

Index

active inference, 327, 338–339, 349
 addiction
 video gaming, 47–48
 aging
 effects on attention, 104
 air traffic control, 44–45
 airport security screening, 41–44
 alerting function of attention, 29
 allocentric neglect, 96, 349
 Alzheimer’s disease, 67, 68
 distinction from healthy aging, 27
 angular gyrus (AG)
 TMS studies, 239–241
 anterior cingulate cortex (ACC), 220
 effects of meditation practices, 264
 ERP studies of error responses, 247–251
 role in attentional control, 245–247
 anterior insula, 236
 anterior P2 attention effect, 152
 anxiety disorders, 27
 attention bias toward threatening stimuli, 114–116
 neurobiological sex differences, 109
 artificial intelligence (AI), 9
 attention
 interaction with expectation, 340–343
 question of what it actually does, 20–21, 23–26
 types of, 23
 attention deficit disorder (ADD), 104, 105
 attention deficit hyperactivity disorder (ADHD), 27, 29, 104–109
 attentional blink (AB) deficits, 282–283
 brain connectivity patterns associated with, 253–256
 diagnostic criteria (DSM-5), 105–106
 effects of video game playing, 267
 history of, 105–106
 insights from the attention network task (ANT), 106–107

subtypes, 105–106
 using video games for diagnosis and therapy, 47
 attention network task (ANT), 29, 257, 264
 in ADHD, 106–107
 in autism spectrum disorder (ASD), 108
 attentional bias
 attention bias modification (ABM) training, 115–116
 in clinical disorders, 114–116
 inhibition of return (IOR), 169–170
 predictive coding perspective, 340
 reward-driven, 205–209
 attentional blink (AB), 56, 274–286, 349
 across sensory modalities, 279–280
 alpha entrainment, 278–279
 causal studies, 283–286
 definition of, 274
 effects of binaural beats, 286
 neural mechanisms, 276–280
 neural sites of conscious and unconscious perception, 280–283
 neurostimulation studies, 283–286
 overcoming, 288
 rapid serial visual presentation (RSVP) task, 274–275
 stimuli that are immune to the blink, 282
 attentional blink (AB) paradigm, 343
 attentional blink (AB) task, 296–297
 attentional capture. *See* capture of attention
 attentional control
 brain plasticity and the training of attentional control networks, 256–271
 brain training studies, 256–260
 cognitive control of attention, 26–29
 components of the dorsal attention network, 215–216

components of the ventral attention network, 236
 dorsal attention network, 214–236
 effects of video game playing and brain training, 265–271
 endogenous vs. exogenous control, 222–224
 ERP indices of attentional processes, 229–231
 evidence from neglect syndromes, 214–215
 evidence from split-brain (callosotomy) patients, 218–219
 executive control of attention, 244–256
 features of, 213–214
 functions of the ventral attention network, 236–237
 meditation and mindfulness training, 260–264
 neurofeedback, 258–260
 neuroimaging evidence of parietal and frontal control regions, 215–225
 neuropsychological evidence for the roles of the ventral attention network, 237–238
 neurostimulation studies of the dorsal attention network, 225–228
 pulvinar nucleus of the thalamus, 243–244
 reticular nucleus of the thalamus, 243
 self-initiated shifts in attention, 218–222
 single- and multiunit studies, 232–236
 subcortical control regions, 242–244
 superior colliculus, 242
 supervisory attention system, 245–247
 TMS studies of the ventral attention network, 239–242
 ventral attention network, 236–242
 attentional load, 28

