

The Two Halves of the Brain

Information Processing in the Cerebral Hemispheres

edited by Kenneth Hugdahl and René Westerhausen

**The MIT Press
Cambridge, Massachusetts
London, England**

© 2010 Massachusetts Institute of Technology

All rights reserved. No part of this book may be reproduced in any form by any electronic or mechanical means (including photocopying, recording, or information storage and retrieval) without permission in writing from the publisher.

MIT Press books may be purchased at special quantity discounts for business or sales promotional use. For information, please email special_sales@mitpress.mit.edu or write to Special Sales Department, The MIT Press, 55 Hayward Street, Cambridge, MA 02142.

This book was set in Stone Serif and Stone Sans by Toppan Best-set Premedia Limited. Printed and bound in the United States of America.

Library of Congress Cataloging-in-Publication Data

The two halves of the brain : information processing in the cerebral hemispheres / edited by Kenneth Hugdahl and René Westerhausen.

p. cm.

Includes bibliographical references and index.

ISBN 978-0-262-01413-7 (hardcover : alk. paper) 1. Cerebral dominance. 2. Laterality.

I. Hugdahl, Kenneth. II. Westerhausen, René, 1976–

[DNLM: 1. Functional Laterality—physiology. 2. Cerebrum—physiology. 3. Dominance, Cerebral—physiology. WL 335 T974 2010]

QP385.5.T86 2010

612.8'25—dc22

2009039297

10 9 8 7 6 5 4 3 2 1

Index

- Achim, A. M., 504
- Acoustics
linguistic factors and, 359–364
speech perception and, 350–351, 359–364, 367–368
- Across-field advantage (AFA), 269–270
- Aging
Alzheimer's disease and, 515
auditory asymmetries and, 417–433
cognitive control and, 469–470, 484
dichotic listening and, 470, 484
dyslexia and, 580
executive functions and, 420–422
forced left (FL) conditions and, 422–423, 429, 431–432
frontal lobe theory of, 421–422
left-ear stimuli and, 422
right ear advantage (REA) and, 422
right-side advantage (RSA) and, 420, 423, 430–433
sex differences and, 274
Stroop task and, 484
theory of cognitive aging and, 421–422
visual asymmetries and, 417–433
white matter pathways and, 152–153
Wisconsin Card Sorting Test and, 484
- Agnosia, 186, 533. *See also* Neglect
- Aleman, A., 623
- Alexia, 186
- Alleles
handedness and, 70–72
language and, 76–77
- Allen, J. J., 227–228
- Alzheimer's disease, 515
- Ambidexterity, 70, 80, 623–624, 631–632
- Amunts, Katrin, 4–5, 145–175
- Amygdala, 157–159
- Analysis of variance (ANOVA), 424, 426, 428–429
- Andersson, B., 12
- Andersson, K., 102
- Andersson, M., 431, 473, 484
- Andrew, R. J., 65–66, 80, 379–380
- Androgens, 256
- Angrilli, A., 630
- Anisotropy of diffusion, 192
- Annett, M., 70–73, 76–77, 79, 303
- Anterior features, 1
brain patterning and, 21–22
dichotic listening and, 445, 447, 454–457, 486
electroencephalography and, 224–227
gene transcription and, 21–22, 24
language and, 37, 45–49, 52
magnetoencephalography and, 224–227
memory and, 504, 507–508, 511–514
pediatric development disorders and, 567, 570, 574, 579–582, 585–586
psychosis and, 624–630, 633, 636–640
songbirds and, 93

- Anterior features (cont.)
 speech perception and, 355–356
 structural indices of asymmetry and, 147, 154–155, 158–163
 white matter pathways and, 191–198, 201
- Apes, 8, 149, 645
 gene transcription and, 25
 gross asymmetries and, 52, 55
 handedness and, 66
 language and, 38–46, 50–57
 speech perception and, 358
- Aphasia
 conduction, 186
 language and, 38, 146, 186, 189, 196, 288
 motor, 38
 strokes and, 288
- Apraxias, 186–188
- Arcopallium (RA), 93
- Arcuate fasciculus, 111, 191, 194, 196, 201
- Ardekani, S., 192
- Asbjørnsen, A. E., 449
- Asperger's syndrome, 563–564, 636
- Associationist theory
 Liepmann and, 186–188
 uncinat fasciculus and, 191
 Wernicke and, 184, 186
 white matter pathways and, 181–188, 194, 196
- Aston-Jones, G., 547
- Asymmetrical time sampling theory, 223–224
- Attentional blink, 542–543
- Attentional theory, 220
- Attention-deficit/hyperactivity disorder (ADHD), 6, 13–14, 632
 basal ganglia differences in, 570–572
 caudate nuclei and, 570–571
 cognitive control and, 470, 482, 489
 commonality of, 569–570
 consonant-vowel (CV) tasks and, 572–573
 corpus callosum and, 572–574, 577
 dichotic listening and, 572–573
 frontostriatal connections and, 576–577
 functional connectivity and, 573–576
 gene transcription and, 27
 handedness and, 71
 hemispheric asymmetry and, 569–577
 language and, 52
 parietal cortex and, 576
 pediatric developmental disorders and, 561–563, 569–591
 prefrontal cortex and, 576
 questionnaires and, 569
 right-hemisphere deficits in, 570
 sex differences and, 287, 289
 speech perception and, 349, 364–367
 task switching and, 576–577
- Attention network test, 469
- Attention to memory (ATOM) model, 515, 517
- Auditory asymmetries, 10–11
 acoustics and, 350–351, 359–364, 367–368
 afferent midline fibers and, 218
 aging and, 417–433
 analysis of variance (ANOVA) on, 424, 426
 asymmetrical time sampling theory and, 223–224
 attentional theory and, 220
 Bergen Dichotic Listening test and, 291, 422, 449, 471–473, 484
 bottom-up manipulation of laterality and, 474–478
 chord changes and, 224
 cocktail party phenomenon and, 12
 complex tones and, 220
 consonant-vowel (CV) tasks and, 219–222, 290, 295–301, 351–353, 357–365, 422, 444, 456, 459, 471–472, 477–478, 481–482, 488, 572–573, 589
 contralaterality studies and, 218–219
 cortical input and, 217–222
 cross-species view and, 350–352
 dichotic listening and, 219–222, 232–233 (*see also* Dichotic listening)
 disengagement from dominant ear and, 450–456

- divided attention and, 426–427
electroencephalography (EEG) and, 217–226
excitatory-excitatory (EE) cells and, 218
executive functions and, 420–422, 431–432
forced left (FL) condition and, 422–425, 429, 431–432, 479–490
forced right (FR) condition and, 422–424, 431, 479–490
hallucinations and, 633
integration with visual asymmetries and, 417–433
language and, 222–226 (*see also* Language)
lateral symmetry and, 218
left ear advantage (LEA) and, 422 (*see also* Left ear advantage)
left-ear suppression and, 445–447, 450–454, 457, 461
magnetoencephalography (MEG) and, 217–226
milliseconds domain and, 224–225
nonforced (NF) condition and, 422
perfect pitch and, 154, 163–164
perisylvian region and, 147–154
planum temporale and, 154 (*see also* Planum temporale)
primary auditory cortex and, 149
right ear advantage (REA) and, 12–13 (*see also* Right ear advantage)
selective attention and, 424–426
sleep and, 320
somatosensory system and, 218
song perception and, 102–108
speech perception and, 223–224, 349–368
temporal lobe lesions and, 441
Austin, J. L., 640
Australopithecus, 41–43, 644, 648
Autism, 6, 14, 27, 92, 287, 561
Asperger's syndrome and, 563–564
attention-deficit/hyperactivity disorder (ADHD) and, 572–574
Broca's area and, 563
corpus callosum and, 562
deixis and, 636
developmental language disorders (DLDs) and, 564–566
dichotic listening and, 568–569, 572–573
GABA and, 567
hemispheric asymmetry and, 563–569, 591
high-functioning, 564
left ear advantage (LEA) and, 568–569
myelinated regions and, 564–566
right ear advantage (REA) and, 568–569
serotonin and, 566–569, 591
structural differences in, 157, 563–566
- Babiloni, C., 520
Baboons, 10, 56, 69, 75, 92, 392
Banich, M. T., 269, 402
Barnett, K. J., 629–630
Barrick, T. R., 637
Barth, J. M., 417
Barthélémy, S., 327
Basal ganglia, 570–572
Bastian, Henry Charlton, 38
Bateson, W., 650
Bayer, Ulrike, 7, 253–285
BBC Internet survey, 631
Behne, N., 444
Belger, A., 269, 358
Bell, M. A., 184
Bengalese finches, 102
Bergen Dichotic Listening test, 291, 422, 449, 471–473, 484
Berger, Hans, 211
Berger, W., 319
Bertelson, P., 460
Bertini, M., 322
Bibawi, D., 259
Bilateral redundancy gain (BRG), 630
Bilder, R. M., 628
Binaural integration, 586, 589
Binaural separation, 586, 589, 591
Bipedalism, 66–67
Bleuler, E., 622

- Blood-oxygen-level-dependent (BOLD) responses, 107
- auditory laterality and, 487
- default mode network and, 606, 613
- dichotic listening and, 444–445
- visual system and, 390–391, 397
- Bocca, E., 442
- Bokert, E., 321
- Boles, D. B., 417–419, 431–432
- Bone morphogenetic proteins (BMPs), 24–25
- Bonobos, 39, 44, 57–58, 68
- Bouillard, 147
- Boulinguez, P., 327
- Bouma, A., 623
- Bradshaw, J. L., 419–420
- Brain, C. K., 42–43
- Brain, R. W., 534
- Brain and Language* journal, 289
- Brain derived neurotrophic factor (BDNF) and, 128–130
- Brain patterning, 100, 639
- centers for, 21–22
- molecular secretions and, 21–25
- sleep and, 322–324
- Brancucci, Alfredo, 2, 211–250
- Broadbent, Donald, 441, 470
- Broca, Paul, 2–3, 14, 533
- language and, 37
- motor aphasia and, 38
- psychosis and, 621, 650
- structural indices and, 147
- Tan and, 37–38
- white matter pathways and, 177
- Broca-Annett axiom, 76
- Broca's area, 5, 8, 25, 384
- autism and, 563
- language and, 37–38, 41, 43, 45, 50, 56, 73–79, 147, 152, 222–223
- neglect and, 533, 539
- pediatric developmental disorders and, 563
- psychosis and, 621, 624–625, 632–639
- sleep and, 328
- speech perception and, 357, 366
- white matter pathways and, 186, 196
- Brodmann, Korbinian, 38, 146, 151, 189
- Brodmann areas
- default mode network (DMN) and, 616
- dyslexia and, 580
- Heschl gyrus and, 149
- language and, 38, 50, 74, 149, 151
- memory and, 511–512, 514
- pediatric developmental disorders and, 580
- prefrontal cortex and, 160
- psychosis and, 626
- schizophrenia and, 160
- structural indices and, 151, 160–161
- white matter pathways and, 196, 198
- Brown-headed cowbirds, 98
- Brown thrashers, 98
- Bryden, M. P., 448–449, 472
- Büchel, C., 192, 194
- Buehler, K., 635, 640
- Burdach, Karl Friedrich, 179, 181–182
- Bureca, I., 388
- Burgess, N., 501, 503–504
- Byrne, R. W., 68
- Cabeza, R., 513, 521
- Calhoun, Vince D., 4, 605–620
- California Verbal Learning Test (CVLT), 201
- Cantalupo, C., 25, 384
- Capuchins, 69
- Carson, H. L., 642
- Casagrande, Maria, 7, 313–345
- Casey, B. J., 577
- Catani, Marco, 5, 177–209
- Catbirds, 98
- Caudolateral mesopallium (CLM), 108
- Central nervous system (CNS), 21, 24–25, 178, 255, 614
- Cerebral blood flow (rCBF), 563
- Cerebral cortex. *See also specific region*
- brain patterning and, 21–25, 100, 322–324, 639
- differential gene transcription in, 21–30

