al, *Subgenual prefrontal cortex abnormalities in mood disorders* *Nature* 386, pp. 824–7, (1997)
 25. Mayberg HS, Brannan SK, Tekell JL, Silva JA, Mahurin RK, McGinnis S, Jerabek PA. *Regional metabolic effects of fluoxetine in major depression: serial changes and relationship to clinical response*, *Biol Psychiatry* 48, pp 830–43 (2000)
 26. Mayberg et al, *Deep brain stimulation for treatment-resistant depression*, *Neuron* 45, pp. 651–60, (2005)
 27. Michael Posner and Marcus E. Raichle (eds.), *Images of Mind* (New York, W.H. Freeman, 1994)
 28. Wayne Drevets et al, 'Subgenual prefrontal cortex abnormalities in mood disorder', letter to *Nature*, 386: 6527 (1997), 824–7

Chapter Five

1. Daniel J. Levitin. *This is Your Brain on Music*. Atalantic Books. 2008
2. P. Schneider, M. Scherg, H. G. Dosch, H. J. Specht, A. Gutschalk & A. Rupp. *Morphology of Heschl's gyrus reflects reflects enhanced activity in the auditory cortex of musicians*. *Nature Neuroscience*. 5 (2002), 688–694
3. D. L. Strait, N. Kraus, E. Skoe & R. Ashley. *Musical experience and neural efficiency – effects of training on subcortical processing of vocal expressions of emotion*. *European Journal of Neuroscience*. 29 (2009), 661–668
4. S. Witelson, D. Kigar, T. Harvey. *The exceptional brain of Albert Einstein*. *The Lancet*. 353 (1999), 2149–2153
5. A.M. Sillito in Richard L. Gregory (ed.), *The Oxford Companion to the Mind* (Oxford University Press, 1987)
6. Spector et al, *Synaesthesia, a new approach to understanding the development of perception*, *Developmental*

- Psychology (2009) Vol. 45, pp175–189
7. J. Ward, D. Thompson-Lake, R. Ely & F. Kaminski. *Synaesthesia, creativity and art, what is the link?* British Journal of Psychology. 99 (2008), 127–141
 8. M. J. Banissy & J. Ward. *Mirror-touch synesthesia is linked with empathy.* Nature Neuroscience. 10 (2007), 815–817
 9. L. B. Merabat, L. Battelli, S. Obretenova, S. Maguire, P. Meijer & A. Pascual-Leone. *Recruitment of visual cortex for sound encoded object identification in the Blind.* NeuroReport. 20 (2009), 132 – 138
 10. K. Patterson and J. Hodges in Alan D. Baddeley et al (eds.), *Handbook of Memory Disorders* (Chichester, John Wiley, 1996)
 11. Glyn W. Humphreys and M. Jane Riddoch, *The Fractionation of Visual Agnosia in Visual Object Processing* (London, Lawrence Erlbaum Associates, 1997)
 12. L.D. Kartsounis and Tim Shallice, 'Modality specific semantic knowledge loss for unique items', *Cortex*, 32:1 (1996), 109–19
 13. G. Gainotti et al, *Cognitive Neuropsychology*, 13 :3 (1996), 357–89
 14. Prosopagnosia website
 15. J.E. McNeil and E.K. Warrington, 'Prosopagnosia: a reclassification', *Quarterly Journal of Experimental Psychology, A*, 43:2 (1991), 267–87
 16. Tim Shallice, *From Neuropsychology to Mental Structure* (Cambridge University Press, 1989), 390
 17. G. Gianotti. *Face familiarity, the right temporal lobe and the possible underlying neural mechanisms.* Brains Research Reviews. 56 (2007) 214–235
 18. G. Blount, 'Dangerousness of patients with Capgras syndrome', *Nebraska Medical Journal*, 71 (1986), 207
 19. T. Canli. *Functional Brain Mapping of Extraversion and Neuroticism: Learning From Individual Differences in Emotion Processing.* Journal of Personality. 72 (2004), 1105–1132
 20. V. S. Ramachandran & E. L. Altschuler. *The Use of Visual feedback, in particular mirror visual feedback, in restoring brain function.* Brain. 132 (2009), 1693–1710
 21. R. Melzack. *Phantom limbs and the concept of a neuromatrix.* Trends in Neurosciences. 13 (1990), 88–92

22. R. Melzack, 'Phantom limbs', *Scientific American* supplement, 7:1 (1997), 84
23. Steven Rose, *The Making of Memory: From Molecules to Mind* (London, Bantam Press, 1993), 103
24. Morton Schatzman, *The Story of Ruth* (London, Gerald Duckworth, 1980)
25. Oliver Sacks, *The Man Who Mistook His Wife for a Hat* (New York, Summit Books, 1985), 135
26. C.D. Frith, 'Functional imaging and cognitive abnormalities', *The Lancet*, 346:8975 (1995), 615–20
27. Louis R. Franzini and John Grossberg (eds.), *Eccentric and Bizarre Behaviours* (New York, John Wiley, 1995)
28. Paul Sieveking, 'Then I saw her face', *Sunday Times*, 2 November 1997
29. D. Westen et al. Emory University, report to the Annual Conference of the Society for Personality and Social Psychology Jan. 28, 2006

Chapter Six

1. Oliver Sacks, *Seeing Voices* (London, Picador, 1991), 40
2. G. Konopka, J. M. Bomar, K. Winden, G. Coppola, Z. O. Jonsson, F. Gao, S. Peng, T. M. Preuss, J. A. Wohlschlegel & D. H. Geschwind. *Human-specific transcriptional regulation of CNS development genes by FOXP2*. *Nature*. 462 (2009), 213–217
3. J. F. Battey et al. *Words Gestures are Translated by same brain regions*. *Proceedings of the National Academy of Sciences*. (2009)
4. Robert Finn, 'Different minds', *Discovery*, June 1991
5. Ursula Bellugi, 'Williams syndrome and the brain', *Scientific American*, December 1997, 42–7
6. Keysers et al. *Neuron*. 42 (2004), 335–346. (image ref)
7. M. Iacoboni, I. Molnar-Szakacs, V. Gallese, G. Buccino, J. C. Mazziotta & G. Rizzolatti. *Grasping the Intentions of Others with One's Own Mirror Neuron System*. *PloS Biology*. 3 (2005), 1–7
8. Uta Frith, 'Autism', *Scientific American*, special issue, April 1997, 92

9. M. Dapretto et al. *Nature Neuroscience*. 9 (2006), 28–31
10. Hadjikhani et al. *Neuroimage*. 22 (2004), 1141–1150
11. Paul Fletcher et al, 'Other minds in the brain – a functional imaging study', *Cognition*, 57 (1995), 109–28
12. Simon Baron-Cohen, 'Is there a language of the eyes?', *Visual Cognition*, 4:3 (1997), 311–31
13. Lorna Wing, 'The autistic spectrum', *The Lancet*, 350:9093 (1997), 1762
14. John J. Ratey and Catherine Johnson (eds.), *Shadow Syndromes* (London, Bantam Press, 1997), 230
15. W. Olsho, 'Infant frequency discrimination', *Infant Behaviour and Development*, 7 (1984), 27–35
16. Jaak Panksepp, reported in *New Scientist* 'Emotions' supplement, 150:2027 (1996)
17. A.C. North et al, 'In-store music affects product choice', *Nature*, 390:6656 (1997), 132
18. D. Strait, E. Skoe, R. Ashley & N. Kraus. *Musical Experience Promotes Subcortical Efficiency in Processing Emotional Vocal Sounds*. *Annals of the New York Academy of Sciences: Neurosciences and Music III*. 1169 (2009), 209–213
19. V. Gazzola, L. Aziz-Zadeh & C. Keysers. *Empathy and the somatotopic auditory mirror system in humans*. *Current Biology*. 16 (2006), 1824–1829
20. M. Bangert, T. Peschel, G. Schlaug, M. Rotte, D. Drescher, H. Hinrichs, H. J. Heinze & E. Altenmüllera. *Shared networks for auditory and motor processing in professional pianists: Evidence from fMRI conjunction*. *NeuroImage*. 30 (2006), 917–926
21. B. Mampe, A.D. Friederici, A. Christophe & A. Wermke. *Newborns' cry melody is shaped by their native language*. *Current Biology*. 19 (2009)
22. G.A. Ojemann, 'Subcortical language' in H.A. Whitaker (ed.), *Studies in Neurolinguistics*, vol. 1 (New York Academic Press, 1976)
 - (1) G.A. Donnan et al, 'Identification of brain region for co-ordinating speech articulation', *The Lancet*, 349:9047 (1997), 221;
 - (2) J.R. Binder et al, 'Human brain areas identified by fMRI', *Journal of Neuroscience*, 17:1 (1997), 353–62