- attentional neglect. *See* neglect syndromes
- attenuating filter theory (Treisman), 15, 127–128
- auditory attention, 25
- localizing neural effects with fMRI, 159–160
- neural effects, 158–159
- neural effects in what vs. where regions, 160–161
- remapping of the auditory complex, 162
- subcortical effects, 162–163
- See also* cocktail party phenomenon
- auditory complex
- remapping by auditory attention, 162
- auditory stimuli
- attentional blink (AB), 279–280
- binaural beats, 286
- autism spectrum disorder (ASD)
- neurobiological sex differences, 109
- predictive coding perspective, 329–330
- role of attention, 108–111
- automatic capture of attention, 178–181
- predictive coding perspective, 346–348
- Bain, Alexander, 17
- Bálint's syndrome, 25, 98–101
- Bayesian theory
- predictive coding models, 316
- behaviorism, 349
- anti-mentalist view of psychology, 6
- Chomsky's critical review, 9–10
- conditioning experiments, 6
- effects of the cognitive revolution, 6–10
- influence on attention research, 4–5
- influence on psychology research, 27
- limitations of, 6–10
- limitations of the behaviorist training approach, 7–8
- Berger, Hans, 73–74, 301–302
- bias. *See* attentional bias
- biased competition model of attention, 54–55
- binaural beats (BB), 286, 349
- binding problem
- feature integration theory (FIT), 23–26
- Binet, A., 52
- BOLD (blood oxygenation level-dependent) imaging, 69–70, 349
- bottom-up model of perception, 315–317
- bottom-up processing
- exogenous (involuntary) attention, 168
- See also* predictive coding models
- brain injury patients
- advent of neuroimaging, 63–64
- Bálint's syndrome, 98–101
- evidence from, 58
- focal lesions to subcortical structures, 102–103
- localization of cognitive functions in the cortex, 61
- neglect syndromes, 92–98
- progressive supranuclear palsy (PSP), 101
- simultanagnosia, 98–101
- brain localization of attention
- combining methods for enhanced spatiotemporal localization, 140
- neuroimaging studies, 136–140
- single-unit recordings, 142–145
- visual system, 135–136
- brain plasticity, 45
- brain training studies, 256–260
- meditation and mindfulness training, 260–264
- remapping of the auditory complex, 162
- training of attentional control networks, 256–271
- brain training studies, 256–260
- effects of video game playing, 265–271
- meditation and mindfulness training, 260–264
- training of attentional control networks, 256–271
- Broadbent, Donald, 12–13
- Broca, Paul, 61, 62, 63
- patient Tan case study, 61
- cancer diagnosis, 67
- capture of attention
- automatic capture, 178–181
- contingent capture, 178–181
- faces, 187–188
- influence of selection history, 209–211
- interaction between emotions, faces, and social gaze, 190–193
- joint attention, 188–190
- looming stimuli, 196
- predictive coding perspective, 346–348
- reward-driven attentional bias in substance users, 208–209
- saliency, 186–187
- social-gaze orienting, 188–190
- special status of new objects, 193–196
- catecholamine system
- role in ADHD, 108
- cell phones
- distraction when driving, 32–36
- cellular recording
- nonhuman animal studies, 86–87
- cerebellum, 289
- change blindness, 21
- Cherry, Colin, 12, 167
- cholinergic system
- role in ADHD, 107
- Chomsky, Noam, 9–10
- cingulate cortex, 236
- structure and functions, 245–247
- clock-drawing task, 93
- cocktail party phenomenon, 10–15, 163, 167, 187
- mathematical modeling, 339–340
- cognitive control of attention, 26–29
- attention network task (ANT), 29
- Eriksen flanker task, 28–29
- function of attention, 26–29
- Stroop tasks, 26–27
- See also* executive control of attention
- cognitive decline
- effects of video game brain training, 267–269
- cognitive flexibility, 251–253
- cognitive functions
- localizationism vs. globalism, 59–61
- cognitive neuroscience
- history of localizing cognitive functions, 58–61
- cognitive neuroscience methods
- combining methods, 89
- comparison of methods used in human research, 88–89
- electrical neurostimulation, 84–85
- electroencephalography (EEG), 73–79
- functional neuroimaging, 67–73
- magnetic neurostimulation, 81–84
- magnetoencephalography (MEG), 79–81
- neurostimulation, 81–86

412 Index

- cognitive neuroscience methods (cont.)
 neurostimulation (nonhuman animals), 87–88
 nonhuman animal studies, 86–88
 structural neuroimaging, 64–67
 transcranial alternating current stimulation (tACS), 85–86
 transcranial direct current stimulation (tDCS), 85
 transcranial magnetic stimulation (TMS), 81–84
 transcranial pulsed current stimulation (tPCS), 86
 transcranial random noise stimulation (tRNS), 86
- cognitive psychology, 27
- cognitive revolution in psychology, 5, 6–10, 27
- cognitive training, 45
- color constancy and illusions, 318–319
- competition for attention, 54–55
- computer analogy for the human brain, 8–9
- computerized tomography (CT), 349
 history of development, 64–65
- conditioning experiments, 6
 limitations of, 7–8
- conjunction search, 25, 41–43, 349
- conscious awareness
 predictive coding perspective, 343–344
- consciousness
 neural correlates of, 281
 relationship to attention, 20–21
- contingent capture of attention, 178–181, 349
 predictive coding perspective, 346–348
- contingent negative variation (CNV)
 component, 287, 350
- continuous theta burst stimulation (cTBS), 226, 350
- control of attention. *See* attentional control
- courtroom stenographers, 49–50
- covert attention, 16, 53, 123, 338, 350
 microsaccades, 17
 pupil dilation, 17
- Crichton, Alexander, 105
- cross-modal attention, 25
 neural effects, 164–165
- CT. *See* computerized tomography
- data compression techniques
 relevance to predictive coding models, 321–323
- deficits in attention, 91
 anxiety disorders, 114–116
 attention deficit hyperactivity disorder (ADHD), 104–109
 autism spectrum disorder (ASD), 108–111
 Bálint's syndrome, 98–101
 development of attention processes in infants, 103–104
 developmental disorders, 103–114
 dyslexia, 112–114
 effects of aging, 104
 focal lesions to subcortical structures, 102–103
 neglect syndromes, 92–98
 progressive supranuclear palsy (PSP), 101
 schizophrenia, 117–121
 sex differences, 109
 simultanagnosia, 98–101
- depression, 29
 attention bias, 116
- developmental disorders
 attention deficit hyperactivity disorder (ADHD), 104–109
 autism spectrum disorder (ASD), 108–111
 deficits in attention, 103–114
 development of attention processes in infants, 103–104
 dyslexia, 112–114
 effects of aging on attention, 104
 sex differences, 109
- dichotic listening and shadowing paradigms, 12–15
- diffusion tensor imaging (DTI), 67, 350
- diffusion-weighted imaging (DWI), 67, 350
- disengaging attention, 55–56
 ERP studies, 238–239
 moth effect, 34
- distracted driving, 32–36
 distribution of attention
 theory and models, 123–126
- Donders, Franciscus, 4–6
- dopamine system
 role in ADHD, 107
- dopamine transporter type 1 (*DAT1*)
 gene, 258
- dorsal attention network, 214–236, 281, 288, 350
 components of, 215–216
 EEG studies of internally generated attentional control, 231
 endogenous vs. exogenous control, 222–224
 ERP indices of attentional control processes, 229–231
 evidence from split-brain (callosotomy) patients, 218–219
 feature-based attentional control, 224–225
 feature-based vs. spatial attention (macaque), 234–236
 location of attention mechanisms in the brain, 214–215
 neuroimaging evidence of parietal and frontal control regions, 215–225
 neurostimulation studies, 225–228
 object-based attentional control, 224–225
 self-initiated shifts in attention, 218–222
 single- and multiunit studies of attentional control, 232–236
 tACS studies, 227
 TMS studies, 226
- dorsolateral prefrontal cortex (DLPFC), 247, 285–286
- dot-probe paradigm, 114–115
- double dissociation studies, 62–63, 350
- driving
 cell phone distractions, 32–36
 dashboard display distractions, 35
 distracted driving, 32–36
- drug addiction
 predictive coding perspective, 330
- dwelt time, 296, 350
- dynamic causal modeling (DCM), 222–224, 350
- dyslexia
 neurobiological sex differences, 109
 role of attention, 112–114
- early selection theories of attention, 12–13, 350
- ecological validity of experiments, 11, 338, 351
- egocentric neglect, 96, 351