- electroencephalography (EEG) and, 212
- hormones and, 274–275 (*see also* Hormones)
- magnetoencephalography (MEG) and, 212
- motor cortex and, 154–157
- rodent studies and, 21
- somatosensory region and, 154–157
- Chabris, C. F., 381
- Chan, P., 624
- Chance, S. A., 163
- Chance alleles, 70
- Chapple, B., 628
- Chimpanzees, 39, 43, 46, 52, 68, 71, 74, 78–80, 621, 646
- Chiron, C., 563
- Chomsky, N., 76, 634, 637
- Chong-Hwa Hong, 319
- Christman, S., 400
- Chromosomes
 - brain maturation and, 257
 - handedness and, 71–72, 302–304
 - hormonal aberrations and, 257
 - psychosis and, 642–650
 - saltation and, 642–644
 - Xq21.3/Yp duplication and, 644–647
 - X Turner syndrome and, 257
 - XXY Klinefelter syndrome and, 257
- Ciaramelli, E., 517
- Cingulate cortex, 159–160
- Clark, G. M., 627
- Cockburn, D., 420
- Cocktail party phenomenon, 12
- Cognitive control
 - aging and, 470, 484
 - anterior cingulate cortex and, 486–487, 489
 - attention network test and, 469
 - auditory asymmetries and, 469–470
 - BOLD response and, 487
 - default mode network (DMN) and, 605–607, 613, 616
 - dichotic listening and, 441–462, 469–470 (*see also* Dichotic listening)
 - dynamic control adjustments and, 469
 - emotion and, 469
 - Flanker paradigm and, 469
 - goal maintenance and, 469
 - hemispheric laterality measurement and, 470–474
 - prefrontal cortex and, 486–487, 489
 - quantification of, 488–490
 - right ear advantage (REA) and, 470–490
 - rule generation and, 469
 - Stroop task and, 469, 487
 - Wisconsin Card Sorting Test and, 484
- Cohen, David, 211–212
- Cohen, H., 256
- Cohen, R., 630
- Cohen-Bendahan, C. C., 356
- Communication
 - axons and, 5, 43, 145, 151, 157, 189, 192, 201, 229, 567, 576, 629
 - gestures and, 8, 10, 42, 69, 73–75, 92, 186
 - language and, 42 (*see also* Language)
 - songbirds and, 91–112
 - speech perception and, 349–368
 - vocal control nucleus (HVC) and, 358–359
- Comparative neurobiology, 43–45
- Complementary DNA (cDNA), 24, 28
- Computerized tomography (CT), 45, 145, 158, 161, 629, 633
- Congenital adrenal hyperplasia (CAH), 256, 302–303
- Conjugated estrogens, 273
- Connectivity, 229–233
- Consonant recognition task (CRT), 322
- Cooper, E. E., 398
- Corballis, Michael C., 8, 42, 65–88, 379–380, 629–630
- Corbetta, M., 418–419
- Corp, N., 68
- Corpus callosum, 12–13, 93, 218–219
 - attention-deficit/hyperactivity disorder (ADHD) and, 572–574, 577
 - autism and, 562
 - cognitive control and, 472, 476
 - dichotic listening and, 442, 445–447, 450, 453–461

- Corpus callosum (cont.)
 handedness and, 65
 hormones and, 264–265, 274
 neglect and, 536
 pediatric developmental disorders and, 563, 591
 speech perception and, 354–355
 visual asymmetries and, 382–384, 399–400, 418, 433, 536
 white matter pathways and, 181, 198
- Corsi-Cabrera, M., 318
- Cortical asymmetry of reflective activity (CARA) model, 512–514
- Corticospinal tract (CST), 189–191, 194, 198
- Cortisol, 256
- Cote, J., 326–327
- Coupling, 230
- COUP-TF1, 22
- Cowell, Patricia E., 11, 349–377
- Crichton-Browne, James, 622
- Crossed-uncrossed difference (CUD), 269
- Crow, Timothy J., 7–8, 13, 163
 handedness and, 66, 71–72, 80
 psychosis and, 621–661
 visual asymmetries and, 379–380
- Cyclops, 26
- Cykowski, M. D., 157
- Cynx, J., 102
- Dart, Raymond, 41
- Darwin, Charles
 language and, 37–38, 41
 psychosis and, 621–622, 641–643
 visual asymmetries and, 121–124
- Darwin, William, 121
- Daselaar, S. M., 518
- Davachi, L., 504
- David, A. S., 624
- Davidson, R. J., 1–2, 226–227
- Dax, Marc, 37–38, 147
- Deakin, J. F., 628
- Default mode network (DMN)
 auditory oddball (AOD) task and, 606–607, 613–615
 BOLD response and, 606, 613
 Brodmann areas and, 616
 dominant eye and, 606
 electroencephalography (EEG) and, 605
 false discovery rate and, 616
 fMRI examinations of, 605–606
 frontal gyrus and, 607
 handedness and, 606
 HZ/SZ neural circuits and, 606–607, 613–614
 independent component analysis (ICA) and, 605–606
 inferior parietal lobule (IPL) and, 607, 613
 intrinsic vs. evoked activity and, 605
 language and, 607, 613
 superior temporal gyrus and, 607
 theory of mind (TOM) and, 613
 voxelwise differences and, 606–607
- Degreef, G., 628
- Deixis, 635–636, 640–641
- Dejerine, Jules, 186
- DeLisi, L. E., 624
- Della Penna, S., 444–445
- Dendrites, 145, 151, 212–213
- Deoxyribonucleic acid (DNA), 28, 72, 78
- Depression, 228–229
- DeQuardo, J. R., 624
- de Saussure, 634–635, 639
- Descent of Man, The* (Darwin), 641–643
- Developmental language disorders (DLDs), 564–566
- Dextral alleles, 70
- Diagnostic and Statistical Manual of Mental Disorders, 614–615
- Dichotic listening, 12
 acoustic radiation and, 443
 aging and, 470, 484
 attentional effects on, 447–456, 478
 attention-deficit/hyperactivity disorder (ADHD) and, 572–573

- audio-visual integration and, 418, 422–425, 433
- auditory cortex and, 443, 456–458, 473
- autism and, 568–569
- Bergen Dichotic Listening test and, 291, 422, 441, 471–473, 484
- binaural integration and, 586, 589
- binaural separation and, 586, 589, 591
- BOLD response and, 444–445
- bottom-up manipulation and, 474–478, 488–490
- callosal relay model and, 456
- cognitive control and, 469–479, 482–490
- commissural lesions and, 445, 447
- consonant-vowel (CV) tasks and, 219–222, 290, 295–301, 351–353, 357–365, 422, 444, 456, 459, 471–472, 477–478, 481–482, 488, 572–573, 589
- contralateral dominance and, 443–445
- corpus callosum and, 442, 445–447, 450, 453–461
- defined, 441
- disengagement from dominant ear and, 450–456
- double dissociation and, 460–461
- duration discrimination and, 443
- dyslexia and, 578, 586–590
- ear of presentation and, 460–461
- electroencephalography (EEG) and, 215, 219–222, 232–233, 459
- executive functions and, 420–422, 431–432
- extinction and, 460–461
- forced left (FL) condition and, 422–425, 429, 431–432, 479–490
- forced right (FR) condition and, 422–424, 431, 479–490
- handedness and, 290
- Heschl's gyrus and, 454–456, 461
- hormones and, 256, 259
- infants and, 419
- inferior colliculus and, 473
- ipsilateral signals and, 442–443
- Kimura and, 441–447, 460–462, 470–473
- Kinsbourne's hemispheric preactivation model and, 448
- late positive component (LPC) and, 458
- left ear advantage (LEA) and, 422
- left-ear suppression and, 445–447, 450–454, 457, 461
- menstrual cycle and, 259
- meta-analysis and, 292
- nonforced (NF) condition and, 422
- nonverbal stimuli and, 471–472
- pediatric developmental disorders and, 562, 568–569, 572, 577–578, 586, 589–591
- reinterpretation of, 487–488
- right ear advantage (REA) and, 290, 422, 441, 444–445, 448–451, 456–462, 470–490
- sex differences and, 293, 295–297, 300
- sodium amytal testing and, 442
- spatial location and, 460–461
- speech perception and, 349, 366, 369n1
- splenic lesions and, 450–451
- stimulus onset asynchrony (SOA) and, 476–477, 488–489
- structural-attentional framework for, 441–462
- structural model of, 473
- superior olivary complex and, 442–443, 473
- term of, 470–471
- thalamus lesions and, 443
- timing issues and, 458–460
- top-down manipulation and, 478–486, 488–490
- varying strength of, 474–478
- Wada test and, 471
- Dictyostelium, 40
- Diencephalic nucleus rotundus, 124
- Diethylstilbestrol (DES), 256, 302
- Diffusion-tensor imaging (DTI), 4–5
- association tracts and, 194–196
- auditory asymmetries and, 450
- behavioral correlates and, 196–201
- dichotic listening and, 450
- fractional anisotropy and, 192, 194, 196
- pediatric developmental disorders and, 577

