Index

Locators in italic refer to figures

A Natural History of Human Thinking (Tomasello), 132
abstract thinking, 143
adaptability; see also changing environments; plasticity
intelligent systems, 74
physiology, 75–77
role of behaviour, 79–80
Adaptive Intelligence (Sternberg), 21
adoption studies, 35–37, 152, 189, 194
Adult Intelligence Scale, Wechsler, 9
African hunting dogs, cooperative hunting, 131
age factors, IQ testing, 10–11, 11
ageing see disease and ageing
agricultural model of intelligence, 26–30, 43, 64–65, 103, 194
cognitive enhancement, 183
individual differences, 148, 152, 153
alleles, 27, 28; see also genetics of intelligence
allostasis, intelligent systems, 74
Alzheimer’s disease, 22
analogical reasoning, 15, 16, 143
analytical thinking, 21–22
Andolina, Ian, 115
animal intelligence see interspecific comparisons
anthropological studies, 153–155
anticipatory systems, 49, 50, 85; see also intelligent systems
circadian rhythms, 78
cognitive intelligence, 117–119
feelings/emotions, 121
neural networks, 82
physiology of organisms, 74–75
ants, 95, 127–128
‘Ants swarm like brains think’ journal article (Arnold), 127
apes, cooperative hunting, 132; see also primates
aptitude, 14, 169–170; see also promoting intelligence
Aristotle, 163
Armstrong, Scott, 173
Army Mental Tests (Yokum and Yerkes), 7–8, 9
Arnold, Carrie, 127–128
Arrival of the Fittest (Wagner), 85
The Art of the Deal (Trump), 129
Arthur, Wallace, 87
artificial intelligence, 183–184
atlases, functional, 125, 189
aurochs (wild cattle), 99
Bajo, Victoria, 118
Ball, Philip, 58
Bányai, Mihály, 115
Bao, Shaowen, 118
Baram, Tallie, 76
Barwich, Ann-Sophie, 117
Bastiaens, Phillipe, 71
Baverstock, Keith, 40, 53
bees, 84–85, 95
behaviour, 79–80; see also instincts
canalisation, 94
development, 87
genetics of, 25
and intelligence/intelligent systems,
57–58, 79–80
The Bell Curve (Murray and
Hernstein), 150
bell-shaped model, 2, 10, 10, 24, 148, 193
Bénard cells, 46, 46
Bernard, Claude, 73
Binet, Alfred, 5–6, 22
biofilms, 70
biogrammars, 49
bio-information intelligence, 58
biological perspectives, 25; see also
genetics; evolution
biomarkers, measures of intelligence,
23–24
birds, flocking behaviour, 128–129
blood count example, physiological
variations, 23
‘blooming, buzzing confusion’, 108, 183
Blueprint (Plomin), 34–35, 39, 149
Blumberg, Mark, 101
Boaler, Jo, 177
Bock, Laszlo, 174
Bonnardel, Nathalie, 144
Bouchard, Thomas, 31–32
brain; see also cerebral cortex; neural
networks/circuits
brain-to-brain coupling, 137–139
developmental plasticity, 96–97, 99, 159
evolution, 81–82, 137–139
eyesight see visual perception
implants, 183
misconceptions about
intelligence, 191
MRI studies, 122–125
non-visual senses, 116
role in intelligence, 105–107
structure, 112–116, 113
uses of testing in brain damage, 22
brain size/volume
evolution, 133–134, 135, 137–139
and intelligence, 122–124
interspecific comparisons,
129–130, 131
Romanian orphanage children, 159
brain-wide associations studies
(BWAS), 123
brightness, 169–170, 176; see also
educational attainment
Brown, James B. 62
Bruner, Jerome, 142, 177
Burt, Cyril, 8, 30–31
butterflies, developmental plasticity, 95
Caenorhabditis elegans (nematode
worm), 81–82
camera metaphor of visual perception,
107–108
canalisation, 93–94, 190, 195
Cannon, Walter, 73
car factory, comparison with DNA
coding, 62
causality, gene–organism relation, 53, 102–103
causation, and correlation, 11–12, 26, 39, 124
Ceci, Stephen, 18
cell(s)
  coordination, 68–70, 69, 73–75
differentiation, 88–90, 89
direction-sensing, 54, 55
  as intelligent systems, 55–57, 58
  knowledge, 58
  signalling, 70, 72–73, 75, 91–93
Centre for Education Policy and Equalising Opportunities (CEPEO), 172
cerebral cortex
  interspecific comparisons, 113, 135
  neural connectivity, 112–113, 114
  role in social interaction, 137–139
  structure, 112–116, 113
changing environments; see also anticipatory systems; plasticity