- electrocorticography (ECoG), 78–79, 308–309, 313, 351
- electroencephalography (EEG), 73–79, 351
- combining with fMRI, 77–78
- creation of the ERP signal, 74–75
- electrocorticography (ECoG), 78–79
- event-related oscillations, 78
- event-related potentials (ERPs), 74–77
- frequency bands of EEG signals, 74, 301–302
- studies of internally generated attentional control, 231
- See also* ERP studies
- Elias, Peter, 321
- EMI (Electric and Music Industries), 64
- emotional stimuli
- interaction with faces and social gaze, 190–193
- empathy
- predictive coding perspective, 327
- exogenous attention, 53, 168, 351
- behavioral effects, 168–171
- inhibitory surround, 174
- interactions with exogenous attention, 176
- mechanisms of action, 168–171
- neural effects, 171–176
- top-down processing, 168
- visual search, 182–186
- engaging attention
- role of the thalamus, 103
- entrainment, 351
- alpha entrainment studies, 278–279
- to ongoing rhythms, 292–293
- epilepsy, 67
- Eriksen flanker task, 28–29, 112, 247–248
- ERP studies
- combining EEG with fMRI, 77–78
- contingent negative variation (CNV) component, 287
- creation of event-related potentials (ERPs), 74–77
- creation of the ERP signal, 74–75
- disengaging attention, 238–239
- dissociating early visual spatial attention components, 132–134
- effects of meditation and mindfulness training, 261–264
- error positivity component (Pe), 249–250
- error-related negativity (ERN) component, 247–250
- executive control of attention, 247–251
- feedback-related negativity (FRN) component, 250–251
- indices of attentional control, 229–231
- ipsilateral invalid negativity (IIN) component, 238–239
- labeling of sensory-evoked ERP components, 75
- late visual spatial attention components, 133–135
- mismatch negativity (MMN) component, 324
- neural mechanisms of the attentional blink (AB), 276–280
- P3a component, 133–135
- P3b component, 133
- predicted results from level-of-processing models, 128–129
- selection negativity (SN) component, 152–155
- selection positivity (SP) component, 152
- spatial localization of EEG/ERPs, 76–77
- visual spatial attention effects, 130–131
- error positivity component (Pe), 249–250
- error-related negativity (ERN) component, 247–250, 351
- event-related magnetic fields (ERFs), 79–81, 351
- event-related optical signals (EROS), 73, 137–139, 351
- event-related oscillations, 78
- event-related potentials (ERPs), 351
- See also* ERP studies
- event-related synchronization/desynchronization, 78
- executive control of attention, 244–256
- anterior cingulate cortex (ACC), 245–247
- cognitive flexibility, 251–253
- ERP studies, 247–251
- error positivity component (Pe), 249–250
- error-related negativity (ERN) component, 247–250
- feedback-related negativity (FRN) component, 250–251
- functional connectivity and the networks of executive control, 253–256
- inhibition, 253
- role of the frontal lobes, 251–253
- supervisory attention system, 245–247
- See also* cognitive control of attention
- exogenous attention, 53–54, 168, 352
- automatic vs. contingent capture, 178–181
- behavioral effects, 168–171
- bottom-up processing, 168
- faces, 187–188
- inhibition of return (IOR), 169–170, 174, 187
- interaction between emotions, faces, and social gaze, 190–193
- interactions with endogenous attention, 176
- ipsilateral invalid negativity (IIN) component, 173, 180–181
- joint attention, 188–190
- long-term memory effects, 201–205
- looming stimuli, 196
- mechanisms of action, 168–171
- neural effects, 171–176
- partial capture vs. all-or-none, 181
- priming effects, 200–201
- relationship with working memory, 197–200
- reward-driven attentional biasing, 205–209
- saliency, 186–187
- short-term memory effects, 200–201
- social-gaze orienting, 188–190
- special status of new objects, 193–196
- visual search, 182–186
- expectation
- interaction with attention, 340–343
- extinction task, 92, 351
- eye movement tracking studies, 207
- eyes and attention, 15–18
- fixation in relation to attention when reading, 36–37
- microsaccades, 17
- faces
- capture of attention, 187–188
- holding of attention, 298
- inhibition of return (IOR), 187