- Diffusion-tensor imaging (DTI) (cont.)
 perisylvian pathways and, 196–201
 projection tracts and, 192–194
 speech perception and, 355
 white matter pathways and, 189, 191–200
- Dihydrotestosterone, 255–256
- Di Russo, F., 420
- Disconnection syndromes, 186–188
- Divided visual field presentation, 537–538
- Dizygotic (DZ) twins, 71–72
- Dollfus, S., 632–633
- Domellöf, E. 419
- Done, D. J., 631
- Dorsal features, 605, 626
 gene transcription and, 21–22
 memory and, 512
 pediatric developmental disorders and, 527, 585
 structural indices and, 147, 155
 visual asymmetries and, 385–386, 394, 396
 white matter pathways and, 190–191
- Dorsolateral prefrontal cortex (DLPFC), 637–639
- Dos Santos Sequeira, S., 355
- Dragovic, M., 623
- Driver, J., 420
- Droste, D. W., 319
- Dura matter, 42
- Duration of untreated psychosis (DUP), 625
- Dyslexia, 289, 562
 aging and, 580
 attention given to, 578
 binaural integration and, 586, 589
 binaural separation and, 586, 589, 591
 Brodmann areas and, 580
 dichotic listening and, 578, 586–591
 effects of, 578
 functional connectivity studies and, 585–586
 functional neuroimaging results and, 580–585
 fusiform cortex and, 585
 fusiform gyrus and, 580–581
 hemispheric asymmetry and, 578–591
 Heschl's gyrus and, 579
 phonological processing and, 579–585
 planum temporale and, 578
 right ear advantage (REA) and, 589, 591
 speech perception and, 349, 364–367
- Early, T. S., 629
- Ehret, G., 102, 106
- Eichele, Tom, 4, 459, 605–620
- Eidelberg, D., 190–191
- Eimer, M., 420
- Electroconvulsive therapy, 76
- Electroencephalography (EEG), 2
 auditory asymmetries and, 217–226
 behavioral measurements and, 215
 coherence analysis and, 316–317
 combining techniques with, 233–236
 coupling and, 230–233
 default mode network (DMN) and, 605
 development of, 211–212
 dichotic listening and, 219–222, 232–233, 459
 differences from other neuroimaging techniques and, 212–214
 electrical potential variation and, 211
 eye-closed waking state and, 318
 fast Fourier transforms (FFTs) and, 314
 frontal asymmetries and, 226–229
 functional connectivity and, 229–233
 inverse problem and, 214
 language lateralization and, 222–226
 laterality index and, 216
 memory and, 500
 pair correlation and, 314
 pyramidal cells and, 212
 rhythmic brain recording and, 214–215
 scalp electrodes and, 211
 schizophrenia and, 605
 signal phase and, 230–231
 sleep and, 314–324, 328–329, 331n4
- Eluvanthinal, T. J., 194, 196
- Embase, 288

- Embryos
head orientation and, 121–122
hormones and, 256
input during ontogeny and, 126–128
pigeons and, 121–124
unusual prenatal environments and, 256
visual asymmetries and, 382
- Emotion
children studies and, 228
cognitive control and, 469
depression and, 228–229
electromagnetic functional connectivity and, 229–233
frontal asymmetries and, 226–229
functional connectivity and, 229–233
gonadotropic hormones and, 227–228
menstrual cycle and, 7, 227–228, 254, 258–259, 264–276, 353–358
tryptophan and, 228–229
- Emx2, 22
- Endocasts, 44–45
- Endrass, T., 629–630
- English, 78, 182, 288, 360–363, 621
- Epicurus, 182
- Epilepsy, 214, 225
cognitive control and, 470–471
dichotic listening and, 441–442, 445
neglect and, 536
psychosis and, 623
sex differences and, 289, 291
sodium amytal testing and, 442
white matter pathways and, 198, 201
- Equipotentiality, 3
- Equivalent current dipole (ECD), 212, 224, 224–225
- Ersland, L., 422
- Estradiol, 255–257, 259, 265–269, 271, 273
- Estrogen, 227, 270–275, 302
- Event-related desynchronization (ERD), 225
- Event-related magnetic fields (ERFs), 211, 225
- Event-related potentials (ERPs)
asymmetric indices and, 211, 224–225
audio-visual integration and, 420, 430–433
dichotic listening and, 456, 458, 461
neglect and, 537, 545
psychosis and, 630
- Event-related synchronization (ERS), 225
- Evidence of Man's Place in Nature* (Huxley), 622
- Evolution
asymmetric advantage and, 9–10
Broca and, 37
comparative neurobiology and, 43–45
endocasts and, 44–45
gradualism and, 641–642
handedness and, 65–80, 121–124
human uniqueness and, 7–9
Huxley and, 641–642
language and, 37–57, 73–74
Meuller and, 641–642
paleoneurology and, 40–43
Peking man and, 42
psychosis and, 622–623, 641–650
putative cerebral dominance and, 648
saltation and, 642–644
species-species variation and, 647–648
speech perception and, 350–352
stone tool use and, 41
Swartkrans fossil site and, 42–43
visual asymmetries and, 379–385
- Excitatory-excitatory (EE) cells, 218
- Extinction, 12
audio-visual integration and, 427, 430, 423, 426, 429–433
dichotic listening and, 445, 447, 450, 454, 460–462
neglect and, 535
- Fadiga, L., 384
- Falk, D., 43
- Falzi, G., 153
- Fast Fourier transforms (FFTs), 314, 324
- Fernandes, M. A., 518
- Ferrillo, F., 314
- Fgf8, 22, 24–25

- File-drawer problem, 291, 301–302
- Finnish, 363, 423, 486
- Fiss, H., 321
- Flanker paradigm, 469
- Flechsig, Paul, 184, 190
- Fodorian modularity, 380–381
- Fogassi, I., 384
- Forebrain. *See* Cerebral cortex
- Forel, Auguste-Henri, 184
- Forkel, Stephanie, 5, 177–209
- Fornito, A., 626
- Forward genetic approach, 27–28
- Foulkes, W. D., 313
- Foundas, A. L., 352
- Fox, N. A., 226
- FOXP2*, 78–79
- Fractional anisotropy, 192, 194, 196
- French, 366
- Freud, Sigmund, 184, 533
- Friederici, A. D., 356, 364
- Frith, C. D., 507–508, 628
- Fruit flies, 122
- Functional magnetic resonance imaging (fMRI), 2–5, 13–14, 200
- asymmetric indices and, 213, 218–219, 225–226, 229–230, 233–234
- auditory asymmetries and, 218–219
- cognitive control and, 487, 489
- combining techniques with, 233–236
- default-mode network analysis and, 4, 605–606, 615–616
- dichotic listening and, 444, 456
- forward genetic approach and, 27–28
- hormones and, 257, 265, 267, 272
- memory and, 500, 504, 511, 517
- pediatric developmental disorders and, 573, 591
- psychosis and, 632–633
- sex differences and, 287–288
- visual asymmetries and, 394, 402
- Functional segregation, 2
- Fusiform face area (FFA), 398–399
- Fusiform gyrus, 398–399
- GABA, 50, 124
- autism and, 567
- hormone therapy and, 273–274
- interhemispheric decoupling and, 265, 267
- pigeons and, 130–131
- serotonin and, 567
- Gabrieli, J. D. E., 421
- Gadea, M., 482–484
- Galaburda, Albert, 42, 50, 190–191
- Galatzer, A., 257
- Gall, Franz Joseph, 3, 37, 147, 182
- Gallese, V., 384
- Galuske, R. A., 25, 151
- Gannon, Patrick J., 7–9, 25, 37–63
- Gazzaniga, M. S., 65, 80, 432, 445
- Genetics
- brain patterning and, 21–25, 100, 322–324, 639
- fetal stages and, 23–24
- handedness and, 65, 70–72, 121, 302–304
- hemispheric transcription and, 21–30
- immediate early gene (IEG) expression and, 92–93, 107–108
- inheritance and, 70–71
- language and, 76–79
- nonhuman gene expressions and, 25–27
- pediatric developmental disorders and, 561–563 (*see also* Pediatric developmental disorders)
- potential regulating mechanisms and, 24–25
- psychosis and, 641–650
- saltation and, 642–644
- songbirds and, 107–108
- Zenk response and, 1070–108
- Gene transcriptions
- brain patterning and, 21–25
- forward genetic approach and, 27–28
- human brain and, 22–29
- microarrays and, 28–29
- nonhuman brains and, 25–27
- protein levels and, 29–30
- proteomic approaches and, 29

- regulating mechanisms for, 24–25
serial analysis of, 28
George, Isabelle, 10, 91–120, 403
German, 363–364
Geschwind, N., 23, 149–150, 190, 196, 198, 445, 578, 624
Gestures
 apraxia and, 186–188
 handedness and, 73–79
 language and, 8, 10, 42, 69, 73–79, 92, 186–188
Ghirlanda, S., 80
Gibbons, 44
Gilbert, J. A., 325
Ginsburg, H. J., 418
Goldschmidt, R., 642, 650
Goldstein, L., 314–315
Goldstein, M. H., 443
Goller, F., 96, 102, 109
Gonadotropic hormones, 227–228
Go/no-go tasks, 547, 577
Gootjes, L., 484
Gordon, H. W., 257
Gorillas, 52, 55
Gottman, J. M., 314
Gratiolet, P., 624, 650
Gray catbirds, 98
Guariglia, C., 388
Güntürkün, Onur, 10–11, 69, 121–141, 264–265, 267, 382
Gur, R. E., 623

Habib, M., 510
Hagmann, P., 355–356
Hall, J. L., 443
Halliday, G., 624
Hämäläinen, Heikki, 12, 417–437
Hammar, A., 422
Hammond, G., 623
Handedness, 253
 ambidexterity and, 70, 80, 623–624, 631–632
 animal kingdom and, 65–66, 69
 childhood development and, 290
 chromosomes and, 302–304
 cingulate cortex and, 159–160
 common external locations and, 420
 congenital adrenal hyperplasia (CAH) syndrome and, 302–303
 default mode network (DMN) and, 606
 dichotic listening and, 290–297
 diethylstilbestrol (DES) and, 302
 environmental factors and, 72–73
 evolution and, 65–80, 121–124
 as facultative trait and, 72–73
 funnel plots of, 68
 genetics and, 65, 70–72, 76–79, 121
 gesture and, 73–79
 inheritance and, 70–71, 121
 language and, 73–79, 287–304
 limb asymmetry and, 69–70
 limbic system and, 157–160
 manual dexterity and, 66–73
 measurement methods for, 289
 meta-analytic techniques and, 291–292
 motor regions and, 154–157
 pediatric developmental disorders and, 562
 planum temporale and, 290, 303–304
 primates and, 67–69
 psychosis and, 623–624
 publication bias in, 291, 301–302
 reaction times and, 419–420
 scatter plots of, 68
 sex differences and, 287–304
 speech perception and, 351–358, 362, 365–366
 throwing and, 67–68
 twins and, 71–72
 visual asymmetries and, 419–420
 white matter pathways and, 194
Harasty, J., 624, 636
Harding, A., 624
Harkins, D. A., 121–122
Harmon-Jones, E., 227
Harris, J. M., 627
Hartley, D., 182

