

# Subject Index

- A<sub>2A</sub> receptor gene
  - EEG theta/alpha activity, 57–58
  - G-protein-coupled adenosine receptors, 57–58
  - T/T genotype, 57–58
- Adenosine deaminase (ADA) gene
  - G/A genotype, 57
  - genotype-dependent alterations, 57
  - pharmacological inhibition, 57
  - pharmacologic and genetic evidence, 57
  - polymorphism, 57
- Adenosine triphosphate (ATP)
  - cytokine–adenosine, 45–46
  - levels, 45–46
  - NREMS, 43–44
  - sleep regulation, 43
- Alpha and theta power (ATR), 281–282
- ATP. *See* Adenosine triphosphate
- ATR. *See* Alpha and theta power
- Blood oxygen-level dependent (BOLD), 234, 285, 286. *See also* Brain's functional network architecture
- BOLD fMRI signal. *See* Spontaneous fMRI activity
- Brain-derived nerve growth factor (BDNF), 6
- Brain-derived neurotrophic factor gene
  - prefrontal cortex and hippocampus, 58
  - REM sleep and wakefulness, 58
  - sleep propensity, 58
  - Val/Val homozygotes, 58
- Brain's functional network architecture
  - alpha-band EEG and rsfMRI correlations
    - BOLD correlations, 285, 286
    - positive and negative,  $\alpha$ HDR, 285
    - short runs and long scan durations, 285
    - thalamus, 285
  - alpha-band oscillatory activity, 278
  - BOLD–BOLD correlation analyses, 280
  - correlations, electrophysiological signals, 290
  - data processing and analysis
    - community structure, 282–285
    - electrophysiological and fMRI BOLD resting state, 281–285
    - large-scale, 282
    - PALS visualization mapping, 285
    - SoNIA visualization, 285
  - definition, human sleep, 278
  - description, sleep, 277–278
  - DMN activity, 279
  - external and internal thoughts, 278
  - frontoparietal cortices and thalamus activity, 279
  - frontoparietal pattern, anticorrelated activity, 289–290
  - functional changes, 279–280
  - general methods
    - analysis set, group 1, 280
    - artifact-free data, group 2, 280
    - electroencephalography, 281
    - functional imaging, 280
    - group 1 and 2, 280
    - image preprocessing, 280–281
  - global network connectivity, 290
  - graph theoretical approach, 279, 290
  - inter-regional connectivity, 290–291
  - large-scale network connectivity analysis
    - community structure, 286–287, 288, 289

## Brain's functional network architecture

*(Continued)*

- dissociation, anterior and posterior nodes, 287
- modularity analysis, 286–287
- parahippocampal node, 287–288, 289
- real-world complex systems, 286
- ROIs, 283, 286
- state dependent changes, 291
- strengthening, DMN, 287, 289
- task-switching (TSw) region, 287
- temporal regions, 287–288
- thalamic regions, 288
- transitional states, 286, 287
- N2 and N3, 279
- positive correlations, 290
- quiet eyes-closed rest, 289
- reduced attention, 278
- seed-based functional connectivity analyses, 290
- sleep onset (N1) and EEG, 278–279
- small-scale network connectivity analysis
  - comparison, attention-related networks, 285–286
  - reduction, functional anticorrelations, 285–286
- “Brain Voyager” software package, 311–312
- Childhood-onset schizophrenia (COS), 74
- COMT* gene
  - amino acid sequence, 58–59
  - sleep variables, 58–59
  - Val158Met polymorphism, 58–59
- Continuous performance tasks (CPTs), 335–337
- Cortical source dynamics and slow waves
  - behavioral states, 202
  - elektrenkephalogram, 202
  - event-triggered fMRI, 205–206
  - hd-EEG
    - advantages, 206
    - source modeling and results, 206–207
- K-complexes
  - auditory and respiratory occlusion, 208–209
  - auditory cortex activation, 209

description, 208–209

- EEG butterfly plot, stimulation modalities, 210, 211
- hd-EEG recording, 209–210
- micro-osmotic animals, 215
- modality specific differences, 214–215
- nonspecific pathways, 215
- peripheral stimulation, 209
- Post hoc* analysis, 212–213
- primary and secondary visual cortex, 212–213
- P200 time period, 213–214
- Quade test, 212
- scalp topography and flat maps, N550 time periods, 210–212
- source modeling technique, 210–212
- stimulation blocks, 209–210
- neuroimaging technologies, 202–203
- PET, 205
- slow oscillation
  - cortical neurons, 204
  - decorticated thalamus, 204
  - EEG recordings, humans, 204–205
  - ketamine/xylazine anesthetized cats, 204
- synchronization
  - anterior cingulate, 208
  - multisite intracellular recordings, 208
  - neurosurgical patients, 208
  - regional specificity, 207
  - scalp-level analysis, 207
  - streamline pathway analysis, 207–208
  - traveling waves, 207–208
- traditional EEG studies
  - deep current source, 203–204
  - electrical fields, 203
  - nasopharyngeal electrode, 203
  - precentral and far frontal focus, 203
  - recordings, 203
  - scalp voltage topographies, 203–204
- CPTs. *See* Continuous performance tasks
- Cytokines, slow wave sleep
  - brain organization
    - biochemical sleep mechanism, 44–45
    - neuronal/glia network, 45
    - sleep and waking cognition, 44–45