414 Index

- faces (cont.)
 interaction with social gaze and emotional stimuli, 190–193
See also fusiform face area (FFA)
- feature-based attention, 23, 124, 352
 back-propagation from higher processing regions, 155–156
 inhibitory surround, 149–150
 neural effects, 152–156
 selection negativity (SN) component, 152–155
 selection positivity (SP) component, 152
- feature-based attentional control, 224–225
- feature binding
 predictive coding perspective, 346
- feature integration theory (FIT), 23–26, 187, 346, 352
- feature search, 25, 43, 352
- feedback-related negativity (FRN) component, 250–251
- filter theory of attention (Broadbent), 12–13
- Flourens, Jean Pierre, 60–61
- focus of attention
 theory and models, 123–126
- focused ultrasound stimulation (FUS), 88
- forward solution, 77, 352
- free-energy principle. *See* predictive coding models
- free-energy systems, 335–337
- frequency analyses, 78
- frequency bands of EEG signals, 74, 301–302
- frontal eye fields (FEF), 216, 220, 232–233, 288, 310
- frontal lobes
 role in attentional control, 251–253
- functional magnetic resonance imaging (fMRI), 69–70, 352
 BOLD (blood oxygenation level-dependent) imaging, 69–70
 combining with EEG, 77–78
 localizing neural effects of auditory attention, 159–160
- functional near-infrared spectroscopy (fNIRS), 71–73, 352
 event-related optical signals (EROS), 73
- functionalism, 4
- fusiform face area (FFA), 298, 341, 352
 object-based attention studies, 156–158
- Gall, Franz Joseph, 60, 71
- Gaming Disorder (ICD-11), 47, 266
- gap task, 95
- Gennari, Francesco, 135
- go/no-go paradigm, 119–121, 249
- group iterative multiple model estimation (GIMME) method, 254–255, 352
- gustatory attention
 neural effects, 164
- habituation
 predictive coding perspective, 323–324
- hallucinations
 predictive coding perspective, 329
- hazard rate functions
 influence on temporal attention, 289–291
- health screening, 43–44
- Helmholtz, Hermann von, 17–18, 53
 eyes and attention, 15–16
- hemispatial neglect syndrome. *See* neglect syndromes
- Herbart, Johann Friedrich, 3
- Heschl's gyrus, 158, 159, 161, 352
- hippocampus
 time cells, 289
- Hippocrates, 59
- history of attention research
 attenuating filter theory, 15
 cocktail party phenomenon, 10–15
 cognitive revolution, 5, 6–10
 computer analogy for the human brain, 8–9
 dichotic listening and shadowing paradigms, 12–15
 ecological validity of laboratory experiments, 11
 influence of behaviorism, 4–5
 introspective method, 4–5
 level-of-processing debate, 12–15
 limitations of behaviorism, 6–10
 mental chronometry (Donders), 4–6
 motor theories of attention, 17
 Posner cuing paradigm, 18–21
 processes involved in attention, 1–2
- spotlight metaphor for attention, 18–23
- structuralism, 4–5
- views of early philosophers and psychologists, 2–6
- work of William James, 1–2
- zoom-lens model of attention, 21–23
- history of localizing cognitive functions, 58–61
- holding of attention, 295–301
 dwell time, 296
 faces, 298
 influence of memory, 296–297
 new objects, 299–300
 rewarded stimuli, 297
 special classes of stimuli, 297–301
 threatening stimuli, 297–298
- hollow mask illusion, 317–318
- Hounsfield, Godfrey, 64
- hyper-priors, 347–348
- illusions
 influence of top-down perceptual processing, 317–319
 as interpretation of insufficient sensory data, 326
 predictive coding perspective, 329
 related to color constancy, 318–319
- illusory conjunction of features, 24–25, 346
- imagination
 predictive coding perspective, 327
- inattention blindness, 21, 51–52
- individual differences in attention, 40
- inferior frontal gyrus (IFG), 216, 236
- inferior parietal lobule (IPL), 95, 216
- information processing models, 13, 352
- inhibition of return (IOR), 352
 distinction from inhibitory surround, 174
 faces, 187
 mechanism(s), 169–170
 research on rhythmicity, 306
 role of the superior colliculus (SC), 102, 242
 TMS studies, 240–241
- inhibitory surround
 distinction from inhibition of return (IOR), 174
 feature-based attention, 149–150
 spatial attention, 147–149