- Hasnain, M. K., 160–161
- Hauber, M. E., 108
- Hausberger, M., 102
- Hauser, M. D., 102
- Hausmann, Markus, 7, 253–285, 382
- Head orientation, 121–122
- Head-turn preference, 418
- Hebb, D. O., 229
- Hedden, T., 421
- Hedge's *g*, 292, 295, 297
- Helland, T., 364–365
- Hellige, Joseph B., 11, 253, 379–415
- Hemispheric asymmetry
- as advantage, 9–10
 - aging and, 152–153 (*see also* Aging)
 - altered asymmetry and, 13–15
 - associationist theory and, 181–185
 - auditory, 10–11 (*see also* Auditory asymmetries)
 - cortical structures and, 4–5
 - default mode network (DMN) and, 605–616
 - dichotic listening and, 219–222 (*see also* Dichotic listening)
 - electroencephalography (EEG) and, 211–236
 - evolution and, 7–10
 - gene transcription in, 21–30
 - handedness and, 65–80 (*see also* Handedness)
 - historical perspective on, 2–3
 - human torque and, 45–46, 162–163, 621, 624, 627–628, 634–641, 650
 - human uniqueness and, 7–9
 - inter-/intraindividual differences and, 5–7
 - language and, 37–57
 - left-right (L-R) features and, 3–4, 21–23, 80, 91, 98–100, 108, 122, 124, 128–132, 146, 151–154, 323, 382, 392, 404–405, 458, 616, 636
 - limbic system and, 157–160
 - magnetoencephalography (MEG) and, 211–236
 - memory and, 499–521
 - motor region and, 154–157
 - as natural default mode, 146
 - neglect and, 533–550
 - neuroimaging and, 2–4
 - perisylvian region and, 147–154
 - petalia and, 45–46, 162
 - potential regulating mechanisms and, 24–25
 - research explosion in, 1
 - schizophrenia and, 605–616
 - sex differences and, 253–276, 287–304 (*see also* Sex differences)
 - sleep and, 313–331
 - social constraints and, 91–92
 - somatosensory region and, 154–157
 - songbirds and, 91–112
 - speech perception and, 349–368
 - structural indices of, 145–164
 - symmetry and, 145–147
 - top-down modulation of bottom-up asymmetries and, 12–13
 - vertebrate studies and, 91–92
 - visual, 10–11 (*see also* Visual asymmetries)
 - white matter pathways and, 177–202
 - whole brain indices and, 161–164
- Hemispheric encoding/retrieval asymmetry (HERA) model, 13, 509–513, 520–521
- Hennig, W., 43–45
- Heschl's gyrus, 1
- dichotic listening and, 445, 454–458, 461
 - dyslexia and, 579
 - language and, 52, 56
 - pediatric developmental disorders and, 579
 - psychosis and, 625
 - structural indices and, 147, 149, 164, 217, 220, 224
- Heschl's sulcus, 38
- Hewes, Gordon, 42
- Hindi-Urdu, 368
- Hines, M., 256, 302
- Hinshelwood, J., 578
- Hippocampus
- episodic left, 504
 - memory and, 500, 504–508
 - multitrace theory and, 507–508

- psychosis and, 621, 628
structural indices and, 157–159
- Hippocratic Corpus, 38
- Hirnstern, M., 382
- Hiscock, M., 300
- Hobbes, 182
- Hochberg, Z., 256
- Hodology, 43
- Hoffer, A., 622
- Holloway, Ralph, 25, 42–43
- Homo erectus*, 41–42, 45
- Homo habilis*, 41, 43
- Homo neanderthalensis*, 42
- Homo rudolfensis*, 43
- Homo sapiens*, 42, 65, 78, 622, 645, 650
- Honeybees, 39
- Hook-Costigan, M. A., 75
- Hopkins, William D., 25, 67–68, 379, 384, 419
- Hormones
- activating effects of, 257–258
 - allopregnanolone and, 255
 - androgens and, 255
 - aromatase and, 255
 - chromosomal aberrations and, 257
 - cortical-interaction hypothesis and, 274–275
 - diethylstilbestrol and, 256
 - dihydrotestosterone and, 255–256
 - estradiol and, 255–257, 259, 265–273
 - gestagens and, 255
 - interhemispheric decoupling and, 264–265, 269–270
 - menstrual cycle and, 258–270
 - organizing effects of, 255–256
 - pregnenolone and, 255
 - progesterone and, 255, 257, 259, 264–269, 273–274
 - sex differences and, 254–258
 - speech perception and, 353–359, 362, 364, 367
 - steroids and, 255–257, 267
 - testosterone and, 255–256, 257, 259
 - unusual prenatal environments and, 256
- Hormone therapy, 270–274
- Horses, 69, 110
- Hottentots, 67
- How to Do Things with Words* (Austin), 640
- Hugdahl, Kenneth, 1–2, 5, 9, 12
- audio-visual integration and, 422, 431
 - cognitive control in auditory laterality and, 469–497
 - dichotic listening and, 449
- Hughlings Jackson, John, 404, 621
- Human Brain Mapping* journal, 289
- Humans. *See also* Infants; Pediatric developmental disorders
- auditory asymmetries and, 218–219 (*see also* Auditory asymmetries)
 - bipedalism and, 66–67
 - comparative neurobiology and, 43–45
 - endocasts and, 44–45
 - language and, 74–75 (*see also* Language)
 - manipulative skills of, 69–70
 - petalia and, 45–46, 162
 - planum temporale and, 38–39
 - torque and, 45–46, 162–163, 621, 624, 627–628, 634–641, 650
- Hurayasu, Y., 625
- Husain, Masud, 13, 533–559
- Husband, J., 628
- Huxley, Julian, 623
- Huxley, Thomas, 621, 622, 641–642, 650
- Hwang, R. J., 227
- Hypokinesia, 541–542
- Iidaka, T., 520
- Immediate early gene (IEG) expression, 92–93
- Impalas, 69
- Independent component analysis (ICA), 605–606
- Indexicals, 635–636
- Infants
- dichotic listening and, 419
 - executive functions and, 420–422
 - head-turn preferences and, 418

- Infants (cont.)
 pediatric developmental disorders and, 561–591
 reaching preferences and, 418–419
 serotonin and, 566–568
 spatial perception and, 419
 spatial right-side advantage and, 429–430
 stepping responses and, 419
 Inferior frontal gyrus, 539, 545
 abnormal cortical surface and, 627
 auditory laterality and, 357
 gender and, 164
 lack of asymmetry in, 153
 language and, 37–38, 42–43, 47, 147–148, 632
 pediatric disorders and, 577, 580, 585–586
 perisylvian region and, 147
 sex differences and, 267
 Tan and, 37–38
 visuospatial function and, 539
 white matter pathways and, 191, 196
 Inferior parietal lobule (IPL), 395
 Ingvar, D. H., 605
 Interhemispheric transfer time (IHTT), 269, 271, 275, 456, 629
 Ipsilateral silent period (iSP), 267, 269

 Jäncke, L., 366
 Japanese, 364
 Johnsen, B. H., 485
 Johnstone, E. C., 627–628
 Jovanovic, U. J., 319–320

 Kahn, S., 623
 Kalpouzos, Grégoria, 13, 499–523
 Kaneshiro, K. Y., 642
 Kanji writing, 39, 582
 Kasai, K., 625, 627
 Kawasaki, Y., 624–625, 628
 Keith, Arthur, 41
 Kelley, W. M., 509–510
 Kenya, 44
 Kertesz, A., 190, 253
 Kibby, M. Y., 579

 Kim, J., 403
 Kim, S. G., 253
 Kimura, Doreen, 221–222, 441–447, 460–462, 470–471, 473
 Kinsbourne, M., 448, 478–479, 537, 541
 Kircher, T. T., 234, 633
 Kirk, I. J., 629–630
 Klein, G., 321
 Kline, J. P., 226–227
 Klingler, L. G., 188
 Koenig, O., 381
 Koivisto, M., 403
 Koo, M. S., 626
 Koobi Fora region, 43
 Korsakoff, Sergei, 184
 Kosslyn, Stephen, 11, 381, 386, 393–394
 Kraepelin, E., 622
 Kraus, J. K., 319
 Kreel, L., 628
 Kwon, J. S., 625

 Laeng, Bruno, 11, 379–415
 Laine, Matti, 486
 Laland, K., 72–73, 77–78
 Lamb, M. R., 399–400
 Lancaster, J. L., 162
 Lancelot, C., 503
 Language, 2
 aphasia and, 38, 146, 186, 189, 196, 288
 asymmetrical time sampling theory and, 223–224
 autism and, 287
 Bergen Dichotic Listening test and, 291, 422, 449, 471–473, 484
 bilateral redundancy gain and, 630
 Broca's area and, 37–38, 41, 43, 45, 50, 56, 73–79, 147, 152, 222–223
 Brodmann's areas and, 74, 149, 151
 cerebral Rubicon for, 41
 childhood development and, 287–288
 Chomsky and, 634, 637
 communication and, 8, 10, 39–40, 42, 69, 73–75, 92, 186

- comparative neurobiology and, 43–45
- consonant-vowel-consonant (CVC) task and, 290, 295–301
- consonant-vowel (CV) tasks and, 219–222, 290, 295–301, 351–353, 357–365, 422, 444, 456, 459, 471–472, 477–478, 481–482, 488, 572–573, 589
- cultural effects on, 349
- Dax and, 37
- default mode network (DMN) and, 607, 613
- deixis and, 635–636, 640–641
- de Saussure and, 634–635, 639
- developmental language disorders (DLDs) and, 564–566
- dichotic listening and, 219–222, 232–233 (*see also* Dichotic listening)
- dura matter and, 42
- dyslexia and, 289, 349, 364–367 (*see also* Dyslexia)
- electroencephalography (EEG) and, 222–226
- fluency and, 287
- frequency processing and, 392
- GABA and, 50
- Gall and, 37
- genetics and, 25–26, 76–79
- gestures and, 8, 10, 42, 69, 73–75, 92, 186
- grammar and, 287
- handedness and, 73–79, 287–304
- Heschl's gyrus and, 149
- historical perspective on, 37–39
- honeybees and, 39
- humans and, 39–40, 74–75
- inferior frontal gyrus and, 37–38, 42–43, 47, 147–148, 632
- inferior parietal lobule (IPL) and, 607, 613
- left-ear advantage (LEA) and, 422, 471–486, 568–569, 589
- lunate sulcus and, 42
- magnetoencephalography (MEG) and, 222–226
- meaning of term, 39
- menstrual cycle and, 259, 267
- milliseconds domain and, 224–225
- minimalist theory and, 635
- mirror neurons and, 74
- MRI and, 56–57
- paleoneurology and, 40–43
- pediatric developmental disorders and, 562–572, 578–579, 582–583, 586, 589
- perisylvian region and, 147–154
- PET scans and, 56–57
- phonological tasks and, 287
- phrenology and, 37
- planum temporale and, 38–39, 149–152, 288–292, 299
- primary auditory cortex and, 149
- primates and, 7–8, 39–40, 45–57
- psychosis and, 621, 624, 630, 632–641
- publication bias in, 291, 301–302
- reading abilities and, 287
- right ear advantage (REA) and, 288 (*see also* Right ear advantage)
- science of, 37
- semantic tasks and, 287
- sensory aphasia and, 38
- sentence length and, 287
- sex differences and, 253, 287–304
- signs and, 39–40, 75–76
- sleep and, 321–322
- songbirds and, 91–112
- specific language impairment (SLI) and, 562, 564, 579
- structural derivation and, 635–641
- study methodologies for, 40–45, 56–57
- superior temporal gyrus and, 149–152
- sylvian fissure and, 9, 21, 38–39, 42, 46–49, 52–56, 147–149, 218, 624
- Tan and, 37–38
- Tpt topography and, 47, 49–50
- trauma and, 38
- verbal IQ and, 198
- visual asymmetries and, 392
- Wada test and, 76
- Wernicke's area and, 37–42, 45–50, 56–57, 147, 149–152, 186, 222–223
- white matter pathways and, 198