  adaptability, 75–77
agricultural model, 29
development of multicellular organisms, 93
evolution, 67–68, 71
innate behaviour, 100–101
intelligent systems, 194–195
life-long development, 97–98
misconceptions about intelligence, 190, 193
role of behaviour in, 79–80
role of intelligence in, 84–85
sensitivity of living systems, 54–55
child development, 142
Chillingham herd, 99
Chinese method of maths learning, 178
Chomsky, Noam, 144
Christe, Philippe, 64
chronological age, IQ testing, 6
circadian rhythms, physiology, 77–79, 78
Clark, Cory J. 164
class see social class
classificatory approaches, IQ testing, 5–6
Clinton, President Bill, 44
Cobb, Matthew, 106, 107
coefficient of heritability, 30
Cofnas, Nathan, 164
cognition/cognitive intelligence,
  195–196; see also correlational patterns; intelligence; visual perception
  brain structure, 112–116
  and consciousness, 118–119
experience-dependence, 119–120
feelings/emotions, 120–121
mechanical metaphors, 105–107
MRI studies, 122–125
non-visual senses, 116
references/further reading, 204–205
cognitive biology, 57, 58
cognitive enfranchisement, 185
cognitive enhancement, 182–183
cognitive systems, xix, 84–85, 130, 136, 145, 195; see also intelligent systems
collective intelligence, 137–139,
  144–145, 146–147, 186
collective learning, 178
complexity
  cell coordination, 68–70, 69
  evolution, 67–70
  IQ testing as inadequate measure, 18–19
  multicellular systems, 70–72
Complexity (Mitchell), 46
computational metaphor of the brain,
  106, 183; see also mechanical metaphors
concentration gradients, role in cell signalling, 92
conscientiousness, and attainment, 170, 174
consciousness, thought experiment, 118–119
construct validity see validity of IQ testing
context-sensitive intelligent systems, 62, 184, 194–195; see also changing environments
cooperative hunting, 130–132, 153–155, 196
coordination, mechanical metaphors of, 73–75
cornflakes in a packet metaphor, xix, 15, 26
correlations
adoption studies, 35–37
agricultural model, 28
and causation, 11–12, 26, 39, 124
IQ testing, 11–12
polygenic scores, 39, 40–43
twin studies, 30–31, 32–35
correlational patterns, 51–52, 195–196
cognitive intelligence, 117–119
collective intelligence, 147
development, 86
environment as, 51–52
evolution of intelligence, 84
experience-dependence, 119–120
feelings/emotions, 120–121
memory, 145–146
non-visual senses, 116
sensitivity of cell receptors, 54, 55
visual perception, 108–112
COVID-19 epidemic, 51, 169, 179
creativity, 21–22
Crick, Francis, 92
Csikszentmihalyi, Mihaly, 162
cultural intelligence, 148, 190–191, 193
culture/cultural tools, 196
child development, 142
evolution, 139–141, 148
individual differences in intelligence, 148, 154
language, 144–145
memory, 145–146
misconceptions about intelligence, 191
psychological tools, 141–142
science, 146
shared/collective, 146–147
Cummings, Dominic, xix
curriculum, school see school curriculum
cystic fibrosis, role of genes, 101
cytokines, 73
Damer, Bruce, 47
Daphnia, developmental plasticity, 95
Darwinism/Charles Darwin, 2, 47
costant vs fluctuating environments, 52
evolution of complexity, 67
On the Origin of Species, 52, 66, 131
theory of gradual evolution, 135–136
Dawkins, Richard, 44
de Vries, Hugo, 85
de Weerth, Carolina, 158
dementia, 22
dendrites, 82
deprivation, consequences, 159; see also social class
determinism, genetic, 86, 149, 150, 151, 152, 182, 190
development see child development; multicellular organisms
Dewey, John, 163
differences see individual differences in intelligence
differentiation, cell, 88–90, 89
direction-sensing by cells, 54, 55
disease and ageing
physiology, 77
role of genes, 101–102
distributed social cognition, 139
DNA, 37–39, 38; see also genetics of intelligence
Donald, Mervin, 147
Drosophila, 62, 112
Duckworth, Angela, 170
Dumbing Us Down: The Hidden Curriculum of Schooling (Gatto), 177
Dunbar, Robin, 129
dynamic systems, 51