23. D.V.M. Bishop, 'Listening out for subtle deficits', *Nature*, 387:6629 (1997), 129
24. J. Graham Beaumont (ed.), *The Blackwell Dictionary of Neuropsychology* (Oxford, Blackwell, 1997)
25. Alan J. Parkin, *Explorations in Cognitive Neuropsychology* (Oxford, Blackwell, 1996), 133
26. H. Goodglass and D. Kaplan, *The Boston Diagnostic Aphasia Examination* (Philadelphia, Lea and Febiger, 1983)
27. M. Kinsbourne and E.K. Warrington, 'Jargon aphasia', *Neuropsychologia*, 1 (1963), 27–37
28. Christine Temple, *The Brain* (Harmondsworth, Penguin Books, 1993), 90
29. Stephen M. Kosslyn and Oliver Koenig, *Wet Mind: The New Cognitive Neuroscience* (New York, Free Press, 1992)
30. Ralph, Sage and Ellis, 'Word meaning blindness: a new form of acquired dyslexia', *Cognitive Neurology* 13:5 (1996), 617–39
31. E. Paulesu, U. Frith et al, 'Is development dyslexia a disconnection syndrome?', *Brain*, 119 (1996), 143–7
32. Margaret Donaldson, *Human Minds: An Exploration* (Harmondsworth, Penguin Books, 1992)
33. Russ Rymer, *Genie: A Scientific Tragedy* (Harmondsworth, Penguin Books, 1993)
34. Oliver Sacks, *Seeing Voices*
35. K.H.S. Kim et al, 'Distinct cortical areas associated with native and second languages', letter to *Nature*, 388:6538 (1997), 171

Chapter Seven

1. A. Takashima, K. M. Petersson, F. Rutters, I. Tendolkar, O. Jensen, M. J. Zwartz, B. L. McNaughton & G. Fernandez. *Declarative memory consolidation in humans: A prospective functional magnetic resonance imaging study*. PNAS 103 (2006), 756–761
2. K. Nader & O. Hardt. *A Single Standard for memory: the case for reconsolidation*. Nature Reviews Neuroscience. 10 (2009), 224–234

3. Farana Vargha-Khadem et al, 'Differential effects of early hippocampal pathology on episodic and semantic memory', *Science*, 277:5324 (1997), 376–80
4. E. Maguire et al, 'Recalling routes around London: activation of the right hippocampus in taxi drivers', *Journal of Neuroscience*, 17 (1997), 7103–10
5. Elizabeth F. Loftus, *The Myth of Repressed Memory* (New York, St Martin's Press, 1994)
6. J. Ost, P-A. Granhag, J. Udell, E. R. af Hjelmsater. *Familiarity breeds distortion: The effects of media exposure on false reports concerning media coverage of the terrorist attacks in London on 7th July 2005*. *Memory*. 16 (2008), 76–85
7. David Schacter et al, 'Recognition memory for recently spoken words', *Neuron*, 17:2 (1996), 267–74
8. Alan D. Baddeley et al (eds.), *Handbook of Memory Disorders* (Chichester, John Wiley, 1996)
9. D. Stuss and D. Benson, 'Neuropsychological studies of the frontal lobes', *Psychological Bulletin*, 95, 3–28
10. Yadin Dudai, *The Neurobiology of Memory: Concepts, Findings, Trends* (Oxford University Press, 1989)
11. S. Harris. *Functional Neuro-imaging of Belief, Disbelief, and Uncertainty*. *Annals of Neurology*. 63 (2008), 141–147
12. Philip J. Hilts, *Memory's Ghost: The Nature of Memory and The Strange Tale of Mr M* (New York, Simon and Schuster, 1996)
13. Baddeley et al, *Handbook of Memory Disorders*
14. J. C. Yang, G-W. Jeong, M-S. Lee, H-K. Kang, S-J. Eun, Y-K. Kim & Y-H. Lee. *Functional MR Imaging of Psychogenic Amnesia: A Case Report*. *Korean Journal of Radiology*. 6 (2005), 196–199
15. A. Costello, P. C. Fletcher, R. J. Dolan, C. D. Frith & T. Shallice. *The origins of forgetting in a case of isolated retrograde amnesia following a haemorrhage: evidence from functional imaging*. *Neurocase*. 4 (1998), 437–446
16. Baddeley et al, *Handbook of Memory Disorders*
17. L.M. Williams, 'Recovered memories of abuse in women with documented sexual victimization histories', *Journal of Traumatic Stress*, 8, 649–73
18. J.D. Bremner et al, 'MRI-based measurement of hip-

- pocampal volume in post-traumatic stress disorder', *Biological Psychiatry*, 41 (1997), 23–32
19. G. Harrison, Pope, Jr., S. Barry, A. Bodkin & J. I. Hudson. *Tracking Scientific Interest in the Dissociative Disorders, a Study of Scientific Paper outputs 1984–2003*. *Psychotherapy and Psychosomatics*. 75 (2006) 19–24
 20. R. Carter, *Multiplicity – the new science of Personality*, Little Brown, (2008)
 21. S. Reinders, E. R. S. Nijenhuis, A. M. J. Paans, J. Korf, A. T. M. Willemsen & J. A. den Boer. *One Brain, Two selves*. *NeuroImage*. 20 (2003) 2119–2125
 22. G. E. Tsai, D. Condie, M. T. Wu & I. W. Chang. *Functional Magnetic Resonance Imaging of Personality Switches in a Woman with Dissociative Identity Disorder*. *Harvard Review of Psychiatry*. 7 (1999), 119–122
 23. A. Hopper, J. Ciorciari, G. Johnson, J. Spensley, A. Sergejew & C. Stough. *EEG Coherence and Dissociative Identity Disorder*. *Journal of Trauma and Dissociation*. 3 (2002), 75–88

Chapter Eight

1. I. I. Goldberg. *When the Brain Loses Its Self: Prefrontal Inactivation during Sensorimotor Processing*. *Neuron*. 50 (2006), 329–339
2. M. S. Christensen, L. Kristiansen, J. B. Rowe & J. B. Nielsen. *Action-blindsight in healthy subjects after transcranial magnetic stimulation*. *PNAS*. 105 (2008), 1353–1357
3. A. Schurge, F. Pereira, A. Treisman & J. D. Cohen. *Reproducibility Distinguishes Conscious From Nonconscious Neural Representations*, *Science*. 2009
4. S. M. Doesburg, J. J. Green, J. J. McDonald & L. M. Ward. *Rhythms of Consciousness: Binocular Rivalry Reveals Large-Scale Oscillatory Network Dynamics Mediating Visual Perception*. *PLOS*. 4 (2009)
5. M. Boly, E. Balteau, C. Schnakers, C. Degueldre, G. Moonen, A. Luxen, C. Phillips, P. Peigneux, P. Maquet & S. Laureys. *Baseline brain activity fluctuations predict somatosensory perception in humans*. *M. PNAS*. 104

- (2007), 12187–12192
6. N. Makris, S. L. Buka, J. Biederman, G. M. Papadimitriou, S. M. Hodge, E. M. Valera, A. B. Brown, G. Bush, M. C. Monuteaux, V. S. Caviness, D. N. Kennedy & L. J. Seidman. *Attention and Executive Systems Abnormalities in Adults with Childhood ADHD: A DT-MRI Study of Connections*. Cerebral Cortex. 2007
 7. Lawrence Weiskrantz, *Blindsight: A Case Study and Its Implications* (Oxford, Clarendon Press, 1986)
 8. C. A. Heywood & R. W. Kentridge. *Affective blindsight?* Trends in Cognitive Sciences. 4 (2000), 125–126
 9. T. Radil. *Anosmic and Hyposmic Olfaction – a blindsight-like phenomenon*. Towards a Science of Consciousness. Abstract no 169. (2000)
 10. Daniel C. Dennett, *Consciousness Explained* (Harmondsworth, Penguin Books, 1993), 331
 11. Marshall Miles, 'A description of various aspects of anencephaly', Lafayette College, USA, <http://www.lafayette.edu/~loerc/miles.html>
 12. J.L. Barbur et al, 'Conscious visual perception without V1', *Brain*, 116 (1993), 1293–302
 13. C.D. Frith, *Schizophrenia* (Hove, Psychology Press, 1997)
 14. Kornhuber, Hans and Deeke, Luder, Hirnpotentialänderungen bei Willkürbewegungen und passiven Bewegungen des Menschen: Bereitschaftspotential und reafferente Potentiale, *Pflügers Archiv für die Physiologie des Menschen und Tiere*. 284 (1965), 1–17.
 15. B. Libet. *Do We Have Freewill?* Journal of Consciousness Studies. 6 (1999), 47–57.
 16. Michael Posner and Marcus E. Raichle (eds.), *Images of Mind* (New York, W.H. Freeman, 1994)
 17. D. Stuss in *The Blackwell Dictionary of Neuropsychology* (Oxford, Blackwell, 1997), 350
 18. E. Bisiach and C. Luzzatti, 'Unilateral neglect of representational space', *Cortex*, 14, 129–33
 19. Wayne Drevets et al, 'Subgenual prefrontal cortex abnormalities in mood disorder', letter to *Nature*, 386:6527 (1997), 824–7
 20. S.S. Ackerly and Arthur Benton, 'Report of a case of bilat-

- eral frontal lobe defect', *Publication of Association for Research in Neurology and Dental Disease*, 27, 479–504, cited in Antonio R. Damasio, *Descartes' Error: Emotion, Reason and the Human Brain* (London, Picador, 1995)
21. R.A. O'Connell, 'SPECT imaging study of the brain in acute mania and schizophrenia', *Journal of Neuroimaging*, 2 (1995), 101–4; also Ian Daly, 'Mania', *The Lancet*, 349:9059 (1997), 1157–9
 22. Itzhak Fried, 'Syndrome E', *The Lancet*, 350:9094 (1997), 1845–7
 23. François L'Hermitte, 'Human autonomy and the frontal lobes', *Annals of Neurology*, 19 (1986), 335–43
 24. *Daily Telegraph* report, 8 November 1997

PICTURE CREDITS

American Journal of Neuroradiology: page 54; Corbis/Brooks Kraft: page 202; Chris Frith: page 280; Elsevier: page 141 (both images), page 165, page 205; page 231, page 233 (top two images); page 244; MedicalRF.com/Science Photo Library: page 316; National Academy of Sciences, U.S.A: page 17, page 26; Nature Publishing Group: page 235, page 179, page 176; Pukrufus: page 31; Roger Harris/Science Photo Library: page 135, page 147.