- innate system for language learning, 9–10
- intellectual attention, 3–4
- Internet Gaming Disorder (IGD) (DSM-5TR), 47–48, 266
- intraparietal lobule (IPL), 289
- intraparietal sulcus (IPS), 95, 215, 216, 281, 284, 288, 289, 311
- introspective method of research, 4–5
- inverse problem, 76–77, 352
 - magnetoencephalography (MEG), 80
- involuntary attention, 53–54, 167–168
 - See also* exogenous attention
- ipsilateral invalid negativity (IIN)
 - component, 173, 180–181, 238–239
- James, William, 1–2, 295
 - functionalist approach, 4
 - nature of attention, 20
 - types and effects of attention, 3–4
- Jasper, Herbert, 74
- joint attention, 50–51, 52, 54, 188–190
- Jones, Mari Riess, 292
- JPEG format for visual images, 322–323
- Kahneman, Daniel, 17, 27–28
- Kramer, Franz, 105
- Kuhn, Gustav, 52
- laminar electrodes, 313, 353
- language acquisition
 - criticism of the behaviorist view, 9–10
 - innate system for language learning, 9–10
- language learning in children
 - role of joint attention, 50–51
- lateral intraparietal (LIP) region in primates, 233–234, 310–311
- late selection theories of attention, 13–15, 353
- learned sequences
 - influence on temporal attention, 293
- Leibniz, Gottfried Wilhelm, 3
- lesion studies
 - nonhuman animals, 87
- level-of-processing debate, 12–15, 126–127
 - ERP studies of visual spatial attention effects, 130–131
 - predicted ERP results, 128–129
- line bisection task, 92–93
- line-drawing copying task, 95
- local field potentials (LFPs), 310, 353
- Locke, John, 20
- looming stimuli
 - capture of attention, 196
- Mackworth, Norman, 45
- magic tricks
 - disappearing coin trick, 53–54
- magicians
 - manipulation and misdirection of attention, 51–56
- magnetic resonance imaging (MRI), 65–67, 353
 - diffusion tensor imaging (DTI), 67
 - diffusion-weighted imaging (DWI), 67
 - functional magnetic resonance imaging (fMRI), 69–70
- magnetic resonance spectroscopy (MRS), 67, 353
- magnetoencephalography (MEG), 79–81, 353
 - event-related magnetic fields (ERFs), 79–81
 - inverse problem, 80
- Malebranche, Nicolas, 2–3
- meditation, 258, 260–264
 - neuroscience studies, 261–264
- memory and attention
 - holding of attention, 296–297
 - influence of selection history, 209–211
 - interactions between, 196–197
 - long-term memory effects on attention, 201–205
 - priming effects, 200–201
 - recall after studying, 37–40
 - reward-driven attentional biasing, 205–209
 - short-term memory effects on attention, 200–201
 - working memory and working attention, 197–200
- mental chronometry, 4–6, 353
- microelectrodes, 310
- microsaccades, 17, 312, 353
- middle frontal gyrus (MFG), 216
- mind-wandering, 3–4, 353
 - distinction from sustained attention, 17–18
- mindfulness, 353
 - neuroscience studies, 261–264
- mindfulness training, 260–264
- mindless reading, 36, 37
- mirror neurons, 327
- mismatch negativity (MMN)
 - component, 324
- missing symptoms in research studies, 109
- Moray, N., 10, 13–15
- moth effect (inability to disengage attention), 34
- motor theories of attention, 17, 353
- MPEG format for video coding, 323
- multitasking
 - impact of distractions when studying, 37–38
 - overconfidence when driving, 32
 - performance impacts, 49–50
 - as rapid switching between tasks, 34
 - supertaskers, 49–50
 - training for, 48
- multivoxel pattern analyses (MVPA), 341
- music
 - effect on worker productivity, 40
 - listening while studying, 38–40
- names
 - forgetting after being introduced, 41
- neglect syndromes, 55–56, 353
 - allocentric neglect, 96
 - brain injury associated with, 97–98
 - clock-drawing task, 93
 - cortical and subcortical connections
 - implicated in, 97–98
 - as disconnection syndromes, 97–98
 - effects of augmented reality (AR)
 - brain training, 270
 - egocentric neglect, 96
 - evidence for the roles of the ventral attention network, 237–238
 - extinction task, 92
 - features of, 92
 - gap task, 95
 - insights about the nature of attention, 92
 - lateralization of attention processes, 94–95
 - line bisection task, 92–93
 - line-drawing copying task, 95
 - location of attention mechanisms in the brain, 214–215
 - patterns of brain damage and neglect, 94–95
 - role of the pulvinar nucleus of the thalamus, 244