educational attainment; see also promoting intelligence
and IQ testing, 170–171
and learning ability, 175–176
misconceptions, 188, 193
school attainment, 171–173
university-level attainment, 172–173
educational system, 168–170
alternatives/critique of curriculum, 178–180
compensatory programmes, 180–182
school curriculum, 176–180, 197

efficiency, mental see mental power

Einstein, Albert, 162
eleven-plus exam, 8
emergent properties, intelligent systems, 119, 137, 139
emotional intelligence, 121, 174
emotions, role in intelligent systems, 120–121
endocrine system, 75
The Enigma of Reason (Mercier and Sperber), 143
enrichment/enriched environments, 180–181
environmental changes see changing environments

environmental factors in intelligence; see also nature–nurture debate
constant vs fluctuating, 52–53
correlational patterns, 51–52
environment as correlational pattern, 51–52
individual differences in intelligence, 158–160
misconceptions about intelligence, 188–189, 191–192
epigenetics, 91, 93, 99, 100, 159
equal environments assumption (EEA), twin studies, 33
equal opportunities, 184–187, 197
equality/social justice, xvii
Erbil, Deniz Gökçe, 180
Ernst & Young Global Ltd. 175
Escherichia coli, 54, 58
eugenics, xix, 2, 8, 165, 197; see also racial perspectives
Evo-Devo (Arthur), 87
Evolution in Changing Environments (Levins), 67
Evolution of the Modern Mind (Donald), 147

evolutionary perspectives, 66–67, 84–85, 126–127, 195
adaptability, 75–77
behaviour, 79–80
brain expansion, 137–139
cell coordination, 68–70, 69
complexity, 67–70
cooperative hunting, 130–132, 153–155
culture/cultural tools, 139–141, 148
and development, 87
feed-forward/feedback loops, 138, 139, 141
fitness for social interaction, 135–137
human, 133, 135, 136, 196
intelligent systems, 147, 148
evolutionary perspectives (cont.)
language, 144–145
mammals, 129–130
memory, 145–146
multicellular systems, 70–72, 103–104
nervous systems, 80–82, 81
primates, 130, 132
references/further reading, 202–203, 205–207
shoals, flocks, and herds, 128–129
swarm intelligence, 127–128
thinking/reasoning, 142–144
exam fiasco, COVID-19 epidemic, 169
exam success see educational attainment
‘Exceptionally Gifted’ study, 161
exon shuffling, 62
experience-dependence, pattern abstractions, 119–120
expertise, alternative conceptions of intelligence, 21
Extraordinary Minds (Gardner), 20–21
eyesight see visual perception

feelings, role in intelligent systems, 120–121
Feldman, Daniel, 173
ferrets, 96, 118
fight or flight system, 76
Finnish educational system, 179
fish, 97, 128–129
Fisher, Ronald, 27, 27–30
fitness, evolutionary, 2, 135–137, 151, 190; see also natural selection
flocking behaviour, 128–129
fluid intelligence, UK Biobank assessment, 43
Flynn effect/James Flynn, 19, 106
Foundation for European Progressive Studies, 168
Frankenhuis, Willem, 158
Freeman, Walter, 118
‘Frontiers’ blog (Lebedev), 183
fruit fly, 62, 112
functional atlases, 125, 189
functional MRI (fMRI), 122–123, 152, 182
Galton, Sir Francis, 2–4, 5
Gardner, Howard, 20–21
GATTACA film, xix
GDP, national differences, 164–165
gender, xvii, xv, 163
general intelligence factor (g), 11–12
misconceptions about intelligence, 188
moving beyond IQ testing/alternative conceptions, 21–22
other factors which influence success, 19–20
gene(s); see also below
constant vs fluctuating environments, 52–53
intelligent systems, 44–45, 58, 60
mutation, 66, 67

familiarity factors, IQ testing, 14–17, 19, 143
Farah, Martha, 182
fatalism, 157; see also deterministic feeblemindedness, historical perspectives, 167, 6–7
feed-forward/feedback loops, 195–196
artificial intelligence, 184
cell signalling, 70
circadian rhythms, 77–79
development of multicellular organisms, 93
homeostasis, 74
human intelligence, 138, 139, 141
intelligent systems, 55, 57
starling murmurations, 128
visual perception, 109, 113–115

familiarity factors, IQ testing, 14–17, 19, 143
Farah, Martha, 182
fatalism, 157; see also deterministic feeblemindedness, historical perspectives, 167, 6–7
feed-forward/feedback loops, 195–196
artificial intelligence, 184
cell signalling, 70
circadian rhythms, 77–79
development of multicellular organisms, 93
homeostasis, 74
human intelligence, 138, 139, 141
intelligent systems, 55, 57
starling murmurations, 128
visual perception, 109, 113–115