While every effort has been made to trace copyright holders, if any have inadvertently been overlooked the publishers would be happy to acknowledge them in future editions.

BIBLIOGRAPHY

Books

- Aleksander, Igor *The World in My Mind, My Mind in the World: Key Mechanisms of Consciousness in People, Animals and Machines* (Exeter, Imprint Academic, 2007)
- Baddeley, Alan D. *Your Memory: A User's Guide* (London, Carlton Books, 2004)
- The Blackwell Dictionary of Neuropsychology* (Oxford, Blackwell, 1997)
- Blakemore, Colin *The Mind Machine* (London, BBC Books, 1988)
- Baron-Cohen, Simon et al *Understanding Other Minds: Perspectives from Autism* (Oxford, Oxford University Press, 1999)
- Broks, Paul *Into the Silent Land: Travels in Neuropsychology* (London, Atlantic Books, 2004)
- Calvin, William H. *How Brains Think* (London, Weidenfeld and Nicolson, 1997)
- Chadwick, Peter *Schizophrenia – The Positive Perspective* (London, Routledge, 1997)
- Coombe, George *Elements of Phrenology* (MA, Marsh, Capen and Lyon, 1834)
- Cytowic, Richard *Synaesthesia: A Union of the Senses* (New York, Springer-Verlag, 1989)
- Damasio, Antonio R. *Descartes' Error: Emotion, Reason and the Human Brain* (London, Picador, 1995)
- Dennett, Daniel C. *Consciousness Explained* (Harmondsworth, Penguin, 1993)
- Donaldson, Margaret *Human Minds: An Exploration* (Harmondsworth, Penguin, 1992)
- Dudai, Yadin *The Neurobiology of Memory: Concepts, Findings, Trends* (Oxford, Oxford University Press, 1989)

Eccles, John C. (ed.) *The Evolution of the Brain: Creation of the Self* (London and New York, Routledge, 1989)

Farah, Marthe J. *Visual Agnosia: Disorders of Object Recognition and What They Tell Us About Normal Vision* (Cambridge, MA, MIT Press, 1991)

Fine, Cordelia A *Mind of its Own: How the Brain Distorts and Deceives* (London, Icon Books, 2007)

Frackowiak, Richard et al (eds.) *Human Brain Function* (New York, Academic Press, 1998)

Frank, Lone *Mindfield: How Brain Science is Changing Our World* (Oxford, Oneworld, 2009)

Franzini, Louis R. and Grossberg, John (eds.) *Eccentric and Bizarre Behaviours* (New York, John Wiley, 1995)

Freeman, Walter J. *Societies of Brains: A Study in the Neuroscience of Love and Hate* (Hillsdale, NJ, Lawrence Erlbaum Associates, 1995)

Frith, Chris *Making Up the Mind: How the Brain Creates our Mental World* (Oxford, Blackwell Publishing, 2007)

Frith, Uta *Autism: Explaining the Enigma* (Oxford, Basil Blackwell, 1989)

Gardner, Howard *Frames of Mind: the Theory of Multiple Intelligences* (New York, Basic Books, 1993)

Gazzaniga, Michael S. *Nature's Mind: The Biological Roots of Thinking, Emotions, Sexuality, Language and Intelligence* (Harmondsworth, Penguin, 1992)

Goodglass, H. and Kaplan, D. *The Boston Diagnostic Aphasia Examination* (Philadelphia, Lea and Febiger, 1983)

Greenfield, Susan (ed.) *The Human Mind Explained: The Control Centre of the Living Machine* (London, Cassell, 1996)

Gregory, Richard L. (ed.) *The Oxford Companion to the Mind* (Oxford University Press, 1987)

Gregory, Richard L. *Eye and Brain*, 4th ed. (Oxford, Oxford University Press)

Halligan, Peter W. and Marshall, John C. (eds.) *Method in Madness: Case Studies in Cognitive Neuropsychiatry* (Hove,

- Psychology Press, 1996)
- Hilts, Philip J. *Memory's Ghost: The Nature of Memory and The Strange Tale of Mr M* (New York, Simon and Schuster, 1996)
- Humphreys, Glyn W. and Riddoch, M. Jane *The Fractionation of Visual Agnosia in Visual Object Processing* (London, Lawrence Erlbaum Associates, 1997)
- Kosslyn, Stephen M. and Koenig, Oliver *Wet Mind: The New Cognitive Neuroscience* (New York, Free Press, 1992)
- LeDoux, Joseph *Synaptic Self: How Our Brains Become Who We Are* (Penguin Books, 2003)
- LeVay, Simon *The Sexual Brain* (Cambridge, MA, MIT Press, 1994)
- Loftus, Elizabeth F. *The Myth of Repressed Memory* (New York, St Martin's Press, 1994)
- Luria, Aleksandr *The Mind of a Mnemonist* (London, Jonathan Cape, 1969)
- McGilchrist, Iain *The Master and his Emissary* (Yale University Press, 2010)
- Metzinger, Thomas (ed.) *Conscious Experience* (Exeter, Imprint Academic, 1999)
- Mithen, Steven *The Pre-History of the Mind* (London, Thames and Hudson, 1996)
- Morton, William H. *The Cerebral Code* (Cambridge, MA, MIT Press, 1996)
- Nabokov, Vladimir *Speak, Memory* (London, Weidenfeld and Nicolson, 1967)
- Ojemann, G.A. *Subcortical Language* in H.A. Whitaker (ed.), *Studies in Neurolinguistics*, Vol. 1 (New York, Academic Press, 1976)
- Parkin, Alan J. *Explorations in Cognitive Neuropsychology* (Oxford, Blackwell, 1996)
- Penrose, Roger *The Emperor's New Mind* (Oxford, Oxford University Press, 1989)

- Piatelli-Palmarini M. *Inevitable Illusions* (New York, John Wiley, 1994)
- Posner, Michael and Raichle, Marcus E. (eds.). *Images of Mind* (New York, W.H. Freeman, 1994)
- Ratey, John J. and Johnson, Catherine (eds.) *Shadow Syndromes* (London, Bantam Press, 1997)
- Redfield Jamison, Kay *Touched with Fire: Manic-depressive Illness and the Artistic Temperament* (New York, Free Press, 1995)
- Rose, Steven *The Making of Memory: From Molecules to Mind* (London, Bantam Press, 1993)
- Rymer, Russ *Genie: A Scientific Tragedy* (Harmondsworth, Penguin, 1993)
- Sacks, Oliver *An Anthropologist on Mars* (London, Picador, 1995)
- Sacks, Oliver *The Man Who Mistook His Wife for a Hat* (New York, Summit Books, 1985).
- Sacks, Oliver *Seeing Voices* (London, Picador, 1991)
- Schacter, Daniel, L. *The Seven Sins of Memory: How the Mind Forgets and Remembers* (New York, Mariner Books 2002)
- Schatzman, Morton *The Story of Ruth* (London, Gerald Duckworth, 1980)
- Schmitt, F.O. and Worden, Frederic G. (eds.) *Neuroscience: Third Study Program* (Cambridge, MA, MIT Press, 1974)
- Shallice, Tim *From Neuropsychology to Mental Structure* (Cambridge, Cambridge University Press, 1989)
- Shorter, Edward *A History of Psychiatry: From the Era of the Asylum to the Age of Prozac* (New York, John Wiley, 1997)
- Silk, Kenneth R. *Biological and Neurobehavioural Studies of Borderline Personality Disorder* (Washington, American Psychiatric Press, 1994)
- Springer, Sally P. and Deutsch, Georg (eds.) *Left Brain/Right Brain*, 4th ed (New York, W.H. Freeman, 1993)
- Tanner, J.M. *Foetus into Man: Physical Growth from Conception to Maturity* (Ware, Castlemead Publications, 1989)
- Temple, Christine *The Brain* (Harmondsworth, Penguin, 1993)
- Toates, Frederick *Obsessional Thoughts and Behaviour* (Thorsons, 1990)