- IL1 and TNF
  - injection, 40
  - sleep regulation, 40–43
- sleep function
  - ATP–cytokine–adenosine, 45–46
  - ATP levels, 45–46
  - molecular signals, 45–46
  - physical and cognitive performance, 45–46
- upstream and downstream events
  - adenosine tissue concentrations, 44
  - ATP, 43
  - brain-derived neurotrophic factor (BDNF)
    - release, 43–44
  - effector molecules, 44
  - purine type 2 receptors (P2Rs), 43–44
  - P2Y1 and the P2X7 receptor, 40–41
  - P2Y receptors, 43–44
  - sleep promoting activity, 43
- Data acquisition and analysis, resting state fMRI
  - BOLD activity and one-sample ANOVAs, 312
  - “Brain Voyager” software package, 311–312
  - scanning sessions, 311
- Data processing and analysis, brain’s functional network architecture
  - community structure
    - final region groupings, 285
    - modularity optimization, 282
    - thresholds range, 282
  - electrophysiological and fMRI BOLD resting state
    - alpha power time series, 281
    - ATR and M2, 281–282
    - band-limited power time series, 281–282
    - $\alpha$ HDR, 281
    - Wilcoxon rank sums test, 281–282
  - large-scale
    - definition, ROI, 282, 283
    - graph theoretic approach and correlation values, 282
    - seed region definition, 282
    - time series and correlation values, 282
  - PALS visualization mapping, 285
  - SoNIA visualization, 285
- Deep quiet sleep (DQS)
  - averaged stimuli, 237
  - P1 and N1 amplitudes, 238
- Default-mode network (DMN)
  - activity, 11
  - and ICNs, 10
- Diffusion tensor imaging (DTI)
  - description, 327
  - preprocessing steps, 327
  - use, DTIquery, 327
- DQS. *See* Deep quiet sleep
- DTI. *See* Diffusion tensor imaging
- EEG. *See* Electroencephalogram
- Electrical and cerebral vascular responses
  - basal neural activity, 239–240
  - blood flow, 239–240
  - cerebral processing and cognitive performance, 234
  - chronic implantation
    - electric potential differences, 235
    - electrocardiographic activity (ECG), 235
    - occipital lobe, 235
  - data analysis
    - evoked response potential (ERP)
      - amplitudes, 237
    - LQS and DQS, 237
    - Mann-Whitney U-test, 237
    - recovery period, 237
    - vascular response, 237
  - deficiency, metabolic, 240–241
  - electrical response potential (ERP), 238, 240
  - electroencephalographic (EEG) and NIRS, 234
  - hemodynamic response, 239
  - LQS and DQS, 237–238, 241
  - membrane potential fluctuations, 239–240
  - metabolite delivery, 234
  - neural activation, 233–234
  - nonpathological conditions, 234
  - optical measurements, 237
  - recovery period, 237–238
  - signal-to-noise ratios, 237–238
  - sleep deprivation paradigm
    - auditory cortex, 236
    - evoked responses, 236
    - room temperature, 235–236

## Electrical and cerebral vascular responses

*(Continued)*time-of-day and novel environment effects,  
235–236

sleep scoring

fast Fourier transform (FFT) analysis, 236

rapid eye movement (REM) sleep, 236

time spent, wake/sleep, 238

vascular responses, 238–240

wake and REM, 240–241

## Electrical status epilepticus (ESES), 74–75

## Electroencephalogram (EEG)

delta waves, 40

description, 325–326

fMRI, 115

gradient and gross motion artifacts, 281

hippocampal, 171–172

human, 189

ISFs (*see* Infra-slow fluctuations (ISFs))

MagLink™ system and Synamps/2™

amplifier, 281

neocortical cells, 182–183

neuroimaging, slow waves

deep current source, 203–204

electrical fields, 203

event-triggered fMRI, 205–206

hd-EEG, 206–207

nasopharyngeal electrode, 203

precentral and far frontal focus, 203

recordings, 203, 204–205

scalp voltage topographies, 203–204

parahippocampal gyrus, 114

patterns, 122

recordings, 339–340

slow rhythm, 112

slow waves, 114

spectral analysis, 63–64

synchronized *vs.* desynchronized, 183

topographic representations, 325–326

wakefulness, 64–65

Empirical mode decomposition (EMD). *See* HHT  
and EMD

E-prime 1.1 software, 248–249

EPSP. *See* Excitatory postsynaptic potential

Evoked response potential (ERP)