feelings, role in intelligent systems, 120–121
Feldman, Daniel, 173
ferrets, 96, 118
fight or flight system, 76
Finnish educational system, 179
fish, 97, 128–129
Fisher, Ronald, 27, 27–30
fitness, evolutionary, 2, 135–137, 151, 190; see also natural selection
flocking behaviour, 128–129
fluid intelligence, UK Biobank assessment, 43
Flynn effect/James Flynn, 19, 106
Foundation for European Progressive Studies, 168
Frankenhuis, Willem, 158
Freeman, Walter, 118
‘Frontiers’ blog (Lebedev), 183
fruit fly, 62, 112
functional atlases, 125, 189
functional MRI (fMRI), 122–123, 152, 182
Galton, Sir Francis, 2–4, 5
Gardner, Howard, 20–21
GATTACA film, xix
GDP, national differences, 164–165
gender, xvii, xv, 163
general intelligence factor (g), 11–12
misconceptions about intelligence, 188
moving beyond IQ testing/alternative conceptions, 21–22
other factors which influence success, 19–20
gene(s); see also below
constant vs fluctuating environments, 52–53
intelligent systems, 44–45, 58, 60
mutation, 66, 67
passive role, 53
role in development, 98–100, 101–103
gene–environment interactions, 29
gene–gene interactions, 29
gene transcription
  complexity of, 61–63
  in intelligent systems, 58, 60
genetic determinism, 86, 149, 150, 151, 152, 182, 190
genetic engineering, 62, 102, 192
‘Genetic Studies of Genius’ study (Terman), 161
genetics of intelligence, 25–26, 194; see also adoption studies; twin studies
  agricultural model, 26–30
  Burt, 30–31
  DNA, 37–39, 38
educational system, 170
  Fisher, 27, 27–30
individual differences, 149–150
make-do research culture, 35, 43
misconceptions, 44–45, 188–189, 191–192, 193
polygenic scores, 39–43
references/further reading, 199–200
  single nucleotide polymorphisms, 38
  study critiques, 37–39, 40–43
‘The genetics of university success’ report, 173
geniuses, 160–162, 192
genome, as read–write (RW) system, 62
genome-wide association studies (GWAS), 39, 151
  Ghazanfar, Asif A. 79
  Gibson, James, 108
gifted children, 160–162, 192
  Glaser, Robert, 143
Global Challenges conference, 106, 107
  Goddard, Henry H. 6–7
  Goldberger, Ary, 76
  Goldthorpe, Richard, 183
  Gomez-Marin, Alex, 79
  Goodwin, Brian, 92
  Google, 174
  Google Health, 184
  Gottfredson, Linda, xvii, 16, 18
  Grant Thornton financial services company, 174
  Gray, Peter, 153
  group mind, 138
  Haier, Richard, xvii
  Handy, Charles, 185
  Hariri, Ahmad, 125
  Head Start programme, US, 181
  heart rate physiology, 77
  herd behaviour, 128–129
Hereditary Genius (Galton), 3
heritability, 26–27, 28, 30; see also genetics of intelligence; twin studies
  coefficient of, 30
  limitations of concept, 63–65
  misconceptions about intelligence, 189
Hernstein, Richard, 150
high achievers, 160–162, 192
historical perspectives, xv, 2
  Binet, 5–6
  British use of, 8
  classificatory approaches, 5–6
  Galton, 2–4, 5
  Goddard, 6–7
  ideological issues, xix
  mass testing developments, 7–8
  original mental endowment concept, 6–7
  physiological tests/urine analysis, 4, 5, 23–24
  Spearman, 12
  Spencer, 2
  Terman, 7, 8
historical perspectives (cont.)
validity, 4
visual perception, 108
Wechsler, 9
homeostasis, 73–74, 76
Homo sapiens, 134, 135, 136; see also
human evolution
house martin, heritability studies, 64
How to Argue with a Racist
(Rutherford), 167
Hsu, Stephen, 160
Human Behaviour and Evolution
Association, 18
Human Brain Project, European, 183
Human Diversity (Murray), 33, 150
human evolution, 133, 135, 136, 196; see also
culture/cultural tools
Human Genome Project, 40, 44, 45, 101
Hunt, Earl, 182
Hunter, John, 13–14
hunter-gatherer groups, 153–155
hunting, cooperative, 130–132,
153–155, 196
Huntington’s disease, 101, 102
Huxley, Aldous, 86
Hydra, nervous system, 80, 81
hyperbrain networks, 139
hypothalamic–pituitary–adrenal axis
(HPA axis), 76