- Lashley, Karl, 3
- Laterality index, 216
- Lateralization. *See also* Hemispheric asymmetry
- avian brain and, 91–112, 121–134
 - default mode network (DMN) and, 605–616
 - environmental factors and, 122
 - fixed vs. progressive, 417–418
 - sex differences and, 287–304 (*see also* Sex differences)
 - sleep and, 313–331
 - structural indices of, 145–164
- Lateralized readiness potential (LRP), 236
- Lauerma, H., 320
- Law, A., 628
- Leakey, Louis, 41
- Leask, S. J., 631
- Left-ear advantage (LEA), 422, 589
- autism and, 568–569
 - bottom-up manipulation and, 474–478
 - cognitive control and, 471–486
 - consonant-vowel (CV) tasks and, 471–472, 477–478, 481–482, 488
 - dissociation and, 481–486
 - effects of stimulus characteristics, 477–478
 - forced left/forced right attention instruction and, 481–486
 - forced right/forced left conditions and, 479–489
 - lag effect and, 476–477
 - stimulus onset asynchrony (SOA) and, 476–477
 - stimulus presentation effects and, 474–477
 - top-down manipulation and, 478–486
- Left-foot bias, 69
- Left-hand bias, 121, 400, 420
- evolution and, 68–73, 76–77
 - forward genetic approach and, 27–28
 - hormones and, 269
 - language and, 45
 - percentage of, 290–291
 - psychosis and, 623, 631
 - sex differences and, 288–291, 299, 303–304
 - sleep and, 319–320, 324, 327
 - speech perception and, 352, 355–356, 365
 - structural indices and, 150–158, 161, 217
 - white matter pathways and, 188, 192, 198
- Left visual field (LVF), 269
- Leibovitch, F. S., 189
- Lenneberg, E., 417
- Lepage, M., 511
- Leuret, F., 624
- Levine, S. C., 253
- Levitsky, W., 149–150, 578, 624
- Levy, J., 321
- Lexigrams, 39–40
- Li, X. B., 632
- Lichtheim, L., 147
- Liepmann, Hugo, 186–188
- Limbic system, 157–160
- LM04 gene, 7, 648
- Locantore, J. K., 513
- Locus coeruleus (LC), 547, 549
- Lopsided Ape, The* (Corballis), 65
- LRRTM1, 71
- Luders, E., 163
- Lunate sulcus, 42
- Lundervold, A., 431, 484
- Luria, A. R., 80
- Macaques, 46–52, 56, 75, 350
- McCourt, M. E., 259
- McGrew, W. C., 25, 68
- McGuire, P. K., 633
- Macko, K. A., 385
- McManus, I. C., 70–73, 76–77, 289
- MacNeilage, P. F., 68–69
- Magnetic mismatch negativity (mMMN), 224, 234
- Magnetic resonance imaging (MRI)
- default mode network (DMN) and, 606, 614
 - dichotic listening and, 447
 - gene transcription and, 21, 27
 - high-field, 234
 - language and, 45, 55–57

- pediatric developmental disorders and, 561, 564, 578
- psychosis and, 625, 628, 632–633, 637, 648
- sex differences and, 288, 293
- structural indices and, 145, 148–163
- ultra-low-field, 234–235
- white matter pathways and, 177, 189–192
- Magnetoencephalography (MEG)
 - auditory asymmetries and, 217–226
 - background noise and, 212
 - behavioral measurements and, 215
 - combining techniques with, 233–236
 - coupling and, 230–233
 - decreasing amplitude and, 231–232
 - development of, 211–212
 - dichotic listening and, 219–222, 232–233
 - differences from other neuroimaging techniques, 212–214
 - frontal asymmetries and, 226–229
 - functional connectivity and, 229–233
 - greater cost of, 211
 - inverse problem and, 214
 - language lateralization and, 222–226
 - laterality index and, 216
 - magnetic field variations and, 211
 - pyramidal cells and, 212
 - rhythmic brain recording and, 214–215
 - signal phase and, 230–233
 - superconducting quantum interference devices (SQUIDS) and, 211–212
 - tissue distortion and, 231
- Maguire, E. A., 501, 507–508
- Mandarin, 363, 368
- Mangun, G. R., 432
- Manns, Martina, 10–11, 121–141
- Manual dexterity
 - bipedalism and, 66–67
 - genetic theories and, 70–72
 - handedness and, 65–73
 - term of, 66
 - throwing and, 67–68
- Marchant, L. F., 25, 68
- Marchi preparations, 188
- Marks, N. L., 401
- Marsolek, C. J., 381
- Martin, R., 391
- Mass action principles, 3
- Matano, A., 388
- Mayr, Ernst, 622–623
- Medial frontal cortex (MFC), 236
- Medial-temporal-lobe (MTL) system
 - autobiographical memory and, 507–508
 - contextual processing and, 503–506
 - encoding vs. retrieval and, 506–507
 - material-driven mnemonic asymmetry and, 500–503
 - memory and, 499–508, 515, 520–521
 - novelty detection and, 507
- Memory, 2, 10
 - Alzheimer's disease and, 515
 - association tasks and, 191
 - ATOM model and, 515, 517
 - attentional functions and, 420–422, 515, 517
 - auditory laterality and, 351, 356, 368, 471–472, 484
 - autobiographical, 507–508
 - avian, 92
 - Brodman areas and, 511–512, 514
 - CARA model and, 512–514
 - cognitive aging and, 421
 - contextual processing and, 503–506, 512–515
 - cortical surface and, 627
 - dichotic listening and, 443
 - electroencephalography (EEG) and, 500
 - electromagnetic functional connectivity and, 229, 234
 - encoding and, 506–512
 - episodic, 13, 198, 499–515, 518–521
 - executive functions and, 420–422
 - frontal lobes and, 508–514
 - functional organization and, 499–521
 - HERA model and, 509–511, 513, 520–521
 - heuristics and, 512–514
 - hippocampus and, 500, 504–508

- Memory (cont.)
 long term, 499
 material-driven asymmetry and, 500–503
 medial-temporal-lobe (MTL) system and, 499–508, 515, 520–521
 mnemonic, 500–503
 multitrace theory (MTT) and, 507–508
 neglect and, 534–536, 539–542, 546
 novelty and, 507, 546
 parietal lobe and, 515–519
 pediatric developmental disorders and, 567, 571, 578–579, 583
 phonological loop and, 639
 pigeons and, 122–123
 prefrontal cortex and, 512, 515
 recollection and, 517–518
 REMO sites and, 511–512
 retrieval and, 506–512
 R-K paradigm and, 514, 518
 schizophrenia and, 606
 short-term, 234, 499
 sleep and, 330
 source, 515
 spatial, 419, 503–506, 541–542
 speech production and, 351
 systematic, 512–514
 time scale and, 507–508
 topographical, 534–536
 transcranial magnetic stimulation and, 391, 500, 511
 verbal, 356
 visual processing and, 387, 390–391, 419
 white matter pathways and, 185, 191, 196, 198, 201
 working, 419–422, 541–542, 639
- Menopause, 270–274
- Menstrual cycle, 7, 227–228
 across-field advantage (AFA) and, 269–270
 dichotic listening and, 259
 estradiol effects and, 265–269
 hemispheric asymmetries during, 258–264
 hormones and, 258–274
 interhemispheric decoupling and, 269–270
 language and, 267
 motor cortex and, 267, 269
 progesterone-modulated decoupling and, 264–265
 speech perception and, 353–358
 visual half-field (VHF) technique and, 259, 264
- Merrill, E. C., 417
- Mesencephalic optic tectum, 124
- Messenger RNA (mRNA), 29
- Meta-analysis
 dichotic listening and, 293, 295–297
 sex differences and, 291–297, 300–301, 303–304
 Meynert, Theodor Hermann, 179–185
- Mice, 22, 26, 28, 75, 78, 102, 106
- Michel, G. F., 121–122
- Michimata, Chikashi, 11, 379–415
- Microarrays, 28–29
- Milner, Brenda, 445, 501
- Minimalist Program, The* (Chomsky), 637
- Mirror neurons, 8, 74, 383–384
- Mishkin, M., 385
- Mistichelli, Domenico, 190
- Mockingbirds, 98
- Mohr, B., 629–630
- Moncrieff, Deborah W., 13, 561–601
- Mondor, T. A., 449
- Monkeys, 110, 384, 454
 auditory laterality and, 351, 362
 gross asymmetries and, 46–47
 handedness and, 68–69, 74–75
 language and, 42–47, 50, 52, 55–57
 New World, 46–47
 Old World, 44, 46–47
 rhesus, 46, 69, 75, 102, 106, 362, 447
 white matter pathways and, 189, 196, 210
- Monozygotic (MZ) twins, 71–72
- Montreal Neurological Institute (MNI), 162–163
- Morais, J., 460
- Morphogens, 24–25
- Motivational salience, 549