DQS, 239

P1 and N1 amplitudes, 237, 240

significant decline, 238

Excitatory postsynaptic potential (EPSP), 23–24,  
127–129

Fast Fourier transform (FFT) analysis, 236

fbEEG. *See* Full band electroencephalography  
[<sup>18</sup>F] Flurorodeoxyglucose positron emission  
tomography (FDG-PET)

Siemens CTI 951 R16/31 scanner, 324–325

SPM analysis, 324–325

fMRI. *See* Functional magnetic resonance  
imaging

fMRI investigation

correlation, 264

description, PICA, 264

DSC values, 267

frequency band and content, 265–266

frequency bandpass characteristics, 265–266

GLM analysis, 264, 266–267

intertrial phase coherence, 266

oscillatory processes, 264

parameters, 264

phase synchrony

function, 266

measurement, 267, 268

PDF and RSN1, 266

significance, testing, 267, 268

statistical significance, 266

time-course, 266

PICA, 264, 265, 267

power spectra, 267, 269

Varian INOVA 3-Tesla MRI system, 264

Full band electroencephalography (fbEEG)

BOLD, 159

human, 156

Functional hemispherectomy. *See* Multimodal  
neuroimaging, consciousness disorders

Functional imaging, 280

Functional magnetic resonance imaging (fMRI).

*See also* Resting state networks (RSNs)

BOLD resting state, 325, 326

“BrainVoyager” software, 325

EEG, 207, 209

- EPI and T1-weighted MPRAGE sequence, 325
- event-triggered, 205–206
- HHT and EMD
  - algorithm, 261–263
  - definition, Hilbert transform, 263–264
  - description, HSA, 261
  - functions, 261
  - IMF, 261, 263–264
  - monocomponent/narrow-band signal, 263–264
  - oscillatory components, 261
- ICA, 260–261
- investigation (*see* fMRI investigation)
- RSN, 146–147
- Gating hypothesis
  - cholinergic (ChATa) neurons, 90
  - memory replay and neuronal plasticity, 90
  - neuronal computations, 90–91
  - SWA, 90–91
- hd-EEG. *See* High-density electroencephalogram
- HHT and EMD
  - algorithm
    - candidate calculation, 261–263
    - description, 261
    - flowchart, 261, 262
    - fMRI signal, 261–263
    - maxima and minima, signal, 261–263
    - sifting process, 261–263
    - stopping criteria, sifting process, 263
  - definition, Hilbert transform, 263–264
  - description, HSA, 261
  - functions, 261
  - IMF
    - calculation, 263–264
    - conditions, 261
  - monocomponent/narrow-band signal, 263–264
  - oscillatory components, 261
- High-density electroencephalogram (hd-EEG)
  - advantages, 206
  - recording, 209–210
  - source modeling and results, 206–207
- Hilbert-Huang transform (HHT). *See* HHT and EMD
- Hippocampal–cortical interactions and memory trace reactivation
  - coherent reactivation
    - EEG and concurrent spike activity, 171–172
    - indexing theory, 171–172
    - memory performance, 172
    - subcomponents, 170–171
    - ventral striatum, 172
  - data structure and ensemble recordings
    - animal's brain state, 167–168
    - distribution, state-vector correlation values, 167, 168
    - Pearson correlation coefficients, 168
    - state and rate correlation matrices, 167, 168
    - template matching procedure, 168
  - organization and indexing
    - cortex and hippocampus, 163–165
    - encoding principle, 163–165
    - knowledge extraction, 165–166
    - rapid plasticity, 165
    - semantic memory, 165
  - place cells
    - hippocampal pairwise correlations, 168–169, 170
    - “phase sequences”, 169–170
    - population vectors and template matching, 169–170
    - rodent hippocampus, 168–169
    - synaptic connections, 168–169, 170
  - sparse vs. distributed coding
    - “indexing” theory, 166–167
    - information transmission, 166
    - primary sensory/motor cortex, 166
  - SWS, 172–175
- Homeostatic sleep pressure
  - amplitude and slopes
    - cortical synchrony, 23
    - high-amplitude slow waves, 23
    - neurons recruitment/decrutment, 23
    - SWA, 22
  - cortical neurons synchronization
    - computer simulations, 31

Homeostatic sleep pressure (*Continued*)

- cortical neurons, 28
- EEG and LFPs, 28–29
- firing patterns, 29
- NREM sleep, 28–29
- ON-OFF and OFF-ON transitions, 31
- sensory stimuli, 28
- cortical plasticity
  - antidromic/polysynaptic components, 19
  - EEG and LFP slow waves, 20
  - left frontal cortex, transcallosal stimulation, 27
  - LTP and LTD, 26
  - miniature excitatory postsynaptic currents (mEPSCs), 19
  - saturation, 26
  - spontaneous and evoked cortical activity, 20
- electrically evoked cortical responses
  - correlated synaptic activity, 23–24
  - cortical interneurons, 25
  - cortical networks, 25–26
  - electrical stimuli, 25
  - excitatory postsynaptic potential (EPSP), 23–24
  - local field potential (LFP) recordings, 24
  - NREM sleep, 24
  - sleep slow waves, 25
  - synaptic efficacy, 24
  - transcallosal evoked response, 25