The Idea of the Brain (Cobb), 106
immune system, life-long
development, 97
inclusivity, promoting intelligence,
184–187
individual differences in intelligence,
148, 196–197
agricultural model, 148, 152, 153
anthropological studies, 153–155
culture/cultural tools, 148, 154
environmental factors, 158–160

giftedness, 160–162
misconceptions about intelligence,
188–189, 191–192
Mitchell, 151–152
Murray, 150–151
passive variation, 152
Plomin, 149–150
race, 162–167
references/further reading, 207–209
social class, 155–158, 163
social factors, 153–155
social order/control, 148–149, 157
inequality, 184–187, 197; see also social
class
information theory, 51
Innate (Mitchell), 15, 33, 124, 151
innate behaviour see instincts
innate intelligence, 168; see also
educational attainment
insects
bees, 84–85
evolution of intelligence, 84
neural networks, 82
swarm intelligence, 127–128
instincts, 66, 79, 94, 106, 195
developmental processes, 100–101
and intelligence, 100–101
thinking/reasoning, 144
intelligence (general information); see
also IQ testing
at cellular level, 55–57, 58
definitions, xvii–xviii, 50
ideological issues, xviii–xix
and instincts, 100–101
misconceptions, 188–193
MRI studies, 122–125
new/alternative conceptions, xix,
20–22
terminology, 1, xvii

Intelligence and Human Progress
(Flynn), 106
The Intelligence Trap (Robson), 20
intelligent systems, 44–45, 194–195; see also canalisation; changing environments; correlational patterns; feed-forward/feedback loops; self-organising systems
allostasis, 74
as anticipatory systems, 85
Bénard cells, 46, 46
cell signalling, 70
cellular level, 57
cognitive intelligence, 117–119
complexity of gene transcription, 61–63
and consciousness, 118–119
constant vs fluctuating environments, 52–53
developmental plasticity, 94–95
evolution, 67–68, 135–136
feed-forward/feedback loops, 55, 57
feelings/emotions, 120–121
gene transcription, 58, 60
individual differences, 148
intelligent behaviour, 57–58
intelligent life, 49–51
limitations of heritability concept, 63–65
misconceptions about intelligence, 190
multicellular, 93, 95, 96–98, 102, 103–104
origins of life, 47–48
origins of systems, 48–49
passive role of genes, 53
references/further reading, 200–202
RNA splicing, 61, 63
sensitivity of cell receptors, 54, 55
shared/collective intelligence, 147
interspecific comparisons; see also specific animals
brain size/volume, 129–130, 131, 133–134
cerebral cortex, 113, 135
cognitive intelligence, 117–119
culture, 139–141
differences in degrees and kinds, 135–136, 190
evolution of intelligence, 130–132
misconceptions about intelligence, 190–191
intersubjectivity, child development, 142
interthinking, 139
‘invariance under transformation’, 108
invisible social brain, 139
IQ and Human Intelligence
(Macintosh), 8
IQ and the Wealth of Nations (Lynn and Vanhanen), 164–165
IQ testing, 1–2, 194; see also validity age factors, 10–11, 11
alternatives to, 21–22
bell-shaped curve, 2, 10, 10, 148
Binet, 5–6
British use of, 8
classificatory approaches, 5–6
complexity of cognitive processing, 18–19
factors which influence success, 19–20
familiarity with test items, 14–17, 19, 143
Galton, 2–4, 5
general intelligence factor, 11–12
Goddard, 6–7
ideological issues, xix
mass testing developments, 7–8
matrix tests, 16, 17
mechanical model of mind/mind as machine, 12
misconceptions about intelligence, 188, 193

© in this web service Cambridge University Press www.cambridge.org
IQ testing (cont.)
nonverbal analogy/analogical reasoning, 15, 16
original mental endowment concept, 6–7
outcome prediction, 170–171
physiological tests/urine analysis, 4, 5, 23–24
quality of studies, 125
references/further reading, 198–199
role in social order/control, 149, 157
social class, xvii, 16, 19, 176–178
Spearman, 12
Spencer, 2
Terman, 7, 8
thinking/reasoning, 142–144
uses of testing, 22–23
Wechsler, 9

Jackson, Jacquelyne Faye, 36
Jaeggi, Susanne, 182
James, William, 108
jellyfish, nervous systems, 80
Jensen, Arthur, 182
job performance see occupational success
Joëls, Marian, 76
Johnson, Boris, xix, 15, 26
Joint Research Centre of the European Union, 40
Joseph, Jay, 32
Kahneman, Daniel, 143–144
Kampourakis, Kostas, xv, 46, 66
kinetic depth effect, 109
King, Andrew, 118
Kohn, Alfie, 178
Koseka, Aneta, 71
Kureishi, Hanif, 166, 167
labelling, 176
ladder metaphor, 1