- Weiskrantz, Lawrence *Blindsight: A Case Study and Its Implications* (Oxford, Clarendon Press, 1986)
- Wolf, Maryanne *Proust and the Squid: The Story and Science of the Reading Brain* (Harper Perennial, 2008)

Articles and Reports

- Barbur, J.L. et al 'Conscious visual perception without V1', *Brain*, 116 (1993), 1293–302
- Baron-Cohen, Simon 'Is there a language of the eyes?', *Visual Cognition*, 4:3 (1997), 311–31
- Bellugi, Ursula 'Williams syndrome and the brain', *Scientific American*, December 1997, 42–7
- Binder, J.R. et al 'Human brain areas identified by fMRI', *Journal of Neuroscience*, 17:1 (1997), 353–62
- Bishop, D.V.M. 'Listening out for subtle deficits', *Nature*, 387:6629 (1997), 129
- Bisiach, E. and Luzzatti, C. 'Unilateral neglect of representational space', *Cortex*, 14, 129–33
- Blount, G. 'Dangerousness of patients with Capgras syndrome', *Nebraska Medical Journal*, 71 (1986), 207
- Blum, Kenneth et al 'Reward deficiency syndrome', *American Scientist*, 84 (1996)
- Brambilla, Riccardo et al 'A role for the Ras signalling pathway in synaptic transmission and long-term memory', *Nature*, 390:6657 (1997), 281
- Bremner, J.D. et al 'MRI-based measurement of hippocampal volume in post-traumatic stress disorder', *Biological Psychiatry*, 41 (1997), 23–32
- British Nutrition Foundation, Institute of Food Research report, January 1998
- Brown, Phyllida. 'Over and over', *New Scientist*, 155:2093 (1997), 27
- Cohen, Philip 'Hunting the language gene', *New Scientist*, 157:2119 (1998)
- Coren, S. and Helpern, D.F. 'Left-handedness: a marker for decreased survival fitness', *Psychological Bulletin*, 109 (1991), 90–106

- Cotton, Ian 'Dr Persinger's God machine', *Independent on Sunday*, 2 July 1995
- Cytowik, Richard. 'Synaesthesia: phenomenology and neurophysiology', *Psyche*, 2:10 (1995)
- Daily Telegraph* report, 8 November 1997
- Damasio, Antonio R. 'Neuropsychology: towards a neuropathology of emotion and mood', *Nature*, 386:6527 (1997), 769
- Donnan, G.A. et al 'Identification of brain region for co-ordinating speech articulation', *The Lancet*, 349:9047 (1997), 221
- Drevets, Wayne et al 'Subgenual prefrontal cortex abnormalities in mood disorder', letter to *Nature*, 386:6527 (1997), 824-7
- Farnham, F.R. 'Pathology of love', *The Lancet*, 350:9079 (1997), 710
- Finn, Robert 'Different minds', *Discovery*, June 1991
- Fischer and Frederikson 'Extraversion, neuroanatomy and brain function – a PET study of personality', *Personality and Individual Differences*, 23, 345–52
- Fletcher, Paul et al 'Other minds in the brain – a functional imaging study', *Cognition*, 57 (1995), 109–28
- Forstl, H. and Beats, B. 'Charles Bonnet's description of Cotard's delusion and reduplicative paramnesia in an elderly patient (1788)', *British Journal of Psychiatry*, 160 (1992) 416–18
- Frank, Paul and Ekman, Paul 'Behavioural markers and recognizability of smile of enjoyment', *Journal of Personality and Social Psychology*, 64:1 (1993), 83–93
- Fried, Itzhak 'Electrical current stimulates laughter', *Nature*, 391:6668 (1998), 650
- Fried, Itzhak 'Syndrome E', *The Lancet*, 350:9094 (1997), 1845–7
- Frith, C.D. et al 'Functional imaging and cognitive abnormalities', *The Lancet*, 346:8975 (1995), 615–20
- Frith, Uta 'Autism', *Scientific American*, special issue, April 1997, 92

- Gainotti, G. et al *Cognitive Neuropsychology*, 13:3 (1996), 357–89
- Gur R.C. et al 'Differences in the distribution of gray and white matter in human cerebral hemispheres', *Science*, 207:4436 (1980), 1226–8
- Hepper, P.G. et al 'Handedness in the human foetus', *Neuropsychologia*, 29:11 (1991), 1107–11
- Hess, U. et al 'The facilitative effect of facial expression on the self-generation of emotion', *International Journal of Psychophysiology*, 12:3 (1992), 251–65
- Hobbs M. 'A randomized controlled trial of psychological debriefing for victims of road traffic accidents', *British Medical Journal*, 313:7070 (1996), 1438–9
- Hohman, G. et al 'Some effects of spinal cord lesions on feelings', *Psychophysiology*, 3 (1966), 143–56
- Kartsounis, L.D. and Shallice, Tim 'Modality specific semantic knowledge loss for unique items', *Cortex*, 32:1 (1996), 109–19
- Katz, Joel 'Phantom limb pain', *The Lancet*, 350:9088 (1997), 1338
- Kim, K.H.S. et al 'Distinct cortical areas associated with native and second languages', letter to *Nature*, 388:6538 (1997), 171
- Kinsbourne, M. and Warrington, E.K. 'Jargon aphasia', *Neuropsychologia*, 1 (1963), 27–37
- Kolb, B. et al 'Developmental changes in the recognition and comprehension of facial expression: implications for frontal lobe function', *Brain and Cognition*, 20 (1992), 74–84
- L'Hermitte, François 'Human autonomy and the frontal lobes', *Annals of Neurology*, 19 (1986), 335–43
- Lane, R. Letter in *Journal of Neurology, Neurosurgery and Psychiatry*, 63:2 (1997)
- LeDoux, Joseph, Wilson, D. H. and Gazzaniga, Michael 'A divided mind', *Annals of Neurology*, 2 (1977), 417–21
- Loftus, Elizabeth F. 'Creating false memories', *Scientific American*, September 1997, 51–5

- Maguire, E. et al 'Recalling routes around London: activation of the right hippocampus in taxi drivers', *Journal of Neuroscience*, 17 (1997), 7103–10
- McNaughton, N. et al 'Reactivation of hippocampal ensemble memories during sleep', *Science*, 19 July 1994, 676–9
- McNeil, J.E. and Warrington, E.K. 'Prosopagnosia: a reclassification', *Quarterly Journal of Experimental Psychology, A*, 43:2 (1991), 267–87
- Melzack, R. 'Phantom limbs', *Scientific American* supplement, 7:1 (1997), 84
- Miles, Marshall 'A description of various aspects of anencephaly', Lafayette College, USA
- Mineka, S. et al 'Observational conditioning of snake fear in rhesus monkeys', *Journal of Abnormal Psychology*, 93 (1984), 355–72
- Morris, J.S. et al 'A differential neural response in the human amygdala to fearful and happy facial expressions', letter to *Nature*, 383:6603 (1997), 812–15
- New Scientist* 'Emotions' supplement, 27 April 1996
- Nisbett, Richard and Wilson, Timothy 'Telling more than we can know – verbal reports on mental processes', *Psychological Review*, 84 (1977), 231–59
- North, A.C. et al 'In-store music affects product choice', *Nature*, 390:6656 (1997), 132
- Nystrand, A. 'New discoveries on sex differences in the brain', National Institute of Ageing, NIH Bethesda, *Lakartidningen* 93:21 (1996), 2071–3
- O'Connell, R.A. 'SPECT imaging study of the brain in acute mania and schizophrenia', *Journal of Neuroimaging*, 2 (1995), 101–4; also Ian Daly, 'Mania', *The Lancet*, 349:9059 (1997), 1157–9
- Olsho, L.W. 'Infant frequency discrimination', *Infant Behaviour and Development*, 7 (1984), 27–35
- Oomura, Y., Aou, S., Koyama, Y. and Yoshimatsu, H. 'Central control of sexual behaviour', *Brain Research Bulletin*, 20 (1988), 863–870
- Pantev, C. et al 'Increased auditory cortical representation in musicians', *Nature*, 392:6678 (1998), 81