ICA. *See* Independent component analysisICNs. *See* Intrinsic connectivity networks

## Image preprocessing

- Fisher-z transformed correlation values, 280–281
- noise signals regression, 280–281
- slice-dependent time shifts compensation, 280–281

IMF. *See* Intrinsic mode function

## Independent component analysis (ICA)

- description, 260–261
- PICA, 260–261

## Infants, children and adolescents disparities

- properties, slow waves, 66
- regional shifts, slow-wave topography

EEG power topography, 67

frontal derivations, 67

posterior–anterior time course, 67

SWA topography, 66

U-shaped time course

brain morphology and function, 66

cross-sectional and longitudinal studies, 66–67

SWA, 67

## Infra-slow fluctuations (ISFs)

amplitude dynamics (*see* Multiscale brain activity fluctuations roles)

## BOLD

described, 337

temporal structure, 338–339

## EEG

mechanisms, 340

neuronal activity, 341

phase, 340–341

scale-specific cellular mechanisms, 340–341

time scales and fractal nature, 341

phase, 339–340

scale-free, 335–337

## Infraslow oscillations (ISO), thalamic relay nuclei

animal brain

cyclic paroxysms, 148–149

LFP, 148–149

LGN neuron activity, 148–149

oscillatory activity, 149–150

rabbits neocortex, 147–148

cyclic paroxysms

HT burst, 156

*in vivo*, 156–158

mGluRs/AchRs, 156, 158

firing rate histograms, 150, 151

human brain

activities, 146

fbEEG, 146–147

fMRI, 146

periodic signals, 146

## hyperpolarizing potentials and astrocytes

adenosine, 153

Ca<sup>2+</sup> oscillations, 153–155

ionotropic glutamate receptors, 153

role, 153–155

- local alpha (8–13 Hz) rhythms
  - BOLD signal, 147, 156
  - depolarized phase, 156, 157
  - EEG rhythms and RSN, 147, 156
  - HT bursts, 156, 157
  - LFP frequency components, 148, 156
  - LFP recording, LGN, 156, 157
  - LGN slice, 156
  - LGN TC neuron, 156, 157
- long-lasting hyperpolarizing potentials, 150–152
  - manifestation, 150
  - physiological and pathological significance, 159
- Interleukin-1 beta (IL1)
  - injection, 40
  - P2 receptors, 43–44
  - sleep regulation
    - animal models, 40
    - ATP, 43
    - circulating levels, 42
    - cytokine levels, 42
    - description, 40
    - NREMS and REMS, 40–41
    - pathology, 42–43
    - recombinant preparations, 40
- Intraclass correlation coefficients (ICC), 53
- Intrinsic connectivity networks (ICNs)
  - amplitude covariance, 344–345
  - amplitude dynamics, 342–344
  - BOLD-signal, 338, 339
  - description, 337–338
  - fluctuations, 340
- Intrinsic mode function (IMF)
  - definition, 261
  - description, top four, 264
  - EMD algorithm, 261–263
  - instantaneous phase and frequency, 263–264
  - oscillatory processes, 264
  - phase function, 266
  - phase synchrony, 266
  - regressors, GLM analysis, 264
- ISFs. *See* Infra-slow fluctuations
- Lateral geniculate nucleus (LGN)
  - LFP, 148–149
  - neurons, 148–149
  - and VB, 156
- LFPs. *See* Local field potentials
- LGN. *See* Lateral geniculate nucleus
- Light quiet sleep (LQS)
  - and DQS, 237
  - EMG, 236
  - hemodynamic response amplitude, 239
  - P1 and N1 amplitudes, 240
  - peak amplitude, 237
  - recovery period, 241
  - time spent, 238, 238
  - vascular responses, 238–239
- Local field potentials (LFPs)
  - deflections, 150
  - DPCPX, 153
  - LGN, 148–149
  - monkey cortex, 191
  - neurons, 149–150
  - recordings, 24, 184–186
  - signal, 150
  - SWS, 182–183
- Long-term depression (LTD), 130–131
- Long-term potentiation (LTP)
  - description, 130–131
  - LTD, 133
- LQS. *See* Light quiet sleep
- LTD. *See* Long-term depression
- LTP. *See* Long-term potentiation
- Magnetoencephalography (MEG)
  - and EEG data, 342–344
  - 1:2-phase synchrony, 345–346
  - prestimulus phase, broadband ongoing activity, 342
- Major depression disorder (MDD), 74
- MEG. *See* Magnetoencephalography
- Multimodal neuroimaging, consciousness
  - disorders
    - behavioral assessment, 324
  - data acquisition and analysis
    - DTI, 327
    - EEG, 325–326
    - FDG-PET, 324–325
    - fMRI, 325
  - DTI analyses, 331