416 Index

- neglect syndromes (cont.)
 - space-based vs. object-based neglect, 95–96
 - subtypes, 95–96
 - tests for, 92–93
- neural activity
 - blood flow changes in the brain, 67–68
- neural correlates of consciousness (NCC), 281, 353
- neural effects of attention
 - endogenous attention, 171–176
 - exogenous attention, 171–176
 - level-of-processing debate, 126–127
 - sites of spatial attention effects, 126–127
- neural effects of auditory attention, 158–159
 - effects in what vs. where regions, 160–161
 - localizing with fMRI, 159–160
 - remapping of the auditory complex, 162
 - subcortical effects, 162–163
- neural effects of cross-modal attention, 164–165
- neural effects of feature-based attention, 152–156
- neural effects of gustatory attention, 164
- neural effects of object-based attention, 156–158
- neural effects of olfactory attention, 164
- neural effects of tactile attention, 164
- neurofeedback, 258–260
- neuroimaging
 - blood flow related to neural activity, 67–68
 - BOLD (blood oxygenation level-dependent) imaging, 69–70
 - combining EEG with fMRI, 77–78
 - computerized tomography (CT), 64–65
 - event-related optical signals (EROS), 73
 - functional magnetic resonance imaging (fMRI), 69–70
 - functional near-infrared spectroscopy (fNIRS), 71–73
 - functional neuroimaging, 67–73
 - impact on neuropsychology, 63–64
 - inverse problem, 76–77
 - lessons from the phrenology fad, 71
 - magnetic resonance imaging (MRI), 65–67
 - magnetic resonance spectroscopy (MRS), 67
 - positron emission tomography (PET), 65, 68–69
 - spatial and temporal resolution of functional techniques, 67–68
 - spatial localization of EEG/ERPs, 76–77
 - structural neuroimaging, 64–67
- neuroimaging studies
 - where spatial attention acts in the brain, 136–140
- neurons
 - receptive fields (RF), 232
- neuropsychology, 354
 - case studies vs. group studies, 61–62
 - early patient studies, 61
 - history of localizing cognitive functions, 58–61
 - impact of the advent of neuroimaging, 63–64
 - localization of cognitive functions in the cortex, 61
 - single vs. double dissociation studies, 62–63
- neurostimulation, 81–86
- neurostimulation studies
 - dorsal attention network, 225–228
- new objects
 - capture of attention by, 193–196
 - holding of attention, 299–300
- Newell, Allan, 9
- nonhuman animal studies, 86–88
 - cellular recording, 86–87
 - electrophysiology studies of attentional rhythms, 310–313
 - feature-based vs. spatial attention (macaque), 234–236
 - focused ultrasound stimulation (FUS), 88
 - lateral intraparietal (LIP) region in primates, 233–234, 310–311
 - lesion studies, 87
 - neurostimulation studies, 87–88
 - optogenetics, 87–88
 - role of the pulvinar nucleus of the thalamus, 243–244
 - single-unit recordings, 142–145
- object-based attention, 23, 124–126
 - neural effects, 156–158
 - predictive coding perspective, 346
- object-based attentional control, 224–225
- older adults
 - effects of video game brain training, 267–269
- olfactory attention
 - neural effects, 164
- ophthalmoscope, 15
- optogenetic stimulation
 - reticular nucleus of the thalamus, 243
- optogenetics, 87–88
- orienting function of attention, 29
- overt attention, 16, 53, 123, 354
- parafoveal preview when reading, 36–37
- parahippocampal place area (PPA), 281, 341, 354
 - object-based attention studies, 156–158
- paranoia
 - predictive coding perspective, 330
- Parkinson's disease, 67, 101
- Pavlov, Ivan, 6
- Penfield, Wilder, 81
- perceptual inference, 337, 354
- perseveration
 - tests of cognitive flexibility, 251–253
- phasic nature of attention, 36
- phrenology, 60
 - lessons for interpretation of neuroimaging, 71
- Pollnow, Hans, 105
- positron emission tomography (PET), 65, 68–69, 354
- Posner cuing paradigm, 18–21, 29, 302
- posterior (Bayesian theory), 316
- posterior cingulate cortex (PCC), 245, 250
- posterior probability (Bayesian theory), 316, 354
- post-traumatic stress disorder (PTSD)
 - predictive coding perspective, 330
- precision of sensory information, 327–328, 354
- prediction errors, 323–325, 354
- predictive coding models, 15
 - active inference, 327, 338–339
 - attentional biasing mechanism, 340