- Motor cortex
apraxia and, 186–188
default mode network (DMN) and, 606
handedness and, 420 (*see also* Handedness)
head-turn preferences and, 418
involuntary attention switch and, 420
menstrual cycle and, 267, 269
sleep and, 319–328
structural indices and, 154–157
- Mueller, Friedrich Max, 641–642
- Muller-Limroth, 319
- Multiple Sleep Latency Test (MSLT), 324, 326
- Multitrace theory (MTT), 507–508
- Murray, R. M., 633
- Nalepa, R., 624
- Napier, John, 41
- Narr, K. L., 627
- Nathan, G., 155, 190, 419–420
- National Institutes of Health, 52
- Nature*, 287
- NEA, 273–274
- Nealen, P. M., 98, 100
- Neanderthals, 42, 78
- Neglect, 14, 123, 420
agnosia and, 533
attentional blink paradigm and, 542–543
behavioral reconfiguration and, 547–550
biased competition model and, 541
contralesional side and, 533–534, 538–541
diaschisis and, 539, 541
directional hypokinesia and, 541
disengaging attention, 541
divided visual field presentation and, 537–538
drawing and, 535–536
early studies of right parietal patients and, 534–536
exploratory states and, 547–550
extinction and, 535
as imperception, 533
inferior frontal gyrus and, 539, 545
interaction/specificity of cognitive deficits to, 544
leftward shift and, 541
locus coeruleus (LC) and, 547, 549
motivational salience and, 549
nonspatial components of, 542–544
novelty and, 534, 546
oddball paradigm and, 545–546
phasic alerting and, 546–547
posterior parietal cortex (PPC) and, 534, 538–539, 544–550
spatial component of, 534–535, 541–542
split-brain operation and, 534, 536–537
stimulus salience and, 544–547
studies in healthy individuals and, 537–538
task-engaged states and, 547–550
task switching and, 547–549
temporoparietal junction (TPJ) and, 539, 545–547
topographical memory and, 534–536
vigilance and, 542
- Nematodes, 122
- Netley, C., 257
- Nettleton, N. C., 1, 419–420
- Neuroimaging, 2–5, 13–14. *See also specific technique*
active voxels and, 292
cognitive control and, 486–489
dichotic listening and, 290
language and, 76
memory and, 500–501, 508–511, 515
pediatric developmental disorders and, 561, 563, 570, 576–580, 591
sex differences and, 253, 276, 290–292, 297, 300–301
sleep and, 318–319, 326–329
speech perception and, 349, 357
structural indices and, 145, 211, 217, 219, 224, 233
visual asymmetries and, 390, 404–405
white matter pathways and, 178, 188–191, 196

- New View of Insanity, A: The Duality of Mind (Wigan), 621
- New World monkeys, 46–47
- Nobel Prize, 39
- Nodal pathway, 22–23
- Nolde, S. F., 512–513
- Non-REM (NREM) awakenings, 313–314
- Nonspatial selective attention, 542–543
- Noppeney, U., 486
- Norwegian, 360–363
- Notochord plate, 24
- Novelty, 507, 534, 546
- Nyberg, Lars, 13, 499–523
- Nyttingnes, J., 422
- Obleser, J., 362
- Occipital cortex, 160–161
- Occipito-parieto-temporal cortex, 637–638
- Octopuses, 122
- Oddball paradigm, 545–546, 606
- Odor, 226–227
- Øie, M., 482
- Okanoya, K., 102
- Okubo, M., 393, 398
- Old World monkeys, 44, 46–47
- Oligocene era, 44
- Olin Neuropsychiatry Center, 615
- Onitsuka, T., 627
- Optic radiation, 191
- Optic tectum, 124, 126
- Organization of Behavior, The* (Hebb), 229
- Origin of Species* (Darwin), 37, 622, 641–642
- Orton-Gillingham approach, 578
- Osmond, H., 622
- Owen, Richard, 621
- Paivio, A., 639
- paleoneurology, 40–43
- Palermo, L., 388
- Papadatou-Pastou, M., 299
- Paracingulate sulcus, 626
- Parietal cortex, 161
- Parietal lobe, 515–518
- Park, H. J., 192, 194
- Patel, U. J., 402–403
- Paterson, A., 535–536
- Patrick, G. T., 325
- PaX6, 22
- Pearlson, Godfrey, 4, 605–620
- Pediatric developmental disorders
- asymmetrical tissues and, 562
 - attention-deficit/hyperactivity disorder (ADHD) and, 561–562, 569–577
 - autism and, 561, 563–569
 - dyslexia and, 562, 578–591
 - handedness and, 562
 - language and, 562–572, 578–579, 582–583, 586, 589
 - linkage overlap and, 562
 - multiple disabilities and, 562–563
 - neuroimaging techniques and, 561
 - risk factors for, 561–563
 - serotonin and, 566–568
 - specific language impairment (SLI) and, 562, 564, 579
- Peking Man, 42
- Perfect pitch, 154, 163–164
- Perisylvian region
- sylvian fissure and, 9, 21, 38–39, 42, 46–49, 52–56, 147–149, 218, 624
 - white matter pathways and, 180, 196–201
- Petalia, 45–46, 161–162
- Petersen, M. R., 350
- Petersen, S. E., 515
- PF mirror neurons, 74
- Phasic alerting, 546–547
- Phrenology, 37
- Pierson, J. M., 419–420
- Pigeons
- activity-dependent processes and, 128–130
 - altricial nature of, 127
 - asymmetrical anatomy in, 124–126
 - bilateral stimulation effects and, 130–131
 - brain derived neurotrophic factor (BDNF) and, 128–130
 - embryonic development of, 121–124

- exposure of eggs to light and, 126
- eye caps and, 122
- fear/escape responses and, 124
- functional architecture for, 132
- GABAergic inhibition and, 130–131
- input during ontogeny and, 126–128
- interhemispheric projections and, 132, 134
- lateralization model for, 122–131
- memory and, 122–123
- optic nerves of, 122–123
- optic tectum and, 124, 126
- retinal development and, 126–130
- tectofugal system and, 124
- tetrodotoxin (TTX) and, 128, 130
- thalamofugal pathway and, 124
- visual asymmetries and, 121–124
- Pitx2, 26
- Planum temporale, 7–8, 13–14
 - dichotic listening and, 457
 - dyslexia and, 578
 - gendered asymmetry in, 299–300
 - gene transcription and, 21, 25
 - handedness and, 303–304
 - language and, 38–39, 45–47, 52, 55–56, 146, 149–154, 288–292, 299
 - left-hand bias and, 290–291
 - meta-analysis and, 292
 - pediatric developmental disorders and, 578–579, 589
 - perfect pitch and, 154, 163–164
 - psychosis and, 624–625, 636, 648
 - sex differences and, 293, 299–302
 - speech perception and, 355, 365
 - structural indices and, 217, 220, 234
 - superior temporal gyrus and, 149–152
- Plaze, M., 633
- Pleistocene era, 72, 121
- Pollmann, Stefan, 12–13, 441–468
- Polymicrogyria (PMG), 28
- Positron emission tomography (PET), 2, 14
 - combining techniques with, 233–236
 - connectivity and, 229–230
 - dichotic listening and, 219
 - language and, 56–57
 - pediatric developmental disorders and, 561, 568
 - sex differences and, 288
 - sleep and, 318, 321, 323, 326, 329
 - structural indices and, 145, 159, 164, 213, 219, 229–230, 233
- Posner, M. I., 515, 629
- Posterior features, 5, 8–9, 14, 390, 421
 - brain patterning and, 21–22
 - default mode network and, 605, 607, 613–616
 - dichotic listening and, 445, 447, 450–458, 461–462
 - language and, 38, 42, 45, 47, 52
 - memory and, 504, 517
 - neglect and, 533–534, 543
 - pediatric developmental disorders and, 564–567, 570, 579–582, 586
 - psychosis and, 624–630, 636–640
 - sleep and, 326, 330
 - speech perception and, 355–356
 - structural indices and, 147–149, 153, 158–163, 217, 219, 224–225, 236
 - white matter pathways and, 177, 190–198
- Posterior parietal cortex (PPC)
 - inferior frontal gyrus and, 454, 539
 - lesions to, 539
 - neglect and, 534, 538–539, 544–550
- Posterior sulci, 163
- Poufour du Petit, François, 190
- Prechordal plate, 24
- Prefrontal cortex, 13, 29, 605
 - audio-visual integration and, 421–422
 - cognitive control and, 486
 - memory and, 512, 515
 - pediatric developmental disorders and, 570–572, 576–577
 - psychosis and, 626, 633, 637
 - sleep and, 319–320, 326, 330
 - structural indices and, 160, 163, 227
- Previc, F. H., 383
- Primary auditory cortex, 149

- Primates
 bipedalism and, 66–67
 chemical asymmetries and, 50, 52
 comparative neurobiology and, 43–45
 endocasts and, 44–45
 forward tilt of head and, 7–8
 functional asymmetries and, 50, 52
 gene transcriptions and, 25–26
 gross asymmetries of, 45–57
 handedness and, 67–69
 language and, 7–8, 39–40, 45–57
 planum temporale and, 38–39
 sylvian fissure and, 46
 Tpt topography and, 47, 49–50
 Wernicke's area and, 47–50
- Prince, S. E., 504
- Principles of Animal Taxonomy* (Simpson), 43
- Proconsul, 44
- Progesterone, 255, 257, 259, 264–269, 273–274
- Proteomic approaches, 29
- Proverbio, A. M., 432
- Psychiatry—Clinical Treatise on Diseases of the Fore-Brain* (Meynert), 182
- Psychosis
 association cortex and, 636–637
 auditory hallucinations and, 633
 BBC Internet survey and, 631
 bilateral field advantage and, 629
 bilateral redundancy gain and, 630
 Broca's area and, 621, 624–625, 633, 635, 638–639
 Brodmann areas and, 626
 Chomsky and, 634, 637
 cortical surface and, 627
 deixis and, 635–636, 640–641
 delusions of control and, 634
 de Saussure and, 634–635, 639
 dorsolateral prefrontal cortex and, 637–639
 duration of untreated, 625
 echo commentary and, 634
 electrophysiological investigations of, 629–631
 evolution and, 622–623, 641–650
 fecundity disadvantage and, 622–623
 genetics and, 641–650
 gyral folding and, 627
 handedness studies and, 623–624
 hippocampus and, 621, 628
 historical perspective on, 621–623
 language and, 621, 624, 630–641
 manic-depressive illnesses and, 622
 meaning of asymmetry and, 631–632
 minimalist theory and, 635
 neurochemical asymmetries and, 628–629
 occipito-parieto-temporal cortex and, 637–638
 paracingulate region and, 626
 planum temporale and, 624–625
 postmortem studies and, 625–626
 primary delusions and, 634
 schizophrenia and, 622–634, 639–641
 separate thoughts and, 621
 sex differences and, 624–633, 637, 642–650
 sexual selection and, 642–644
 speech and, 632–633
 structural derivation and, 635–641
 temporal gyri volumes and, 624–626
 thought broadcast and, 634
 thought disorder and, 633
 thought insertion and, 634
 thought withdrawal and, 634
 torque and, 621, 624, 627–628, 634–641, 650
 UK National Child Development Survey and, 623, 631
 ventricular enlargement and, 628
 voice commenting and, 634
 Wernicke's area and, 638
- PsyLit, 288
- Publication bias, 291, 301–302
- PubMed, 109, 288
- Pulvermüller, F., 630
- Punctuated equilibria, 642
- Raichle, M. E., 4, 605, 616
- Rajarethinam, R. P., 624