- Multimodal neuroimaging, consciousness disorders (*Continued*)
  - functional and structural connectivity, 331
  - head trauma
    - GCS, brain CT and EEG, 327
    - standardized behavioral and multimodal neuroimaging assessments, 327
  - VS and MCS, 324
  - metabolic PET and hemodynamic fMRI
    - results, 330–331
  - multimodal imaging
    - DTI tractography, 328–329
    - FDG-PET and fMRI default mode network connectivity, 328–329, 330
    - high-density EEG, 328, 329
    - resting state FDG-PET data, 328
    - resting state fMRI, 326, 328
    - WS/VS vs. MCS, 329–330
  - multimodal neuroimaging techniques, 324
  - objective paraclinical markers, 324
  - resting state BOLD and functional
    - hemispherectomy, 330
  - resting state fMRI acquisitions, 330
  - “resting state” network, 331
  - unremarkable medical history
    - brain CT-scan, EEG and structural MRI, 327–328
    - coma recovery scale-revised assessment, 328
  - user-independent automatic analyses, 330
  - UWS/VS
    - characterization, 324
    - patient lacking clinical proof, 331
- Multiscale brain activity fluctuations roles
  - amplitude dynamics
    - fMRI ICN fluctuations, 342–344
    - frequency bands, prestimulus oscillation, 344
    - ISFs, 342
    - mechanisms, ICN and amplitude covariance, 344–345
    - M/EEG use, 344–345
    - MEG and EEG data, 342–344
    - transcranial magnetic stimulation (TMS), 344
  - behavioral scaling laws, 337
  - BOLD-signal, correlation
    - behavioral variability, 339
    - dorsal attentional regions, 338, 339
    - prestimulus activity, 339
    - requirements, neuronal process, 339
    - stimulus detection, 339
  - causal dissection
    - role, neuronal activities/interaction, 346
    - TMS and microstimulation, 346
  - CPTs, 335–337
  - cross-scale binding, CF phase-amplitude and
    - phase-phase interactions
    - complementary roles, 345
    - neuronal mechanisms, 345
    - n:m*-phase synchronization, 345
    - ordering, 346
    - phase-amplitude correlation, 345
    - 1:2-phase synchrony, 345–346
    - physiological mechanisms, 345
    - spatiotemporally tree-like excitability windows, 346
  - description, TSDTs, 335–337
  - electrophysiological characterization
    - EEG ISFs and cellular mechanisms, 339–340
    - EEG ISFs phase and functional connectivity, 340–341
    - ISF phase, 339–340
    - ISOs phase, 339–340
    - LFP/EEG recordings, 339–340
    - scale-specific cellular mechanisms, 340–341
    - time scales and fractal nature, 341
  - human perceptual/cognitive performance, 335
  - hypotheses examination, 337
  - infraslow fluctuations (ISFs), fMRI
    - BOLD and “resting-state networks”, 337
    - DAN and data-driven functional connectivity mapping techniques, 337–338
    - description, 337
    - ICNs and DMN, 337–338
    - temporal structure, BOLD ISF, 338–339
  - ISFs/“behavioral avalanches”, 335–337
  - neuronal oscillations
    - coexistence, scale-free and scale-specific dynamics, 341
    - cognitive operations and neuronal activity *per se*, 341
    - invasive depth electrode recordings, 341



- non-scale-free/scale-specific, 341
- synchronization, 341
- oscillation phase, behavioral dynamics
  - attentional and motor phenomena, 342
  - neuronal oscillations, 342
  - prestimulus phase, broadband ongoing activity, 342
  - scale-free, 342
  - scale-free infraslow neurophysiological and psychophysical dynamics, 342, 343
  - sensory-attentional-communication channel, 342
- scale-free activity, 346–347
- scale-free behavioral fluctuations, 335–337
- Neocortical neuron's membrane potential, slow oscillation
  - active and silent states
    - described, 182–183
    - detection methods, 186, 187
    - onset delay vs. distance, cell pairs, 188, 189
    - overlap calculation, 186–189
    - phase-relation, 189
    - quadruple intracellular and LFP recording, 186–189
- correlation dynamics
  - crosscorrelogram computation, state transition, 193, 195
  - electrode location, 193, 194
  - recorded neurons, 193, 194
  - time course and state transition, 193, 194
- electric activity patterns, 182–183
- intracellular analysis, 183
- long-range correlation
  - correlograms, 191–193
  - crosscorrelogram peak shift, 190, 191
  - distance-dependency, 189–191
  - fluctuations, 195–197
  - intracellular recording, 191–193
  - recorded neurons, 189–191
  - slow oscillation vs. without slow oscillation, 191–193
  - strength vs. peak shift, 190, 191
- simultaneous intracellular recording
  - anesthetized animals, 183–184
  - cat neocortex, 183
  - experimental setup, 184–186
  - ketamine–xylazine anesthesia, 184–186
  - nonanesthetized animals, 184
  - offline data analysis, 184
  - synchronized vs. desynchronized EEG, 183
- Neonatal sleep function
  - correlation-based studies, 222
  - experience-dependent plasticity, 221
  - pharmacological sleep deprivation
    - anxiety and sexual behavior, 222
    - behavioral changes, 222
    - neonatal treatments, 222
  - REM sleep deprivation (RSD), 222
  - rapid-eye-movement (REM) sleep, 221
- Neuronal plasticity
  - brain oscillations, 135–136
  - description, 121–122
  - homeostatic
    - cortical network, 134, 135
    - GABA, 134
    - mEPSCs, 134
    - and neocortical epilepsy, 134
    - and SWS, 134
  - intrinsic, 133–134
  - synaptic, 125–133
  - TC system, 122
- Nocturnal slow-wave activity affects reduction
  - auditory stimulation, 252–253
  - brain mechanisms, 254
  - cognitive functioning and psychomotor vigilance, 251–252
  - declarative memory formation, 252
  - deep sleep, 253–254
  - disruption, sleep affects, 246
  - implicit memory acquisition, 252–253
  - primary insomnia patients, 246
- PVT
  - declarative memory, 248–249
  - implicit memory, 249
  - vigilance, 248
  - sleep and lower sleep efficiency, 252–253
  - statistical analysis