- autism spectrum disorder (ASD), 329–330
- automatic vs. contingent capture of attention, 346–348
- balancing top-down vs. bottom-up influences, 327–337
- Bayesian modeling, 316
- benefits of top-down predictions, 326–327
- brain mechanisms of attention vs. expectation, 340–343
- color constancy and illusions, 318–319
- comparing top-down and bottom-up processing at each level of the hierarchy, 328–333
- comparison with bottom-up model of processing, 315–317
- efficiency in visual coding and transmission, 321–323
- features of, 315
- frequencies associated with top-down and bottom-up processing, 335–337
- habituation, 323–324
- hollow mask illusion, 317–318
- illusions, 329
- illusions as interpretation of insufficient sensory data, 326
- illusions illustrate top-down perceptual processing, 317–319
- importance of top-down feedback processing, 315–317
- interaction of attention and expectation, 340–343
- laminar cortical microcircuitry and neural oscillations, 335–337
- level of confidence in bottom-up sensory inputs, 327–328
- models of perception, 315–317
- object-based attention and feature binding, 346
- perceptual inference, 337
- perspective on empathy, 327
- perspective on imagination, 327
- precision of bottom-up information, 327–328
- prediction error processing in the brain, 323–325
- relationship to attention, 339–348
- relevance of data compression techniques, 321–323
- repetition suppression, 323–324
- role of bottom-up feedforward processing, 315–317
- role of conscious awareness, 343–344
- role of context in adjusting the balance, 328
- saliency maps and attention, 345–346
- schizophrenia, 329–330
- terminology, 316
- top-down feedback connections in the visual system, 319–321
- where top-down predictions come from, 333–334
- pre-supplementary eye fields (pre-SEF), 220
- pre-supplementary motor area (pre-SMA), 220
- priming effects, 200–201
- prior (Bayesian theory), 316
- prior probability (Bayesian theory), 316, 354
- progressive supranuclear palsy (PSP), 101
 - impairment of inhibition of return (IOR), 102
- psychological refractory period (PRP), 276, 354
- psychology
 - anti-mentalistic view of the behaviorists, 6
 - cognitive revolution, 5, 6–10, 27
- pulvinar nucleus of the thalamus, 288
 - role in attentional control, 243–244
- pupil dilation
 - covert attention and, 17
 - focused attention and, 17–18
- pure insertion approach, 6
- putamen, 98
- radar monitors, 44–45
- Rafal, Robert, 101, 103
- rapid serial visual presentation (RSVP) task, 274–275, 354
- rating scales
 - lack of measurement invariance, 109
- reaction time, 4
- reading, 36–37
 - eye fixation and movement of attention, 36–37
 - mindless reading, 36, 37
 - parafoveal preview, 36–37
 - phasic nature of attention, 36
 - role of attention in dyslexia, 112–114
- real-life situations
 - air traffic control, 44–45
 - airport security screening, 41–44
 - courtroom stenographers, 49–50
 - distracted driving, 32–36
 - forgetting someone's name, 41
 - health screening, 43–44
 - joint attention, 50–51
 - magic tricks, 51–56
 - multitasking, 48–50
 - radar and sonar monitors, 44–45
 - reading, 36–37
 - studying and remembering, 37–40
 - video gaming, 45–48
- receptive fields (RFs) of neurons, 232, 354
- repetition blindness, 276
- repetition suppression
 - predictive coding perspective, 323–324
- research studies
 - missing symptoms in, 109
 - selection bias, 109
- resources for attention, 27–28
 - allocation of attentional resources, 150–152
 - allocation of limited resources, 54–55
 - competition for attention, 54–55
 - effect of distractions when driving, 35–36
 - limited mental resource, 16
 - mental resources capacity limits, 13
 - selective nature of attention, 18
 - when meeting someone new, 41
- response times
 - mental chronometry (Donders), 4–6
- reticular nucleus of the thalamus
 - role in attentional control, 243
- reward-driven attentional biasing, 205–209
- rewarded stimuli
 - holding of attention, 297
- rhythmic theory of attention, 354
 - alpha entrainment studies, 278–279
- rhythmic theory of attention (Fiebelkorn and Kastner), 144–145, 301–313
 - behavioral evidence for rhythmic attention, 303–307
 - human neuroscience studies, 307–310
 - nonhuman primate electrophysiology studies, 310–313

418 Index

- rhythmic theory of attention (Jones), 292
- rhythms
 - influence on attention, 292–293
- saccadic suppression, 302, 338
- saliency
 - role in exogenous attention, 186–187
- saliency maps, 186–187, 355
 - predictive coding perspective, 345–346
- saliency network, 236
- schizophrenia, 27, 29, 243
 - atypical attention processes, 117–121
 - hallucinations, 329
 - predictive coding perspective, 329–330
- selection bias in research studies, 109
- selection history
 - influence on attention, 209–211
- selection negativity (SN) component, 152–155
- selection positivity (SP) component, 152
- selective nature of attention, 18
- sensorial attention, 3
- sensory modalities and attention
 - attentional blink (AB) across modalities, 279–280
 - effects across modalities, 164–165
 - See also* specific modalities
- serial reaction time (SRT) task, 293, 355
- sex differences
 - deficits in attention, 109
- Shaw, John Clifford, 9
- signal suppression hypothesis, 185–186
- Simon, Herbert, 9
- simultanagnosia, 98–101, 355
- single-dissociation studies, 62–63, 355
- single-unit recordings, 142–145, 355
- Skinner, B. F., 5, 6, 7
 - Chomsky's criticism of behaviorist language acquisition theory, 9–10
 - on the role of attention, 10
- social-gaze orienting, 52, 188–190
 - interaction with faces and emotional stimuli, 190–193
 - joint attention, 50–51
- social phobia, 78
- sonar monitors, 44–45
- spatial attention
 - allocation of attentional resources, 150–152
 - all-or-none pattern of effects, 150–152
 - division across spatial locations, 145–147
 - inhibitory surround, 147–149
 - interactions with temporal attention, 294–295
 - level-of-processing debate, 126–127
 - location of effects in the brain, 135
 - mechanisms, 145–152
 - sites of effects, 126–127
 - splitting the spotlight, 145–147
 - spotlight model, 18–23, 123–124
 - timing of effects, 128–135
 - zoom-lens model, 123–124
- special classes of stimuli
 - holding of attention, 297–301
- split beam of attention, 22–23
- split-brain (callosotomy) patients, 218–219
- spotlight model of attention, 18–23, 123–124, 355
 - inhibitory surround, 147–149
 - splitting the spotlight, 145–147
- steady-state visual evoked potentials (SSVEPs), 146–147, 149, 266
- Still, George, 105
- Stroop tasks, 26–27, 246–247
- structuralism, 4–5
- studying
 - efficiency of remembering, 37–40
 - impact of distractions, 37–38
 - individual differences in attention, 40
 - listening to music, 38–40
 - where to study, 40
- substance addictions, 29
- substance use disorders
 - attention bias toward addiction-related cues, 116
 - reward-driven attentional bias, 208–209
- subtractive method, 5–6, 355
- superconducting quantum interference devices (SQUIDs), 81
- superior colliculus (SC), 288
 - effects of focal lesions, 102
 - role in attentional control, 242
 - role in inhibition of return (IOR), 102, 242
- superior parietal lobule (SPL), 216
- superior temporal gyrus (STG), 216, 236
 - role in hemispatial neglect, 97, 98
 - suppression using TMS, 239
- supervisory attention system, 245–247
- supplementary motor area (SMA), 215, 216
- supramarginal gyrus (SMG)
 - TMS studies, 239, 241–242
- sustained attention, 355
 - distinction from mind-wandering, 17–18
 - influential factors, 36
 - intense, repetitive tasks, 43
 - vigilance, 45
- tactile attention, 25
 - neural effects, 164
- tactile stimuli
 - attentional blink (AB), 279–280
- task difficulty
 - influence on attention, 27–28
- taste
 - gustatory attention, 164
- temporal attention
 - alpha entrainment, 278–279
 - attending to a moment in time, 287–295
 - attentional blink (AB), 274–286
 - attentional blink (AB) deficits in ADHD, 282–283
 - contingent negative variation (CNV) component, 287
 - disengaging attention, 55–56
 - dissociating early visual spatial ERP components, 132–134
 - ERP studies of visual spatial attention effects, 130–131
 - features of, 273
 - holding of attention, 295–301
 - influence of different types of temporal information, 289–293
 - influence of hazard rate functions, 289–291
 - influence of implicitly learned sequences, 293
 - influence of rhythms, 292–293
 - interactions with spatial attention, 294–295
 - late visual spatial attention ERP components, 133–135
 - mental chronometry, 4–6
 - neural control systems compared with spatial and feature-based attention, 288–289
 - neutral (baseline) condition in studies, 134