language, evolution, 140, 144–145
lateral geniculate nuclei (LGN), 113
latte art, 45, 46
league tables, PISA, 178
learning, 116
learning ability, 168–170
and outcome prediction, 171–173, 175–176
and social class, 176–178
Lebedev, Mikhail, 183
Lee, James, 39
Lehrer, Miriam, 85
Lenon, Barnaby, 171
Levins, Richard, 67
Lewontin, Richard, 148
life/living systems
intelligent, xx, 49–51; see also
intelligent systems
natural selection, 48
origins of, 47–48; see also evolution
sensitivity to change, 54–55
Liker, Jeffrey, 18
locusts, developmental plasticity, 95
logical thinking/reasoning, 142–144
Lorentz, Hendrik, 162
Lubinski, David, 161
Lyell, Charles, 67
Lynn, Richard, 164–165
machine metaphors see mechanical metaphors
Macintosh, Nicholas, 8, 9
magnetic resonance studies, brains, 122–125
mammals, 113, 129–130; see also
primates
mapping, functional atlases, 125, 189
mass testing developments, IQ
testing, 7–8
maternal nutrition/stress, 159; see also
epigenetics
INDEX  221

mathematics, school curriculum, 177
matrix tests, 16, 17, 143
Maxwell, James Clerk, 162
McGregor, Simon, 49
mechanical metaphors of mind, 12, 105–107, 111–112, 113, 118, 194
eyesight see visual perception
feelings/emotions, 120–121
IQ testing, 125
misconceptions about intelligence, 191
MRI studies, 122–125
Melhuish, Edward, 181
membranes, cell, 54, 55
memory, human evolution of intelligence, 145–146
Mendel, Gregor, 27, 101, 102
mental age, IQ testing, 6
mental power, xviii, 12, 16, 19
biological perspectives, 25
mechanical metaphors, 12, 106, 194
misconceptions about intelligence, 188
metabolic memory, 58
metazoa see multicellular organisms
Metrical Scale of Intelligence (Binet and Simon), 5
Minnesota Study of Twins Reared Apart (MISTRA) study, 31–32
Mitchell, Amit, 58
Mitchell, Kevin, 55, 59, 106, 151–152
Innate, 15, 33, 124, 151
Mitchell, Melanie, 46
molecular grammars, 49
monkeys, cerebral cortex, 113
Morgan, Thomas H., 160
motivation, role in outcome, 174
MRI studies, brains, 122–125
multicellular organisms, development, 86–87, 101
brains, 96–97, 99
canalisation, 93–94, 195
cell differentiation, 88–90, 89
cell signalling, 91–93
evolution, 70–72, 103–104
information provided by egg and sperm, 90
instincts, 100–101
intelligent systems, 93, 95, 96–98, 102, 103–104
life-long development, 97–98
physiology, 72–73
plasticity, 94–95
references/further reading, 203–204
role of genes, 98–100, 101–103
stem cells, 88, 90
Multiple Intelligences (Gardner), 20–21
murmurations, starlings, 128
Murray, Charles, 33, 150–151
mutation, genetic, 66, 67
national differences in intelligence, 164–165; see also racial perspectives
National Foundation for Educational Research, 173
Natural Genetic Engineering (NGE), 62
A Natural History of Human Thinking (Tomasello), 132
natural selection, 48–49, 52, 66, 85, 103; see also fitness
nature–nurture debate, xviii, 25–26, 29, 30, 152, 191–192; see also environmental factors; genetics
neural networks/circuits, 80–82, 83, 112, 195–196
cerebral cortex, 112–113, 114
evolution, 80–82, 81
experience-dependence, 119–120
feed-forward/feedback loops, 55–57
function, 80–82
functional atlases, 125
nature–nurture debate (cont.)
misconceptions about
intelligence, 191
visual perception, 110
neuroeducation, 182, 183
neurogenetic reductionism, 105
Ng, Thomas, 173
Nijhout, Frederik, 53, 99
Noble, Denis, 53, 57, 92, 102
nonverbal analogy, IQ testing, 15, 16
normal distribution see bell-shaped model
nucleotides, 38, 40–41
occupational success, 13–14, 169, 171, 173–175, 188
Office of Qualifications and Examinations Regulation (Ofqual), 171
olfactory processing, 117
*On the Origin of Species* (Darwin), 52, 66, 131
one gene–many proteins model, 61–63
one gene–one protein model, 60, 189
*Origin of Species* see *On the Origin of Species*
original mental endowment concept, 6–7
outcome prediction by IQ tests see educational attainment
*Outgrowing God* (Dawkins), 44
Oxford Brookes Business School, 172
oxygen absorption, physiology, 75–76
Pagán, Oné R. 70
Paige Harden, K. 65
Panofsky, Aaron, 165
*Paramecium*, intelligent behaviour, 58
parasites, evolution, 72
Parkinson, John, 55
passive variation, intelligence, 152
pattern abstractions/assimilation function see correlational patterns
Penguin Random House, 175
perception, visual see visual perception
persistence, role in educational attainment, 170
phenylketonuria (PKU), role of genes, 101
physiological measures of intelligence, 4, 5, 23–24, 78–79
physiology of organisms adaptability, 75–77; see also changing environments
circadian rhythms, 77–79, 78
hormone systems, 75
hypothalamic–pituitary–adrenal axis, 76
mechanical metaphors of cell coordination, 73–75
multicellular systems, 72–73