- Rakic, P., 21, 190, 624
- Ramsey, N. E., 623
- Rapid eye movement (REM) sleep, 313–325, 328–329
- Razafimandimby, A., 632–633
- Real-time reverse transcription polymerase chain reaction (RT-PCR), 23
- Reeves, B., 227
- Region-of-interest (ROI) approaches, 192, 194
- Reil, Johann Christian, 179–181
- Reinvang, I., 431, 482, 484
- Retrieval Mode (REMO) sites, 511–512
- Revonsuo, A., 403
- Reynolds, G. P., 628
- Rhesus monkeys, 46, 69, 75, 102, 106, 362, 447
- Ribonucleic acid (RNA), 23, 28–29
- Right-ear advantage (REA), 12–13, 102
- aging and, 422
- attentional effects and, 447–456, 478
- audio-visual integration and, 422–431
- autism and, 568–569
- bottom-up manipulation of laterality and, 474–478
- callosal relay model and, 473
- cognitive control and, 470
- consonant-vowel (CV) tasks and, 219–222, 290, 295–301, 351–353, 357–365, 422, 444, 456, 459, 471–472, 477–478, 481–482, 488, 572–573
- dichotic listening and, 290–297, 422, 441, 444–445, 448–451, 456–462, 470–490
- dissociation and, 481–486
- dyslexia and, 589, 591
- ear of presentation and, 460–461
- executive functions and, 431–432
- forced right/forced left conditions and, 479–489
- as hardwired phenomenon, 473
- Kinsbourne's hemispheric preactivation model and, 448
- lag effect and, 476–477
- left-hemispheric speech processing and, 473
- pediatric developmental disorders and, 568, 573, 589–591
- sex differences and, 288
- spatial right-side advantage and, 429–430
- speech perception and, 351–365
- stimulus dominance effect and, 477
- stimulus onset asynchrony (SOA) and, 449, 476–477, 488–489
- structural indices and, 218–220, 232
- superior olivary complex and, 442–443
- top-down manipulation and, 478–486
- Wada test and, 471
- Right-foot bias, 69
- Right-hand bias, 10, 21, 45, 92
- chimpanzees and, 67–68
- cognitive control and, 472
- forward genetic approach and, 27–28
- handedness and, 65–80
- hormones and, 256
- pediatric developmental disorders and, 568
- psychosis and, 623, 631–632
- sex differences and, 289–304
- sleep and, 319–324
- speech perception and, 351–358, 362
- structural indices and, 150–164, 217, 232, 236
- visual asymmetries and, 132, 383, 386, 394–396, 400, 419, 430, 432
- white matter pathways and, 190, 192
- Right-side advantage (RSA), 420, 423, 430–433
- Right-visual-field advantage (RVFA), 630
- Rimol, L. M., 351, 360, 362, 487
- Rizzolatti, G., 74, 384
- Robertson, L. C., 399–400
- Rockstroh, B., 629–630
- Rod, R., 256
- Rogers, L. J., 8, 65–66, 69, 75, 80, 379–380
- Rönqvist, L., 419
- Rosenthal, R., 292
- Rosenzweig, M. R., 442
- Rossell, S. L., 624
- Rossett, 188

- Rossi, S., 511
Rovet, J., 257
- Saba florida, 68
Sachs, Bernard, 182, 184
Sagan, C., 37
SAGE screening approach, 23, 28
Salisbury, D. F., 625, 627
Saltation, 642–644
Sanders, G., 259
Saneyoshi, A., 394–397
Scheirs, J. G., 256
Schelling, 181
Schizophrenia, 6, 13–14
 auditory oddball (AOD) task and, 606–607, 613–615
 BOLD response and, 606
 Brodmann areas and, 160
 cognitive control and, 470, 481–482, 487–490
 default mode network (DMN) and, 605–616
 DSM-IV diagnosis and, 614–615
 electroencephalography (EEG) and, 605
 gene transcription and, 27
 gyral folding and, 627
 handedness and, 71
 HZ/SZ neural circuits and, 606–607, 613–614
 independent component analysis (ICA) and, 605–606
 language and, 45
 paracingulate gyrus and, 626
 pediatric developmental disorders and, 562, 576
 psychosis studies and, 622–634, 639–641
 sex differences and, 287–291
 structural indices and, 151, 157–160, 234
 white matter pathways and, 186
Schmidt, L. A., 227
Schmidt, M. F., 98, 100
Schneider, G. E., 385
Schneider, K., 634
Schuler, E., 319
Schulman, S., 476
Schwartz, J., 359–360
Science Direct, 288
Scoville, W. B., 501
Seldon, H. L., 624
Serotonin, 50, 159, 164, 566–569, 591
Sex differences, 5–6
 across-field advantage (AFA) and, 269–270
 aging and, 274
 bilateral resource sharing and, 272
 dichotic listening and, 293, 295–297, 300
 endogenous vs. exogenous, 273–274
 face recognition and, 253
 functional imaging results and, 297
 gonadotropic hormones and, 227–228
 handedness and, 253, 287–304
 hormones and, 254–258, 270–274
 interhemispheric decoupling and, 264–265
 intrahemispheric processing and, 271
 language and, 253, 287–304
 menopause and, 270–274
 menstrual cycle and, 7, 227–228, 254, 258–259, 264–276, 353–358
 meta-analysis and, 291–297, 303–304
 neuroimaging and, 290, 297, 300–301
 odor and, 226–227
 planum temporale and, 293, 299–302
 progesterone-modulated decoupling and, 264–265
 psychosis and, 624–633, 637, 642–650
 publication bias in, 291, 301–302
 songbirds and, 107–108
 spatial orientation and, 253
 speech perception and, 352–357, 367
 transsexuals and, 257–258
 unusual prenatal environments and, 256
 visual half-field (VHF) technique and, 253, 259, 264, 267, 269
Shah, G. M. S., 633
Shankweiler, D., 359, 476
Shapleske, J., 624
Shaywitz, B. A., 287
Shenton, M. E., 625, 627
Shipley, C., 256

- Shtyrov, Y., 361–363
- Sidtis, J. J., 221
- Simons, J. S., 520
- Simpson, George Gaylord, 43–45
- Singh-Curry, Victoria, 13, 533–559
- Single photo emission computed tomography (SPECT), 563, 629, 633
- Sinha, S., 442
- Situs inversus, 27–28
- Skinner, E. I., 518
- Sleep
- alpha activity and, 315, 323
 - auditory asymmetries and, 320
 - awakenings and, 313–314, 320–325
 - Broca's area and, 328
 - carry-over effects and, 321
 - cerebral blood flow and, 319
 - coherence analysis and, 316–317
 - deprivation of, 320, 325–330
 - early research on, 313–314
 - electroencephalography (EEG) and, 314–324, 328–329, 331n4
 - eye-closed waking state and, 318
 - fast Fourier transforms (FFTs) and, 314, 324
 - finger-tapping task and, 320–324
 - homeostatic hypothesis and, 320
 - motor asymmetry during, 319–320
 - motor cortex and, 320–328
 - Multiple Sleep Latency Test (MSLT) and, 324, 326
 - neuroimaging studies and, 318–319
 - non-REM (NREM), 313–325
 - nose tickling during, 319
 - onset of, 319–325, 331
 - orienting task and, 327
 - perceptual illusion and, 321
 - rapid eye movement (REM), 313–325, 328–329
 - reaction time and, 320, 323–327
 - slow wave (SWS), 316–318, 325, 329
 - theta activity and, 323
 - verbalization and, 321–322
 - Wernicke's area and, 328
 - Sleep debt, 320, 325–330
- Slotnick, S. D., 391, 514
- Smedley, B., 420
- Smith, L. L., 302
- Smithsonian Institution, 55
- Smith Surgical Papyrus, 38
- Sodium-amytal procedure, 76, 223, 225, 442, 471
- Somatosensory region, 154–157, 218
- Sommer, Iris E. C., 5–6, 287–313, 355, 623–624, 632–633
- Songbirds
- arcopallium and, 93
 - artificial stimuli and, 105–106
 - asymmetries in song perception and, 102–107
 - asymmetries in song production and, 93–102
 - behavioral quantification of, 92
 - BOLD measurements and, 107
 - fundamental frequency and, 96, 98
 - HVC premotor activity and, 98, 100–106, 358
 - hypoglossal nucleus and, 93
 - immediate early gene (IEG) expression and, 92–93, 107–108
 - left bias in, 92–93
 - sex differences and, 107–108
 - sexual imprinting and, 92–93
 - song matching and, 109
 - speech perception and, 358–359
 - study conclusions and, 109–112
 - subsyringeal pressure and, 96
 - syllable count and, 96
 - syrinx and, 26, 93–98, 100–102, 108–109
 - vocal muscles and, 26, 93–102, 108–109
 - warbling and, 102, 104–106, 110, 358
 - whistles and, 102, 104, 358
 - Zenk response and, 107–108
- Sovrano, V. A., 69
- Spaniel, F., 632
- Spanish, 368
- Sparks, R., 445

- Specht, K., 422, 484
- Specific language impairment (SLI), 562, 564, 579
- Speech perception. *See also* Language
- acoustics and, 350–351, 359–364, 367–368
 - animal models and, 349–350
 - asymmetrical time sampling theory and, 223–224
 - biological basis for, 350–359
 - brain asymmetry studies and, 354–357
 - Broca's area and, 366
 - call signals and, 362
 - childhood development and, 363–367
 - cross-species view and, 350–352, 362
 - deixis and, 635–636, 640–641
 - dichotic listening and, 219–222, 232–233 (*see also* Dichotic listening)
 - different languages and, 360–368
 - dyslexia and, 364–367
 - handedness and, 351–358, 362, 365–366
 - hemispheric decoding of, 224
 - hormones and, 353–359, 362, 364, 367
 - human perceptual studies and, 352–354
 - individual differences and, 350–359
 - input-output complex and, 357–359
 - linguistic factors and, 359–364
 - menstrual cycle and, 353–354
 - milliseconds domain and, 224–225
 - neurodevelopmental disorders and, 364–367
 - neuroimaging and, 349, 357
 - planum temporale and, 355, 365
 - psychosis and, 632–633
 - rhyming discrimination and, 357
 - ribbon of sound and, 635
 - right ear advantage (REA) and, 351–355
 - sentence length and, 287
 - sex differences and, 352–357, 367
 - structural derivation and, 635–641
 - tonal inflections and, 363
 - vocal control nucleus (HVC) and, 358–359
 - voice onset time (VOT) and, 360–361, 366
 - white matter pathways and, 365–366
- Sperling, R., 504
- Sperry, R. W., 445, 536
- Spiers, H. J., 501, 503, 520
- Spinelli, D., 420
- Split-brain studies, 65, 73, 189, 216, 400, 432, 534–537
- Springer, S. P., 445
- Squire, Larry, 499
- Staresina, B. P., 504
- Starlings, 106, 110
- Steno, Nicolaus, 178
- Steroids, 255–257, 267
- Stimulus onset asynchrony (SOA), 449, 476–477, 488–489
- Stone tools, 41
- Strange, B. A., 507
- Stroop task, 400, 469, 484, 487, 490
- Studdert-Kennedy, M., 359, 476
- Sugishita, M., 447
- Sugiyama, Y., 68
- Sun, Tao, 7, 21–36
- Superconducting quantum interference devices (SQUIDS), 211–212
- Superior frontal gyrus
- language and, 47
 - memory and, 514
 - pediatric disorders and, 570, 586
 - schizophrenia and, 607
- Superior occipital gyrus, 395
- Superior temporal gyrus, 397
- default model network and, 607
 - dichotic listening and, 451, 454–458, 461–462
 - hormones and, 257
 - language and, 38, 50, 149–152
 - pediatric developmental disorders and, 580–585
 - planum temporale and, 149–152
 - psychosis and, 624–625
 - speech perception and, 362
 - structural indices and, 164, 224
- Superior temporal sulcus (STS), 74, 224
- Suthers, R. A., 26, 96–98, 102, 109