- overcoming attentional blink (AB), 288
- predicted ERP results from level-of-processing models, 128–129
- preparation for an upcoming event, 287–288
- psychological refractory period (PRP), 276
- repetition blindness, 276
- rhythmic theory of attention (Fiebelkorn and Kastner), 301–313
- timing of visual spatial attention effects, 128–135
- temporoparietal junction (TPJ), 216, 236–237, 284–285
- thalamus, 289
 - caudate nucleus, 98
 - effects of focal lesions, 103
 - pulvinar nucleus, 98, 243–244, 288
 - reticular nucleus, 243
 - role in engaging attention, 103
- The Beatles, 64
- threatening stimuli
 - holding of attention, 297–298
- timing of attention events. *See* temporal attention
- Titchener, Edward, 4–5, 167
- top-down feedback connections in the visual system, 319–321
- top-down processing
 - endogenous (voluntary) attention, 168
 - role in visual perception, 15, *See also* predictive coding models
- transcranial alternating current stimulation (tACS), 85–86, 355
 - dorsal attention network, 227
- transcranial direct current stimulation (tDCS), 85, 355
- transcranial electrical stimulation (tES), 355
- transcranial magnetic stimulation (TMS), 81–84, 355
 - angular gyrus (AG), 239–241
 - dorsal attention network, 226
 - inhibition of return (IOR), 240–241
 - repetitive TMS (rTMS), 83
 - single-pulse TMS, 83–84
 - suppression of the superior temporal gyrus (STG), 239
 - supramarginal gyrus (SMG), 241–242
 - ventral attention network, 239–242
- transcranial magnetic stimulation (TMS) studies
 - supramarginal gyrus (SMG), 239
- transcranial pulsed current stimulation (tPCS), 86
- transcranial random noise stimulation (tRNS), 86
- Treisman, Anne, 11, 15, 127–128
 - feature integration theory (FIT), 23–26
- Turing Test, 9
- unilateral neglect. *See* neglect syndromes
- ventral attention network, 236–242, 288, 356
 - components of, 216, 236
 - ERP studies of disengaging attention, 238–239
 - functions of, 236–237
 - neuropsychological evidence for the roles of, 237–238
 - transcranial neurostimulation studies, 239–242
- ventral frontal cortex (VFC), 216
- ventral frontoparietal network. *See* ventral attention network
- ventral prefrontal cortex (VFC), 236
- ventricular doctrine, 58–60
- video game playing, 45–48
 - addiction to, 47–48
 - effects on cognitive functions and attentional control, 265–271
- Gaming Disorder (DSM and ICD), 266
- vigilance, 45, 356
- visual perception
 - color vision, 15
 - top-down processing, 15
- visual search
 - interaction between exogenous and endogenous attention, 182–186
- visual search tasks, 41–43
- visual stimuli
 - attentional blink (AB), 279–280
 - saccadic suppression, 302
- visual system
 - active inference, 338–339
 - efficiency in coding and transmission, 321–323
 - neuroimaging studies of spatial attention effects, 136–140
 - pathways and processing regions, 135–136
 - saccadic suppression, 338
 - top-down feedback connections, 319–321
- voluntary attention, 53, 167–168
 - See also* endogenous attention
- Watson, John, 5, 6
- Weikard, Melchior Adam, 105
- Wernicke, Carl, 61, 63
- Wisconsin Card Sorting Test (WCST), 251–253, 356
- World War II
 - communications issues, 12
 - limitations of behaviorist training of soldiers and pilots, 7–8
 - vigilance of naval sonar technicians, 45
- Wundt, Wilhelm, 4
- yoga, 258
- zoom-lens model of attention, 21–23, 123–124, 356