Piaget, Jean, 52, 95
Pilpel, Yitzhak, 58
Pinker, Steven, 144
Piran, Mehran, 62
plasticity; see also changing environments
developmental, 94–97, 99
life-long development, 97–98
misconceptions about intelligence, 190
neural networks, 82
Plomin, Robert, 31–32, 33, 39, 59, 172
*Blueprint*, 34–35, 39, 149
individual differences in intelligence, 149–150
polygenic scores, 40
Twins Early Development Study, 35
pluripotent stem cells, 88, 90
point light walker, visual perception, 110–111, 111
political perspectives, individual differences, 163
pollutants, environmental factors in intelligence, 159
polygenic scores, 39–43
polyphenisms, 95
Poropat, Arthur, 170
power of mind see mental power
Practical Assessment of Clinical Examination Skills (PACES), 173–174
practical intelligence, 21–22
predictive validity, 13–14; see also validity of IQ tests
preformationism, 86, 190; see also determinism
PriceWaterhouseCooper, 175
primates
cerebral cortex, 113
cooperative hunting, 132
evolution of intelligence, 130, 132
misconceptions about intelligence, 190–191
principle of adequate design, 23
problem-solving ability, 188
processing speed see mental power
promoting intelligence, 168, 197; see also educational attainment; educational system; occupational success
artificial intelligence, 183–184
cognitive enhancement, 182–183
inclusivity and equal opportunities, 184–187
misconceptions about intelligence, 192
references/further reading, 209–210
proteins, 40
proto-brains/proto-cognitive abilities, 70
Pseudomonas spp., evolution, 70
psychological tools, 141–142
quantitative genetics, 29–30; see also genetics of intelligence
quorum sensing (QS), cell signalling, 70
racial perspectives, xvii, xv, 197
controversies, 164–166
educational system, 182
individual differences in intelligence, 162–164
misconceptions about intelligence, 192
race as social not biological construct, 166–167
Radulescu, Eugenia, 124
Ralser, Markus, 47
Rashevsky, Nicolas, 23
Raut, Ryan V. 74
Ravens Matrices tests, 16, 17
‘read–write’ (RW) information storage systems, 62
reasoning, human evolution, 142–144
reductionism, neurogenetic, 105
reflective conversation, 144
relativity theory, 162
reptiles, developmental plasticity, 95
reputation, as measure of intelligence, 3
rhythms, circadian, 77–79, 78
Richter, Curt, 74
Ritalin, 182
Ritchie, Stuart, xvii
RNA splicing, 61, 63
Robson, David, 20
Rock, Irving, 108
Romanian adopted children study, 123, 159
Rose, Steven, 148
Rosen, Robert, 49
rote learning, 177–178, 179
roundworms, nervous system evolution, 81–82
Routledge Companion to Gifted Education (Claxton and Meadows), 161
Rutherford, Adam, 167
Rutter, Michael, 123
Saini, Angela, 157, 163
Salehi, Mehraveh, 125
Sammons, Pam, 158
Sapolsky, Robert, 157
Scarr, Sandra, 36
Schmidt, Frank, 13–14
Schönemann, Peter, 64
school curriculum, 176–180, 197
Schrader, Sven, 115
science, as cultural tool, 146
score patterns, validity of IQ testing, 9–11, 10
Scribner, Sylvia, 143
Seghier, Mohamed, 182
selective breeding, 192
Self and Identity journal article (Jackson et al.), 157
self-confidence/self-esteem
educational attainment, 19–20, 170, 176
social class, 156
stress hormones, 157
self-organising systems, 45–46, 47–48, 118, 190; see also intelligent systems
The Selﬁsh Gene (Dawkins), 44
sensory reception, 107
shape perception, 48, 108, 109; see also visual perception
Shapiro, James, 62
shared intelligence, 137–139, 144–145, 146–147, 186
shared intentionality, 132
shoaling behaviour, fish, 128–129
Shteynberg, Garriy, 178
sight see visual perception
Simon, Henri, 5
single nucleotide polymorphisms (SNPs), 38, 40–43; see also genetics of intelligence
slime mould (Dictyostelium), evolution, 68–69, 69
social brain hypothesis, 129
social class, 124, 151, 196–197
and differences in intelligence, 153–158, 163
educational system, 170
inclusivity and equal opportunities, 185, 186
IQ testing, xvii, 16, 19–20, 176–178
social interaction
culture/cultural tools, 139–141
evolution of intelligence, 126–127, 129–130, 135, 139
giftedness, 162
shared intelligence, 138, 144–145, 146–147, 186
social justice, xvii; see also equal opportunities
social order/control, role of IQ testing, 148–149, 157
Spearman, Charles, 12
speed of processing see mental power
Spencer, Herbert, 2
spiders, neural networks, 82
The Spirit Level (Wilkinson and Pickett), 157
sponges, marine, 80
stabilising agents, 48
Stanford–Binet test, 8, 9
starling murmurations, 128
statistical significance, MRI studies, 124–125
stem cells, 88, 90
stereotype threat, 166
Sternberg, Robert, 21–22
stochastic resonance, 78
stress
brain size/volume, 123–124
hypothalamic–pituitary–adrenal axis, 76
and self-esteem, 157
INDEX 225