- Paulesu, E. et al 'The physiology of coloured hearing', *Brain*, 118 (1995), 661-76
- Paulesu, E., Frith, U. et al 'Is developmental dyslexia a disconnection syndrome?', *Brain*, 119 (1996), 143-7
- Pendick, Daniel 'The New Phrenologists', *New Scientist*, 2091 (1997), 34-47
- Penfield, W. and Perot, P. 'The brain's record of auditory and visual experience', *Brain*, 86 (1963), 595-696
- Phillips, M.L. et al 'A specific neural substrate for perceiving facial expressions of disgust', letter to *Nature*, 389:6550 (1997), 495-7
- Putnam, F.W. 'Dissociative phenomena', *American Psychiatric Press Review of Psychiatry*, 10, 145-60
- Raine, A. et al 'Brain abnormalities in murderers indicated by positron emission tomography', *Biological Psychiatry*, 42 (1997), 495-508
- Ralph, Sage and Ellis 'Word meaning blindness: a new form of acquired dyslexia', *Cognitive Neurology* 13:5 (1996), 617-39
- Reading, P.J. and Will, R.G. 'Unwelcome orgasms', *The Lancet*, 350:9093 (1997)
- Rees, G. 'Too much for our brains to handle', *New Scientist*, 158:2128 (1998), 11
- Rothenberger, A. et al 'What happens to electrical brain activity when anorectic adolescents gain weight', *European Archives of Psychiatry and Clinical Neurosurgery*, 240:3 (1991), 144-7
- Sieveking, Paul 'Then I saw her face...', *Sunday Times*, 2 November 1997
- Sperry, R.W. 'Hemisphere disconnection and unity in conscious awareness', *American Psychologist*, 23 (1968), 723-33
- Stuss, D. and Benson, D. 'Neuropsychological studies of the frontal lobes', *Psychological Bulletin*, 95, 3-28
- Tiihonen, J. et al 'Increase in cerebral blood flow in man during orgasm', *Neuroscience Letters*, 170 (1994), 241-3

- Van der Ster, Wallin G. et al 'Selective dieting patterns among anorectics and bulimics', *European Eating Disorders Review*, 2 (1994), 221-32
- Vargha-Khadem, Farana 'Differential effects of early hippocampal pathology on episodic and semantic memory', *Science*, 277:5324 (1997), 376-80
- Weltzin, Kaye 'Serotonin activity in anorexia and bulimia', *Journal of Clinical Psychiatry*, 52, supplement (1991), 41-8
- Williams, L.M. 'Recovered memories of abuse in women with documented sexual victimization histories', *Journal of Traumatic Stress*, 8, 649-73
- Wing, Lorna 'The autistic spectrum', *The Lancet*, 350:9093 (1997), 1762
- Wright, Lawrence 'Double mystery', *New Yorker*, 7 August 1995

INDEX

Page numbers in *italic* refer to illustrations

- acetylcholine (ACh), 30, 104
- Ackerly, S.S., 330
- addiction, 18, 96, 97, 100, 104–5, 105, 118, 167
- adrenaline, 135
- advertising, 61
- ageing, 24, 108
- aggression, 113–14, 149, 330–1
- agnosia, 188–93, 245
- alcoholism, 96, 97, 105
- alexithymia, 136–7
- alien hands, 70–4, 75
- alpha brainwaves, 304
- Alzheimer's disease, 19, 30, 283, 284
- amnesia, 277, 278–86, 283, 292
- amphetamines, 104
- amputation, phantom limbs, 205, 206, 209, 316–17
- amygdala, 34, 40, 40, 41, 91, 147; and consciousness, 311; depression, 161; and drug addiction, 104; emotions, 21, 129, 134–5, 134, 135, 143, 145–50, 153, 157, 162; and facial expressions, 139–40; fears and phobias, 157, 159–60, 161; flashbacks, 211; memory, 159, 161, 163, 264, 266, 273, 278, 286–7; nightmares, 318; psychopathic behaviour, 149–50, 153; sense of smell, 186; and sexual behaviour, 76, 112, 117; Syndrome E, 331
- analgesics, 187
- anatomy, 38–42, 38–41
- androgens, 108, 113, 123
- anencephaly, 307
- anger, 83, 84, 143–53
- angular gyrus, 226, 251, 253, 253
- animals: consciousness, 155; depression, 170; language, 228; noises, 238
- anorexia, 102–3
- anosognosia, 51, 240–1, 322–6, 323
- anterior cingulate cortex, 22, 281; attention, 298; depression, 161, 167, 169; emotion, 316; hypnosis, 318; neglect, 325; obsessive-compulsive disorder (OCD), 90, 94; and pain, 187, 316; Tourette's syndrome, 85
- anterior commissure, 66, 67, 68, 108, 109
- antidepressants, 42, 104, 107, 170
- Anton's delusion, 325–6
- anxiety, 60
- aphasia, 249–50
- apoptosis, 19
- apperceptive agnosia, 190
- appetite control, 98, 102–3
- art, 60–1, 176–8
- artificial intelligence (AI), 329
- Asperger's syndrome, 122, 123, 234, 236, 237–42
- association areas, 175, 181, 188
- associative agnosia, 190
- attention, 22, 211, 303–5, 324, 325, 333
- Attention Deficit Hyperactive Disorder (ADHD), 100, 298, 305, 305, 311
- auditory cortex, 33, 160; dreams, 318; hallucinations, 208; hearing, 183, 183; and language, 242, 247; music, 178, 242, 244; speech, 246, 247, 255; tinnitus,

- 207–9, 208; word deafness, 249
- Australopithecus africanus*, 34
- autism, 19, 119–23, 234–9, 235, 236, 245, 330
- autistic savants, 181
- autokinetic effect, 213–15
- automatic movements, 87
- automatic thinking, 92
- autoscopical delusions, 210
- axons, 38, 39, 42, 55–6, 57
- babbling, 256
- babies: bonding with, 124, 245; brain development, 17–22, 17, 18, 20; fear, 154; internal map, 312–16; ‘prejudices’, 215; sex differences in brain, 123; speech development, 254–8; *see also* children
- Baddeley, Alan, 308–10
- Baron-Cohen, Dr Simon, 119–23, 238–9
- basal ganglia, 85, 86, 92, 325
- basolateral nucleus, amygdala, 113, 153
- Bayes, Thomas, 199
- Baysian induction, 199
- behaviour: determinist view, 314; psychopathic, 133–4, 144–5, 149–50, 153; sexual, 106–18, 107, 334; urge-driven, 84–9
- behaviour therapy, 142
- behavioural pharmacology, 97
- belief–disbelief, 281, 281
- Benton, Arthur, 330
- benzodiazepines, 105
- birdsong, 238
- Blakemore, Colin, 153
- Blakemore, Sarah-Jayne, 45–6
- blind spot, 324–5
- blindness, 185–6; Anton’s delusion, 325–6; blindsight, 138, 301–7, 302; neglect, 324
- blindsight, 138
- Blum, Kenneth, 96
- body: awareness of, 187; bodily hallucinations, 209; body language, 140–1, 238; effects of emotion, 129
- body dysmorphic disorder, 92
- bonding, 124, 245
- Bonnet, Charles, 164
- Bourne, A., 284
- Brack, Charles, 72
- Braille, 252
- brainstem, 40–1; attention, 304; and consciousness, 300–1; dreams, 318; evolution, 36; and sexual behaviour, 114
- brainwaves, 27
- Brambilla, Riccardo, 163
- Broca, Pierre, 10, 11, 32
- Broca’s aphasia, 250–1
- Broca’s area, 22, 226, 246, 247, 249, 250, 251, 251, 253, 256, 299
- Broks, Paul, 43–4
- Brown, Lucy, 167
- bulimia, 103
- Capgras delusion, 200–2, 201
- Carroll, Lewis, 292
- Cartesian dualism, 23, 297, 335
- catatonia, 100, 311
- category-specific recognition failure, 191–3
- caudate nucleus, 40; memory, 264; obsessive-compulsive disorder (OCD), 90, 91, 92–4, 93
- cells: glial cells, 41; programmed cell death, 19; *see also* neurons
- cerebellum, 38, 41; evolution, 34, 36; memory, 266, 283; and speech, 255
- cerebral cortex, 38; baby’s brain, 17; as cause of actions, 313; consciousness, 194, 298–307, 298; emotions, 128, 129, 129,

- 133, 135, 146–9; evolution, 34, 36; and facial expressions, 136, 139; grey matter, 55; mapping, 32–7; memory, 266, 268–73; sense of touch, 118; sensory processing, 175; sex differences, 123; and sexual behaviour, 114–18
- cerebro-spinal fluid, 23
- cerebrum, 38–9
- Chadwick, Peter, 83, 84
- Charles Bonnet syndrome, 195
- children: eidetic (photographic) memory, 207; emotional development, 146–8; imaginary friends, 207, 211; language development, 229, 254–8; *see also* babies
- choices, making, 320
- Chomsky, Noam, 130, 248
- Chugani, Harry, 148
- cingulate cortex *see* anterior cingulate cortex
- cingulate gyrus, 105
- cocaine, 104, 105
- cochlear nucleus, 183
- codeine, 187
- cognitive illusions, 215–19
- cognitive therapy, 60
- colour: sensory processing, 176; synaesthesia, 19, 176, 179
- coma, 16, 301, 304, 311
- Comings, David, 96
- communication, 224–58; body language, 140–1, 238; gestures, 140, 154, 226, 228, 229; music, 242–6; reading, 252–3, 253, 255; speech, 243, 247–58; theory of mind, 234–6, 240; writing, 252–3; *see also* language
- compulsions, 331–4
- Computerized Tomography (CT), 26
- computers, 297, 329
- concussion, 304
- conditioned fear, 156–7, 160–1, 163–4
- confabulation, 276–7
- conscious brain: emotions, 136, 143, 155, 155; facial expressions, 136; recognition, 181, 188
- conscious volition, 314–15
- consciousness, 42, 296–336; computers and, 329; free will, 313–15, 327, 335–6; meaningfulness, 327; planning, 321; self-awareness, 22, 22, 256, 300, 311, 329; split-brain experiments, 77; thinking, 317–28
- convergence zones, 220
- Cook, Captain, 179
- Cool, Nadean, 286–7
- coprolalia, 83–4
- Coren, Stanley, 79
- corpus callosum, 41, 49, 54; alien hands, 71; communication between hemispheres, 39, 57, 58, 66; and homosexuality, 111; sex differences, 108, 109, 123; split-brain experiments, 63, 65
- cortex *see* cerebral cortex
- corticomedial nucleus, amygdala, 113
- Cotard's delusion, 164, 169
- counselling, 60
- counting, obsessive-compulsive disorder (OCD), 89–90
- covert memories, 285–7
- creativity, 165, 327
- Crick, Francis, 332–3
- Cytowic, Richard, 173
- Damasio, Antonio, 127, 129, 220–1
- deafness, 183, 226, 227
- death, delusions of, 164, 168
- deduction, 181