## Nocturnal slow-wave activity affects reduction

*(Continued)*

declarative memory, 250

implicit memory, 250

vigilance, 249–250

subjects, 247

supplementary motor area (SMA),  
252SWA reduction, 247–248  
declarative memory, 251

implicit memory, 251

sleep parameters, 250–251

vigilance task performance, 251

test procedures, 247

## Non-rapid eye movement (NREM) sleep

ATP, 43–44

cortical neurons, 26–28

cyclic occurrence, 52

distinct frequency bands, 54–55

duration, 41

EEG, 53, 59, 111–112

electrical brain activity, 54–55

genotype-dependent differences, 56

IL1, 40

large-amplitude slow waves, 26

LFP slow waves, 29

locus coeruleus, 41

and REM sleep, 18

responses, 40–41

slow waves

brainstem activity, 114

cerebellar activity, 114

parahippocampal gyrus, 114

rhythm (1 Hz), 112

subcortical and cortical, 114

SWA, 112

transient activity, 114

variability, 112–114

spindles

kinds, 114–115

memory consolidation, 115

 $\mu$  rhythm, 115

slow and fast, 115, 116

structure and intensity, 52

SWA, 21

NREM sleep. *See* Non-rapid eye movement sleep

## Ocular dominance plasticity (ODP)

adult brains

infant animal sleep, 228

neural development, 228

neuron path-finding, 228

plasticity change, lifespan, 228

REM and non-REM sleep, 228

cellular mechanisms

AMPA receptor, 226

cortical neuronal activity, 225

downstream kinase activation, 226

GABA-A (R) receptor agonists, 226

normal enhancement, 226

visual response properties, 225

wakefulness, synaptic changes, 226

hypnotic sleep, early life

childhood/adolescent mental disorders,  
226–227

psychotropic medications, 226–227

sleep-dependent consolidation, 227

sleep-mediated functions, 226–227

investigations

developing cortex *in vivo*, 225

intrinsic cortical signals, 224–225

ocular dominance, 224–225

sleep deprivation procedure, 224–225

natural forms, stimuli, 224

physiological and anatomical changes, 224

REM and non-REM

brain development and plasticity, 227

visual development, 227–228

waking experience, 227–228

ODP. *See* Ocular dominance plasticityPALS. *See* Population-average, landmark-and  
surface-based