‘Study of Mathematically Precocious Youth’ (SMPY), 161
super-brains, 139
‘Super-intelligent humans are coming’ journal article (Hsu), 160
Superior (Saini), 157
Sur, Mriganka, 96
Sure Start programme, UK, 181
survival of the fittest, 2, 135–137, 151, 190; see also natural selection
swarm intelligence, 127–128
symbols/symbolic tools, 140
synaptic pruning, 97
The Systems Model of Creativity (Csikszentmihalyi), 162
systems, origins of, 48–49; see also intelligent systems
tacit model of intelligence, 12, 123
talents, alternative conceptions of intelligence, 21
taxi drivers, 120, 146–147
Taylor, Steve, 154
Téglás, Erno, 18
Terman, Lewis, 7, 8, 161
test–retest reliability, MRI studies, 124–125
thermostat metaphor, homeostasis, 74
thinking, human evolution of, 142–144
Thinking Big: How the Evolution of Social Life Made Us Human (Dunbar et al.), 129
Thinking Fast and Slow (Kahneman), 143–144
three-dimensional shape perception, 48, 108, 109; see also visual perception
Tomasello, Michael, 132
tool use, evolution, 134, 139–140
toxins, environmental factors in intelligence, 159
transcription factors (TFs), 59; see also gene transcription
transgenerational epigenetics, 100
Trump, Donald, 129
Turing, Alan, 92
Turkheimer, Eric, 159
twin studies, 28, 152, 194
Burt, 30–31
classical, 32–33
false assumptions, 33–35
make-do research culture, 35
misconceptions about intelligence, 189
MISTRA study, 31–32
study limitations, 32
Twins Early Development Study (TEDS), 35
Tyagarajan, Tiger, 186

UK Biobank, 43
Understanding Evolution (Kampourakis), 46, 66
universe, origins of, 45–46
university outcome prediction, 172–173; see also educational attainment
urine analysis, validity of measures, 4
validity of IQ testing, 4, 8–14, 152
age factors, 10–11, 11
correlation/correlation coefficient, 11–12
predictive validity, 13–14
score patterns, 9–11, 10
Vanhanen, Tatu, 164–165
verbal intelligence, 145
verbal reasoning, 15
Vibrio cholerae, 58
violinists, 120, 146–147
visual cognition, 117; see also cognitive intelligence
visual perception
   brain structure, 112–116
   camera metaphor, 107–108
   correlational patterns/pattern abstractions, 108–112
   feed-forward/feedback loops, 109, 113–115
   neural connectivity, 110
   point light walker, 110–111, 111
Volvox, physiology, 73

Waddington, Conrad, 93
Wagner, Andreas, 85, 99
Wallach, Hans, 109
water snails, developmental plasticity, 95
Watson, James, 165

Wechsler, David, 9
Wechsler Digit Symbol test, 22
Wechsler Adult Intelligence Scale, 9
Weinberger, Daniel, 124
West-Eberhard Mary Jane, 104
The Wisdom of the Body (Cannon), 73
Wissler, Clark, 5
Wolpert, Lewis, 92
Woodhead, Chris, 169
World Forum for Democracy (2016), 185
Wright, Jeremiah, 99
Yang, Chengran, 62
Yerkes, Robert, 7–8, 9
Yokum, Clarence, 7–8, 9