- déjà vu, 188
 dementia, 42, 188; *see also*
 Alzheimer's disease
 dendrites, 38, 42, 304
 depression, 60, 209, 298; and cre-
 ativity, 165; dopamine and,
 100, 166, 167; frontal lobe
 changes, 330; loss of meaning-
 ness, 327; and rejection, 166–7
 Descartes, René, 23, 23, 335
 determinism, 314
 dichotomania, 50
 diencephalon, 98
 Diffusion Tensor Imaging, 26
 disgust, facial expressions, 141,
 141
 dispositional representations,
 220–1
 dopamine, 42, 56; and addiction,
 97, 100, 101, 104, 105, 105;
 attention, 304; dysfunction,
 100, 101; functions, 31, 100;
 hallucinations, 31, 211; and
 love, 72, 118; and memory,
 315; pathways, 31; pleasure,
 162; and recognition, 200; and
 satisfaction, 93, 95; and schiz-
 ophrenia, 170; and sexual
 behaviour, 107; and Tourette's
 syndrome, 84
 doppelgangers, 208, 209–10
 dorsolateral prefrontal cortex,
 298, 317, 318
 dorsomedial nucleus, hypothala-
 mus, 114
 Down's syndrome, 19, 231
 dreams, 212, 266, 270, 318, 319
 drugs: addiction, 18, 96, 97,
 104–5, 105; analgesics, 187;
 antidepressants, 42, 104, 170;
 control of urge-driven behaviour,
 97; hallucinations, 195, 212
 dualism, 23, 297, 335
 Duchenne, Guillaume, 136
 Duchenne smile, 136, 139
 Dürer, Albrecht, 70–1
 dyslexia, 251, 253, 254
 ears *see* hearing
 eating disorders, 93, 96–7, 102–3
 echolalia, 251
 Ecstasy, 104
 Egypt, ancient, 23
 eidetic memory, 19, 206–7
 Einstein, Albert, 178–9
 Ekman, Paul, 141
 electricity, sensory processing,
 175
 electroencephalography (EEG),
 27, 27, 106
 emotions, 126–36; anger, 143–53;
 baby's brain, 19–21; communi-
 cation between hemispheres,
 66, 67–8; complex emotions,
 135–6; controlling, 146–8, 155;
 depression, 158, 164–70; dif-
 ferences between hemispheres,
 51, 60; emotional recognition
 system, 198–203, 201; express-
 ing, 136–43; facial expressions,
 136–40, 141–3, 238–9; feeling,
 128–9; happiness, 162; limbic
 system, 34, 39; and memory,
 268; 'mirroring' in others,
 231–3; moral judgements,
 132–3; music and, 244–6; psy-
 chopathic behaviour, 130,
 133–4, 135, 149–50, 153; psy-
 chotherapy, 60; and sense of
 smell, 186; sex differences,
 108; split-brain experiments,
 68, 68; as survival mechanism,
 134, 136, 155
 empathy, 231–3, 240–1
 endorphins, 30, 105, 124
 enkephalins, 30, 105, 187
 environment dependency syn-
 drome, 331–4
 epilepsy, 10, 32–3, 64, 114–15,
 118, 151–3, 211, 278

- episodic memories, 265, 266, 272, 273, 283, 333
- erotomania, 116
- Event-Related Potentials (ERPs), 27
- evolution, 34–5, 34, 97, 99, 257, 257
- expressions, facial, 136–40, 141–3, 238–9
- extroverts, 203
- eyes: attention, 304; brainstem and, 16; ‘language of the eyes’, 234, 239; *see also* vision
- Face Recognition Units (FRU), 196
- faces: differences between hemispheres, 70–1; expressions, 136–40, 141–3, 238–9; face blindness, 189, 193–203; hallucinations, 208; recognition, 53–4, 196, 196, 202, 216, 216
- false memories, 273–6, 279
- fear, 141, 145, 153–64, 266, 286
- feedback, 14, 15; facial expressions, 142; and stuttering, 255
- female brain *see* sex differences
- fight or flight response, 135, 145, 157
- fish brain, 34, 34
- Fisher, Helen, 166–7
- flashbacks, 211, 266, 273, 287
- foetal development, 17, 18–19, 123
- foreign languages, 248, 258
- fovea, 185
- free association, 286
- free will, 313–15, 327, 328, 335–6
- Fregoli’s delusion, 198–200
- Freud, Sigmund, 155, 156
- Freudian psychoanalysis, 61, 84
- Fried, Itzhak, 330–1
- Frith, Chris, 24, 195
- Frith, Uta, 236
- frontal lobe, 38, 39; ageing, 108; confabulation, 277; consciousness, 296, 298–302, 298, 321–8; depression, 159, 169; development of, 21–2; dreaming, 266; dysfunction, 330–5; emotions, 129, 146; evolution, 34; and facial expressions, 139; hallucinations, 208; language cortex, 228; language development, 256, 257; memory, 266; mirror neurons, 231; neglect, 325; obsessive-compulsive disorder (OCD), 90, 92–4; psychopathic behaviour, 144; schizophrenia, 318; sense of smell, 186, 186; sense of taste, 186; and sexual behaviour, 116–17; thought, 311
- fugue, 283–6
- functional brain scanning, 12
- future, imagining, 290–3
- Gage, Phineas, 25–8, 25, 278, 300, 321, 328
- Gall, Franz, 9, 10, 37
- ‘gay brain’, 111
- Gazzaniga, Michael, 63, 68–9, 74
- genetics: and alcoholism, 105; brain development, 17, 18–19; and depression, 170; genetic engineering, 97; and homosexuality, 111; language development, 257
- gestures, 35, 140, 154, 226, 228, 229
- ghosts, 207, 208, 211, 212
- glial cells, 41
- glutamate, 30
- God, 208
- gossip, 257
- gourmand syndrome, 186
- grammar, 257, 258
- grapheme-colour synaesthesia, 176, 179
- Gregory, Richard L., 194

grey matter, 16, 55
 grief, 60
 guilt, cognitive illusions, 217–18
 gyus, 17, 38

 Haggard, Patrick, 314–15
 hallucinations, 31, 100, 195, 203–12, 208
 hallucinogenic drugs, 104
 Hamer, Dean, 111
 hands: alien hands, 70–4; gestures, 140, 154, 226, 228, 229; handedness, 78–9
 Happé, Francesca, 236
 happiness, 162
 Harlow, John, 28
 Hauser, Marc D., 130–1
 hearing: deafness, 183, 226, 227; hallucinations, 195, 208; sensory processing, 49, 174, 183, 183; synaesthesia, 19, 173, 177, 178; tinnitus, 207–9, 208
 heart disease, 187
 hemispheres: alien hands, 70–4, 75; anatomy, 38–42, 41; brain damage, 51, 52, 52, 53; communication between, 58–9, 65–7, 66; differences between, 48–61, 59; divergent politics, 72; dominance, 71–4; hearing, 183, 183; and homosexuality, 76; language, 228–9, 252, 255; and left-handedness, 78–9; neurotransmitters, 56; orienting, 325; split-brain, 62–4, 63–77; working methods, 49, 55–8; *see also* frontal lobe; occipital lobe; parietal lobe; temporal lobe
 Hermann's grid, 214, 222
 heroin, 105
 Heschi's gyus, 183
 hippocampus, 40, 40, 41; ageing, 108; dreams, 266, 318; evolution, 34; memory, 21, 157–8, 160, 161, 264, 266, 268–73, 269, 272, 273, 278, 283, 287, 292–3, 333; sex differences, 108; spatial ability, 53
 Hitch, Graham, 310
 homosexuality, 76, 111
 hormones: emotions, 129; maternal bonding, 245; sex differences, 18–19, 108, 112–13, 123; and sexual behaviour, 115, 124; stress hormones, 105, 161, 164, 287; unconscious memories, 160, 164
 humour, 10, 51–3, 181
 hunches, 59–60
 hunger, 99–103
 hypnosis, 318, 319
 hypochondria, 91–2
 hypothalamus, 40, 40, 41; eating disorders, 93, 102–3; emotions, 129, 146, 157; evolution, 34; sex differences, 108; and sexual behaviour, 106, 108, 111, 112–14, 118
 hypotheses: and learning, 194; and vision, 199

 illusions, 204, 212–22, 212–14, 216
 impotence, 115
 'in two minds', 69–77
 inferior colliculus, 183
 information: communication, 224–58; sensory processing, 174–6, 179–80
 instincts, 92, 154, 264
 insula, 247, 253, 316; falsehoods, 281, 281
 introverts, 203
 intuition, 19