Pedunculopontine nucleus (PPN), cortical

high-frequency oscillations

acetylcholine receptors, 85

cerebral cortex, 85

cholinergic hypothesis, 86

gating hypothesis, 90–91

neurochemical markers, 86

- neuromodulatory systems
  - acetylcholine receptors, 90
  - cholinergic afferents, 90
  - thalamic neurons, 90
  - thalamocortical systems, 90
  - wakefulness, 90
- neurons, sleep
  - acetylcholine-receptor activation, 87–89
  - axon collaterals, 87–89
  - cortical slow oscillations, 88
  - functional properties, 87
  - nested gamma oscillations, 87
  - neuronal subtypes, 86–87
  - phasic components, 87
  - thalamic neurons, 87
- sleep wake cycle, 86
- subcortical modulation
  - brainstem activating structures, 89
  - forebrain neuronal networks, 89–90
  - midbrain/brainstem networks, 89–90
  - reticular-activating system, 89
- thalamocortical neurons, 86
- PER3* gene
  - human chromosome 1, 56
  - REM, 56
  - sleep architecture, 56
- PET. *See* Positron emission tomography
- PICA. *See* Probabilistic independent component analysis
- Population-average, landmark-and surface-based (PALS), 285
- Positron emission tomography (PET), 205
- Prion protein gene
  - fatal familial insomnia, 59
  - Met/Val genotype, 59
  - NREM sleep, 59
- Probabilistic independent component analysis (PICA)
  - analysis, 272–273
  - description, 260–261
  - fMRI data, 260–261
  - production, RSNs, 265, 267
  - use, MELODIC, 264
- Psychomotor vigilance tasks (PVT)
  - declarative memory
    - E-prime 1.1 software, 248–249
    - hippocampal activation, 248–249
    - paired t-tests, 249
    - retrieval performance, 249
  - implicit memory, 249
  - vigilance
    - complex, 248
    - simple, 248
- Purine type 2 receptors (P2Rs), 43–44
- PVT. *See* Psychomotor vigilance tasks
- Rapid-eye-movement (REM) sleep
  - density, 53
  - distinct frequency bands, 54–55
  - duration, 40–41
  - EEG, 53–55
  - genotype-dependent differences, 56
  - IL1, 41
  - and non-REM
    - brain development and plasticity, 227
    - visual development, 227–228
  - PER3*<sup>4/4</sup> genotype, 56
  - timing, 52
  - TNF receptors, 41
  - wakefulness, 58
- Regions of interest (ROI)
  - correlation matrices and spatial correlation maps, 280–281, 283
  - large-scale network analysis, 282
  - thalamic, 288
- REM sleep. *See* Rapid-eye-movement sleep
- Resting state fMRI, hypnotic modulation
  - autobiographical mental imagery, 310–311
  - block design, 316–317
  - characterization, 313–315
  - connectivity, posterior midline parts, 317–318
  - correlation analysis, 310
  - functional connectivity, 318–319
  - generation, autobiographical episodic mental images, 318
  - hypnosis
    - vs. autobiographical mental imagery, 316–317
  - definition, 310
  - induced modulation, 319