- Sutton, S. K., 227
- Swanson, Nathan, 4, 605–620
- Swartkrans fossil site, 42–43
- Swedish, 363, 486
- Sylvian fissure
- language and, 9, 21, 38–39, 42, 46–49, 52–56, 147–149, 218, 624
 - psychosis and, 624
 - structural indices and, 147–149, 218
- Syrinx, 26, 93–102, 108–109
- Takio, Fiia, 12, 417–437
- Talairach space, 162–163
- Tallal, P., 359–360
- Tan, 37–38
- Tandon, R., 624
- Target-related salience, 545–546
- Taylor, L., 445
- Taylor, P. C., 236
- Tectofugal system, 124
- Telencephalic entopallium, 124
- Temple, E., 366
- Temporoparietal junction (TPJ), 539, 545–547
- Testa, P., 322
- Testosterone, 255–259
- Tetrodotoxin (TTX), 128, 130
- Thalamic radiations, 190–191
- Thalamofugal pathway, 124
- Thelen, E., 418–419
- Theory of mind (TOM), 613
- Thiebaut de Schotten, Michel, 5, 177–209
- Thomsen, T., 5, 422, 431, 433, 484, 487
- Throwing, 67–68
- Tirosh, E., 256
- Toads, 69
- Tobias, Phillip V., 41–43
- Topography, 43
- Topology, 43
- Torque, 45–46
- psychosis and, 621, 624, 627–628, 634–641, 650
 - Yakovlevian, 162–163
- Tpt, 47, 49–50, 151
- Transcranial alternate current stimulation (TaCS), 233, 235
- Transcranial direct current stimulation (TDCS), 233, 235
- Transcranial magnetic stimulation (TMS), 233, 235–236, 267–269, 391, 420, 500, 511
- Transsexuals, 257–258
- Trevarthen, C. B., 321
- Trojano, L., 390–391
- Tryptophan, 228–229
- Tulving, Endel, 13, 499, 507
- Turner's syndrome, 257, 643–644
- Twins, 71–72, 121, 163, 289, 353, 632, 648
- Tzourio-Mazoyer, N., 351, 357
- UK National Child Development Survey, 623, 631
- Ultra-low-field (ULF) MRI, 234–235
- Uncinate fasciculus, 191
- Ungerleider, L. G., 385
- University of Halle, 179
- Valium, 40
- Vallois, 41
- Vallortigara, G., 80
- Ventral features
- default mode network and, 605
 - gene transcription and, 21
 - handedness and, 74
 - neglect and, 546
 - pediatric developmental disorders and, 576
 - structural indices and, 149
 - visual asymmetries and, 385, 394, 396, 420, 546
 - white matter pathways and, 180, 191, 196
- Vicq d'Azyr, 182
- Vieussens, 182
- Vingerhoets, A. J., 256
- Visual asymmetries, 10–11
- aging and, 417–433
 - analysis of variance (ANOVA) on, 428–429
 - attentional blink paradigm and, 542–543
 - attentional functions and, 420–422

- Visual asymmetries (cont.)
- between-categories discrimination and, 394
 - BOLD response and, 390–391, 397
 - brain derived neurotrophic factor (BDNF) and, 128–130
 - common external locations and, 420
 - complementary specializations and, 380
 - coordinate relations and, 386
 - corpus callosum and, 384–385
 - cross-species view of, 379–385
 - cues and, 381–382
 - decomposable systems and, 380–381
 - divided field studies and, 386–387, 429, 537–538
 - double dissociation and, 387–388
 - embryonic development in pigeons and, 121–134
 - evolutionary time and, 379–385
 - executive functions and, 420–422, 431–432
 - exposure of eggs to light and, 126
 - face recognition and, 382, 398–399
 - Fodorian modularity and, 380–381
 - frequency processing and, 391–393
 - fusiform gyrus and, 398–399
 - geometry and, 387
 - global-local processing and, 397–398
 - handedness and, 419–420
 - hierarchical stimuli and, 392–393
 - infants and, 419
 - inferior parietal lobule (IPL) and, 395
 - input during ontogeny and, 126–128
 - integration with auditory asymmetries and, 417–433
 - interhemispheric interaction in, 399–405
 - involuntary attention switch and, 420
 - language and, 392
 - left visual field (LVF) and, 269
 - letter case and, 403
 - mirror neurons and, 384
 - neglect and, 533–550
 - object recognition and, 393–397
 - occipital cortex and, 160–161
 - optic tectum and, 124, 126
 - overlapping receptive fields and, 393
 - parietal cortex and, 161
 - reaction times and, 387, 419–420
 - selective attention and, 428–429
 - shearing forces and, 383–384
 - snowball mechanism for, 383, 392
 - spatial relations and, 385–393, 419
 - Stroop test and, 400
 - superior occipital gyrus and, 395
 - tectofugal system and, 124
 - tetrodotoxin (TTX) and, 128, 130
 - thalamofugal pathway and, 124
 - transcranial magnetic stimulation (rTMS) and, 391
 - weak modularity and, 380–381
- Visual auditory presentation package (VAPP), 614
- Visual-field-by-task interaction, 393–397
- Visual half-field (VHF) technique, 253, 259, 264, 267, 269
- Vocal control nucleus (HVC), 358–359
- Vogel, J. W., 67
- Voice onset time (VOT), 360–361, 366
- Von Frisch, Carl, 39
- Voxel-based morphometry (VBM), 159–160, 163, 190–194
- Voyer, D., 300
- Wada test, 76, 223, 225, 471
- Walker, S. F., 69
- Walruses, 69
- Wang, L., 626
- Warbling, 102, 104–106, 110
- Washoe, 39
- Wasserschlager canaries, 95–96, 98, 100
- Wehling, E., 431, 484
- Weidenreich, 41
- Weigert-Pal method, 188
- Weis, S., 107, 267
- Weissman, D. H., 402
- Wenmoth, D., 259
- Wernicke, Carl, 2–3, 147
- associationist model and, 184

- background of, 186
- language and, 38
- Meynert and, 184
- sensory aphasia and, 38
- white matter pathways and, 184, 186
- Wernicke's area, 7, 9, 13
- Brodman's areas and, 38
- cellular-level asymmetry and, 47–50
- chemical asymmetries and, 50, 52
- dichotic listening and, 232–233
- functional asymmetries and, 50, 52
- hormones and, 257
- language and, 37–50, 56–57, 147, 149–152, 186, 222–223
- planum temporale and, 38–39
- primates and, 47, 49–50
- psychosis and, 637–638
- sleep and, 317, 328
- sylvian fissure and, 38–39
- white matter pathways and, 186, 196
- Westerhausen, René, 12, 454, 469–497
- White matter pathways, 4–5
 - anisotropy of diffusion and, 192
 - arcuate fasciculus and, 191, 194, 196, 201
 - associationist theory and, 181–188, 194, 196
 - Broca's area and, 186, 196
 - Brodman areas and, 196, 198
 - Burdach and, 179, 181–182
 - cingulate gyrus and, 180
 - classification of, 182, 184
 - commissural fibers and, 184
 - diffusion-tensor imaging (DTI) and, 191–200
 - disconnection syndromes and, 186–188
 - discovery of association tracts and, 179–181
 - fluidist approach and, 178
 - fractional anisotropy and, 192, 194, 196
 - frontal lobe and, 181
 - Geschwind's territory and, 196, 198
 - historical perspective on, 177–188
 - hodological approaches to, 178–178
 - inferior frontal gyrus and, 191, 196
 - inferior fronto-occipital fasciculus and, 181
 - insula and, 180
 - language and, 198
 - lateralization studies and, 188–191
 - Liepmann and, 186–188
 - logical functions and, 184
 - long association bundles and, 184
 - longitudinal fasciculus and, 189
 - Meynert and, 179, 181–185
 - neuroimaging and, 188–191
 - occipital lobe and, 180–181
 - optic radiation and, 191
 - perisylvian regions and, 180, 196–201
 - postmortem studies and, 188–191
 - projection fibers and, 184, 192, 194
 - region-of-interest (ROI) approaches and, 192, 194
 - Reil and, 179–181
 - speech perception and, 365–366
 - spinal cord and, 184, 189–191, 194, 198
 - split-brain patients and, 189
 - Steno and, 178
 - temporal lobe and, 180
 - termination of fibers and, 182–183
 - thalamic radiations and, 190–191
 - tractography contribution and, 191–201
 - tract-specific approaches and, 192
 - uncinate fasciculus and, 191
 - unilateral neglect and, 189
 - verbal IQ and, 198
 - vibratory explanations of, 178
 - in vivo molecule quantification and, 191–192
 - voxel-based morphometry (VBM) and, 190–194
 - Wernicke's area and, 184, 186, 196
- Wiegand, L. C., 627
- Wigan, Arthur, 621
- Wilson, L., 26, 419–420
- Wisconsin Card Sorting Test, 482, 484, 490, 547
- Wojan, T. J., 398
- Woodruff, P. W., 624, 633
- Workman, L., 69
- Wray, A., 639

Xhosa, 363
Xq21.3, 71
X Turner syndrome, 257
XXY Klinefelter syndrome, 257

Yakovlev, P. I., 190, 624
Yakovlevian torque, 162–163
Yonelinas, A. P., 506
Yotsutsuji, T., 628
Yp11.2, 71
Yucel, M., 626

Zaehle, T., 351, 357
Zaidel, E., 400
Zangwill, O. L., 535–536
Zani, A., 432
Zatorre, R. J., 110–111
Zebra finches, 96, 98, 106, 123
Zebra fish, 26, 29
Zebras, 69
Zenk response, 107–108
Zulu, 363