 James, William, 332
 Jamison, Kay Redfield, 165
 jokes, 51–3, 181

- Kandinsky, Wassily, 176
 Kawabata, Hideaki, 43
 Klein, Rüdiger, 163
 Kluver-Bucy syndrome, 117–18
 Koch, Christof, 332
 Korsakoff's syndrome, 277
 Kyushu University, 106
- language, 226–31; aphasia, 249–50; development of, 226–9, 240, 254–8; dyslexia, 251, 253, 254; foreign languages, 248, 258; and left-handedness, 78; and memory, 227; phonological loop, 310; reading, 252–3, 254, 255; speech, 243, 247–58; split-brain experiments, 69, 74–7; Tourette's syndrome, 83–4, 87–9; Williams syndrome, 230–1; writing, 252–3
- language areas, 10, 11, 21–2, 29, 32, 35, 226, 228, 242, 246, 247–58, 253, 256–8
- language cortex, 228, 247, 248, 249, 250
- Lashley, Karl, 23
- lateral geniculate body, 184
- lateral inhibition, 214
- lateral nucleus, hypothalamus, 99, 102
- lateral pulvinar, 304
- lateral thinking, 56
- learning, 194; *see also* memory
- LeDoux, Joseph, 68–9, 74, 134, 146, 155, 156, 157, 159, 160, 161
- left-handedness, 78–9
- leucotomy, 11, 12
- LeVay, Simon, 111
- L'Hermitte, François, 331–4
- Libet, Benjamin, 313, 314, 315
- lie detection, 141–2, 277, 280, 280
- limbic system, 39–40, 40, 41, 316; child development, 21; communication between hemispheres, 67–8; consciousness, 299, 311; and drug addiction, 104; eating disorders, 102–3; emotions, 128, 129, 134–5, 137, 146, 155; evolution, 34, 36; and facial expressions, 137; hallucinations, 208; and happiness, 162; motor skills, 88; music, 245; psychopathic behaviour, 144; recognition, 188, 201; sense of smell, 186, 186; sensory processing, 175; sexual behaviour, 110, 115; sleep, 318; synaesthesia, 180; urges, 95
- lobotomy, 11–12, 331
- locus coeruleus, 30
- Loftus, Elizabeth, 274–5
- long-term memory, 266, 268–73, 320
- long-term potentiation (LTP), 262, 263, 268
- loop-back system, 14, 15, 16
- lordosis, 107, 113, 115
- love, 118, 124
- LSD, 104
- macaque monkeys, 106, 113
- magic mushrooms, 104
- magnetic apraxia, 327
- Magnetic Resonance Imaging (MRI), 12, 26, 26, 28–32, 29, 106
- Magnetoencephalography (MEG), 27, 27
- Maguire, Eleanor, 292–3
- mammalian brain, 34, 34, 36, 39
- mania, 100, 165, 170, 298, 327, 330
- manic-depressive illness, 165
- maps, internal, 269, 272, 312–17, 325
- Mark, Vincent, 153

marriage, autism and, 239–42
 ‘mass action’ theory, 11
 massa intermedia, 108, 109
 mathematics, 181
 Maynard Smith, John, 257
 meaning: and consciousness,
 327; in mania, 100, 170, 327
 medial geniculate body, 183
 medial prefrontal cortex, 45–6
 medial preoptic area, hypothalamus, 106, 108, 109, 113–14
 meditation, 187, 318, 319
 medulla, 41
 memory, 260–93; and ageing,
 108; Alzheimer’s disease, 283,
 284; amnesia, 277, 278–86,
 283, 292; conditioned fear,
 154, 163–4; and dopamine,
 315; dreams, 266; eidetic (photo-
 graphic) memory, 19, 206–7;
 emotions, 21; false memories,
 273–6, 279; flashbacks, 211,
 266, 273, 287; imagining the
 future, 290–3; language and,
 227; long-term memory, 266,
 268–73, 320; neural connec-
 tions, 15, 261–8; oxytocin and,
 124; recognition, 188, 192–3;
 recovered memories, 160, 273,
 279; short-term, 278–83, 333;
 smells and, 186; state of mind,
 265–8; storage, 33, 261–8, 263,
 266, 270, 271; unconscious
 memories, 160–1, 285–7;
 working memory, 308–10,
 308–9, 317, 320, 333
 mentalising, 45–6
 microtubules, 329
 midbrain, 41; attention, 304; and
 consciousness, 300–1
 migraine, 211
 mirror neurons, 137–8, 231–3,
 231, 233, 240–1, 245
 modular brain theory, 10, 11
 modules, 39–40

Mona Lisa, 142
 Mondrian, Piet, 176
 Moniz, Egas, 11, 12
 monkeys, 106, 113, 154, 232,
 240, 241
 morality, 328; and emotion,
 132–3; moral faculty theory,
 130–1
 morphine, 105, 187
 Morton, John, 279
 motor cortex, 24, 118, 299;
 anosognosia, 322; dopamine
 pathways, 100; motor skills,
 87, 88;
 and sexual behaviour, 114; and
 speech, 250
 mouth cortex, 255
 movement, 29; automatic, 87
 multiple personality disorder
 (MPD), 287–90
 music, 60–1, 178, 242–6, 242,
 244, 282
 myelin, 16, 18, 39
 myelination, 21, 22
 Myers, Ronald, 65

 Nabokov, Vladimir, 177
 natural selection, 16–17, 225
 Near-Infra-red Spectroscopy
 (NIRS), 27, 27
 neglect, 322–6, 323
 neocortex, 34, 36
 neural Darwinism, 16–17
 neural networks, 16, 18
 neurons, 16, 42; baby’s brain,
 18–19; brainstem, 304; con-
 nections, 15; differences
 between hemispheres, 56; fir-
 ing, 14, 15; memory, 261–8,
 263; microtubules, 329; mirror
 neurons,
 137–8, 231–3, 231, 233, 240–1,
 245; scanning, 26
 neurotransmitters, 30, 30, 42;
 attention, 304; and conscious-

- ness, 300–1; in depression, 170; dopamine dysfunction, 100, 101; drug addiction, 104–5, 105; eating disorders, 103; Tourette's syndrome, 84; unconscious memories, 160; *see also individual neurotransmitters*
- nicotine, 104
- nightmares, 318
- noradrenaline, 30, 42, 56, 104, 304
- nose, sensory processing, 174
- Obama, Barack, 202
- obesity, 99, 102
- obsessive-compulsive disorder (OCD), 89–96, 90, 91, 93, 100, 101
- occipital lobe, 38
- occipito-parietal area, 208
- oestrogen, 115
- olfactory bulb, 113
- opioids, 105, 187
- optic chiasma, 184
- optic nerve, 324
- orbito-frontal cortex, 43, 90, 94, 298, 321–7, 331
- orgasm, 106–12, 110, 114–15, 124
- orientation, 304–5, 325
- out-of-body experiences, 187
- oxytocin, 30, 118, 124, 245, 326
- pain, 12, 105, 186–7, 316
- painkillers, 187
- panic attacks, 160
- Panksepp, Jaak, 244
- paranoia, 170, 330
- Parfit, Derek, 44
- parietal lobe, 38–9; ageing, 108; artificial urges, 315; attention, 304, 305; depression, 169; development of, 21; hallucinations, 208; language cortex, 247; meditation, 318; neglect, 325; recognition, 188; and sexual behaviour, 118; spatial processing, 53
- Parkinson's disease, 31, 42, 86, 100, 209
- Pavlov, Ivan, 156
- Penfield, Wilder, 32–3, 270
- penis, 107, 114
- Penrose, Sir Roger, 329
- Persinger, Michael, 13
- Persistent Vegetative State, 304
- personality, multiple personality disorder (MPD), 287–90
- phantom limbs, 205, 206, 209, 316–17
- phobias, 153–64, 266
- phonological loop, working memory, 308–9, 309, 310
- photographic memory, 19, 206–7
- phrenology, 9, 9, 10, 10, 11
- Pickrell, Jacqueline, 274–5
- pineal gland, 23, 39
- Pinker, Steven, 248, 249
- pituitary gland, 40
- planning, 321
- pleasure, 85–6, 97, 99, 162
- poets, 165
- pons, 41
- Positron Emission Topography (PET), 24, 27, 27, 106
- post-traumatic stress disorder (PTSD), 160, 211, 287
- prefrontal lobe: adolescence, 45–6; attention, 305; consciousness, 298, 298; depression, 161, 169; and drug addiction, 104; dysfunction, 25–8, 330; emotional development, 146; evolution, 34; functions, 299; and happiness, 162; obsessive-compulsive disorder (OCD), 90; self-determination, 25–8; theory of mind, 236, 236; thought, 317, 320;

- Tourette's syndrome, 85
 pregnancy, 18–19
 prehistoric man, 34–5, 78, 257
 prejudices, 215–19
 premotor cortex, 88, 92, 299, 318
 priapism, 115
 primates, 106, 228, 257
 priming, 286
 procedural memory, 266, 282–3
 proprioception, 187
 prosopagnosia, 191, 193–203
 psychiatry, biological, 10
 psychoanalysis, 61, 84, 145
 psychopaths, 144–5, 144, 149–50, 153
 psychotherapy, 60
 putamen, 40; memory, 264, 266, 283; motor skills, 88; obsessive-compulsive disorder (OCD), 92; tics, 86–7, 93

 racism, 72
 Ramachandran, Vilayanur S., 205, 240–1
 Ras-GRF, 163
 Ratey, John, 239–42
 rationalization, 61–3
 Readiness Potential (RP), 313
 reading, 246, 252–3, 253, 255
 recognition, 181–203, 189; 'acquired' tastes, 262–5; agnosia, 188–93; emotional recognition
 system, 198–203, 201; faces, 193–203, 196, 216, 216
 recovered memories, 160, 273, 279
 reflex actions, 301, 307, 313
 rejection, 166–7
 religious beliefs, 12–14, 96
 reptilian brain, 34, 34, 36, 40
 Restak, Richard, 144
 Reticular Activating System, 304
 reticular formation, 22
 retina, 184, 214, 324
 reward deficiency syndrome, 96
 right-handedness, 78
 Rimbaud, Arthur, 176
 rituals, 85–6, 89
 Rizzolatti, Giacomo, 232, 240
 Rolls, E.T., 92
 Romanian orphans, 148
 romantic love, 72, 118, 124, 166–7

 saccades, 185
 Sacks, Oliver, 89, 197, 227, 291
 satisfaction, 93, 95, 96–7
 scanning, 26–7, 26–7
 scene construction, 293
 Schacter, Daniel, 275–6
 Schatzman, Morton, 207
 schizophrenia: auditory hallucinations, 195, 209; dopamine and, 100; frontal lobe in, 298, 318, 319; negative symptom schizophrenia, 311; paranoia, 170
 Schumann, Robert, 165
Science, 111
 self, sense of, 311–17
 self-awareness, 22, 22, 256, 300, 311, 329
 self-determination, 24–8
 semantic memory, 265, 266, 283
 sensation, 29, 186–7
 senses: pain, 186–7; sixth sense, 187; smell, 49, 173, 175, 186, 186, 209; taste, 173, 186; *see also* hearing; vision
 sensory cortex, 114, 118
 sensory processing, 172–222, 182; hallucinations, 195, 203–12, 208; illusions, 212–22, 212–14, 216; learning, 194; recognition, 181–203, 189; synaesthesia, 173
 septum, 104, 115
 serotonin, 42; and drug addiction, 104; eating disorders,

- 103; functions, 30; gourmand syndrome, 186; pathways, 30; and sexual behaviour, 107
- sex differences, 108–9, 109, 119–23, 120–2; depression, 158; hormones and, 18–19, 123;
- sexual behaviour, 110
- sex hormones, 108, 112–13, 115
- sexual behaviour, 106–18, 107, 334
- short-term memory, 278–83, 333
- Shostakovich, Dmitri, 209
- sight *see* vision
- sign language, 226, 228, 229
- simultagnosia, 208
- sixth sense, 187
- skull: evolution, 34, 257; phrenology, 9, 9, 10, 11
- sleep, 270–1, 311, 318, 319
- 'smell brain', 34
- smell, sense of, 49, 173, 175, 186, 186, 209
- smiles, 136, 137, 138–9, 140, 142, 143, 144
- snakes, fear of, 152, 154, 157
- social brain, 45
- social integration, 231
- social intelligence, 316
- social organization, 61–2
- somatosensory cortex, 24, 33, 205
- somatosensory hallucinations, 209
- soul, 43–4
- sound: hallucinations, 207–9; hearing, 183, 183; music, 242–6; synaesthesia, 19, 173, 177, 178
- spatial ability, 53, 119
- spatial memories, 269, 273
- specific language impairment (SLI), 248
- speech, 243, 247–58; Broca's area, 22, 226, 246, 247, 250, 251, 256, 299; development of, 254–8; and emotion, 136
- Sperry, Roger, 65, 68, 69, 77
- spinal cord, 40, 41
- spirituality, 12–14
- split-brain experiments, 62–4, 63–77
- stalkers, 116
- state of mind, 265–8
- statistics, cognitive illusions, 218–19
- stimuli, 84–5
- stress hormones, 105, 161, 164, 287
- stroke, 42; agnosia, 188, 190; anosognosia, 240, 322; effect on emotions, 51; and language, 32, 247, 251–2, 258; and memory, 285
- stuttering, 255
- subgenual cortex, 328
- subjective experiences, measuring, 43
- suicide, 165, 168
- sulcus, 17, 38, 41
- superior colliculus, 304
- supplementary motor area (SMA), 255, 299, 318; artificial urges, 315
- surgery: leucotomy, 11, 12; lobotomy, 11–12
- survival strategies, 16, 61, 145, 155, 170
- synaesthesia, 19, 173, 177, 178–80
- synapses, 38, 42, 45
- Syndrome E, 331
- syntax, 248–9
- Tan, 32
- taste, 173, 186; 'acquired', 262–5; phantom, 209
- tegmenum, 210–11
- Temple, Christine, 251
- temporal lobe, 39; ageing, 108;

delusions of death, 164;
 depression, 169; and drug
 addiction, 104; hallucinations,
 208; language cortex, 228;
 memory, 264; recognition,
 188; sense of smell, 186; and
 sexual behaviour, 110, 117
 testosterone, 18, 115, 123
 thalamus, 40, 40, 41; attention,
 304; and consciousness,
 300–1; depression, 161; emo-
 tional
 stimuli, 152, 157; evolution, 34;
 memory, 277; speech recogni-
 tion, 247; vision, 184, 184
 theory of mind, 236, 237
 thinking, 29
 Third Eye, 296
 thought, 317–28; lateral think-
 ing, 56; working memory,
 308–10, 308–9, 317, 320, 333
 tics, 85, 86–7, 93, 100
 tinnitus, 207–9, 208
 tone-deafness, 245
 tongue, sensory processing, 174
 touch, sense of, 49, 114, 117, 118
 Tourette, Georges Gilles de la, 84
 Tourette's syndrome, 83–4, 85,
 86–9, 96, 100, 101
 tranquilizers, 105
 trauma: post-traumatic stress
 disorder (PTSD), 160, 211,
 287; unconscious memories,
 160
 twins, 17, 78–9

 unconscious brain: anger, 144;
 emotions, 19–21, 82, 129;
 magnetic apraxia, 327; memo-
 ries, 160–1, 285–7; *see also*
 limbic system
 urges, 84–9, 95, 96–7, 327; artifi-
 cially generated, 315

 vasopressin, 124

 ventral tegmental nucleus, 31,
 104, 167
 ventromedial cortex, 162, 298,
 328
 ventromedial nucleus, hypothal-
 amus, 99, 102, 107, 115, 118
 Virgin Mary, 212, 215
 vision and visual cortex, 184–6,
 184, 191, 194; autokinetic
 effect, 213–15; blind spot,
 324–5;
 blindsight, 301–7, 302; differ-
 ences between people, 175–8;
 dreams, 318; emotional stim-
 uli, 152, 157; hallucinations,
 195, 203–7, 208, 210–12; and
 hypotheses, 199; illusions,
 212–22, 212–14, 216; reading,
 246; sensory processing, 29,
 49, 62, 174, 175, 178; split-
 brain experiments, 65–7, 68;
 synaesthesia, 19, 173, 176, 178,
 179; visual agnosia, 188, 190;
 visual association area, 251,
 318; visual consciousness,
 332–3
 visionaries, 211
 visuo-spatial sketch pad, working
 memory, 308–9, 309, 310
 voices, hallucinations, 195, 208,
 209
 von Economo neurons, 316

 Weiskrantz, Larry, 302–6
 Wellcome Department of
 Cognitive Neurology, 236, 309
 Wernicke, Carl, 10, 11, 32
 Wernicke's aphasia, 249–50
 Wernicke's area, 22, 226, 247,
 248, 249, 251, 251, 252, 253,
 256
 Whistler, James McNeill, 176
 white matter, 55
 Williams syndrome, 230–1, 276
 Wisconsin Card Sorting Task,

320-1
withdrawal symptoms, and drug
addiction, 105
word deafness, 249
working memory, 308-10,
308-9, 317, 320, 333
writing, 252-3

Zaidel, Eran, 68
Zajonc, Robert, 286
Zeki, Semir, 43