## Resting state fMRI, hypnotic modulation

*(Continued)*

selection, control condition, 315–316

independent component analysis (ICA), 310

intrinsic and extrinsic system, 310

methods

absorption, dissociation and external

awareness scores, 312, 313

data acquisition and analysis, 311–312

default mode network and extrinsic system,  
313, 316

healthy subjects, 311

hypnosis vs. mental imagery, 313, 317, 318

hypnotic state, permissive and indirect

suggestions, 311

mental imagery and hypnotic state, 313, 315

posterior cingulate/precuneus, 313, 314

ongoing resting activity, 313–315

“self-centered absorption”, 319

spontaneous brain activity, 310

## Resting state networks (RSNs)

 $\alpha$  band power, 146

broadband neuronal process, 274

connectivity, 11

contributing frequency, 272

correlation analysis and DMN, 259–260

description, 259–260

determination, EMD/PICA analysis, 272–273

fluctuations, 10–11

fMRI

HHT, 261–264

ICA, 260–261

investigation, 264–267

Fourier analysis, 260, 264, 272

GLM approach, 273

global regulation, 273–274

mean phase synchrony, 268, 274

phase synchrony, frequency bands, 268,  
273–274

resting data connectivity, 259–260

spectra, HRF blurring

analysis, BOLD data, 267–268

deconvolution, 270–271

DMN, 269–270

gamma-based, 270–271

“neural” spectrum, 271

power spectra, 269–270

spatial maps and time-courses, 268–269

3-T Siemens Trio, fMRI data, 268

spectral characteristics, 274

spectra, perfusion fMRI

described, ASL, 271

DMN, perfusion (ASL) data, 271–272

power spectra, 272, 273

single channel radio-frequency transmit/  
receive head coil, 271

“tag” acquisitions, 271

tag-control, sinc-based shifting, 271–272

temporal characteristics, 260

use, low-frequency fluctuations, 260

“REST” periods, 298

ROI. *See* Regions of interestRSNs. *See* Resting state networks

## Serial reaction time (SRT), 249

## Sleep and developmental plasticity

central visual pathways, subcortical

LGN, 224

morphological plasticity, LGN, 223–224

regulated cortical plasticity *in vitro*, 223

## neonatal sleep function

correlation-based studies, 222

experience-dependent plasticity, 221

pharmacological sleep deprivation, 222

rapid-eye-movement (REM) sleep, 221

## ocular dominance plasticity (ODP)

adult brains, 228

hypnotic sleep, 226–227

investigations, 224–225

natural forms, stimuli, 224

physiological and anatomical changes, 224

REM and non-REM, 227–228

## Sleep and waking oscillations

cortical neurons, 123, 124

EEG, 122

electrophysiological types, 123–125

firing frequencies, 123–125

TC and reticular thalamic neurons, 122

## Sleep EEG profiles genetic determination

delta oscillations, 51–52

- description, 51–52
- genetic polymorphisms
  - ADA gene, 57
  - A<sub>2A</sub> receptor gene, 57–58
  - brain-derived neurotrophic factor gene, 58
  - COMT gene, 58–59
  - PER3 gene, 56
  - prion protein gene, 59
- heritability
  - candidate genes, 55
  - monozygotic and dizygotic twins, 55
  - rhythmic brain oscillations, 55
- NREM sleep and REM sleep
  - homogenous sample, 53–54
  - ICC, 53–54
  - internight reliability coefficients, 54–55
  - Pearson correlation coefficients, 54–55
- sleep architecture
  - genetic control, 53
  - intraclass correlation coefficients (ICC), 53
  - NREM sleep stages, 53
- sleep–wake regulation
  - basic process, 52
  - characteristics, 52
  - delta/theta activity, 52
  - NREM and REM sleep, 52
  - two-process model, 52
- slow brain oscillations, 51–52
- waking heritability
  - additive genetic factors, 52–53
  - Val158Met polymorphism, 52–53
- Sleep homeostasis, freely behaving rats
  - behavior and brain activity, waking and sleep
    - architecture and vigilance-specific cortical activity, 18
    - cerebral metabolic rates, 20
    - cortical neuronal firing patterns, 19
    - EEG level, 19
    - intracortical and cortico-subcortical interactions, 17–18
    - mitochondrial electron transport chain, 20
    - mRNA and protein levels, 20
    - NREM sleep, 19
    - physiological conditions, 20
    - slow waves, 18, 19
  - EEG slow waves, 30–31
  - global and local regulation
    - cortical plasticity, 22
    - frontal predominance, 20–22
    - local slow waves, 22
    - mammals and birds, 20–22
    - neurobehavioral performance, 22
    - physiological indicator, 20
    - SWA, 20–22
  - homeostatic sleep pressure
    - amplitude and slopes, 22–23
    - cortical neurons synchronization, 28–30
    - cortical plasticity, 26–28
    - electrically evoked cortical responses, 23–26
  - principal observations, 30
  - SWA, 30, 31
- Sleep regulatory substances (SRSs), 40
- Sleep slow waves developmental aspects
  - amplitude, 67
  - characteristics
    - definition, generation and behavior, 64–65
    - homeostatic sleep regulation, 65–66
    - sleep homeostasis, 65, 223–224
  - cognitive skills
    - behavioral level, 73
    - brain development and learning, 73
    - brain maturation, 73
    - chronic sleep restriction, 72–73
    - saccadic task performance, 73
    - SWA predominance, 73
  - electroencephalography (EEG), 63–64
  - infants, children and adolescents disparities
    - regional shifts, 67
    - SWA topography, 66
    - U-shaped time course, 66–67
  - linking brain maturation, 68
  - mental and neurological developmental disorders
    - ADHD, 74
    - cerebral functioning, 74–75
    - COS, 74
    - ESES, 74–75
    - MDD, 74
    - Williams syndrome (WS), 73–74
  - neuronal activity, 64

## Sleep slow waves developmental aspects

*(Continued)*

neurophysiological and cellular process, 63–64

sleep homeostasis, 63–64

SWA, 67–69, 71–72, 75–77

## Slow brain oscillations

description, 4

fluctuations

BOLD signals, 10

description, RSNs, 10

DMN activity, 11

ICNs and DMN activation, 10

independent component analysis (ICA), 11

infraslow, BOLD signal, 10–11

ISOs modulation, 11–12

local field potentials/neuronal activity, 12

posterior midline and parahippocampal structures, 11

RSN connectivity, 11

spectrum, 10–11

synaptic downscaling and memory consolidation, 12

sleep

age, slow waves activity, 7

amplitude and steep slope, 5

BDNF, TNF and IL1, 6

cellular mechanisms, 9

complex and widespread neuronal network activity, 5

cortical layer, 5–6

DMN and RSNs, 5–6

dopaminergic innervation, 10

down-and up-state, 4–5

endogenous electric field, 5–6

external stimuli, 5

genes polymorphisms, 7

hippocampal activation and memory encoding, 8

hippocampo-neocortical network, 8

homeostatic regulation, 5

locus coeruleus (LC) activation, 10

memory consolidation processes, 9

memory-enhancing capacity, 8

memory trace reactivation hypothesis, 8–9

NREM, 4

pedunculopontine nucleus (PPN)

association, 9

putative cholinergic basal forebrain neurons, 9

rhythmic discharges, corticofugal pathways, 7–8

scalp signals, EEG, 5–6

slow-wave activity, 5, 6

steady state, synaptic plasticity, 8–9

striatal slow waves, 7–8

topography, 6

up-state, high-frequency, 7

## Slow oscillations and memory consolidation

active system consolidation, slow-wave sleep

declarative memory system, 94–95

feed-forward control, 95–96

hippocampo-neocortical redistribution, 94–95

hippocampus-dependent declarative memories, 94

neocortical pyramidal cells, 95–96

spindles and ripples, 96

description, 94

electrical stimulation

EEG theta activity, 96–98

nocturnal sleep, 96–98

SWS and waking vigilant behavior, 96–98

transcranial direct current stimulation (tDCS), 96, 97

word-pair memories, 96–98

fast vs. slow spindles

basal conditions, 101

sleep-dependent memory, 101

slow-wave sleep, 102

SWS, 101

waning depolarization phase, 101

grouping spindles

detection algorithm, human EEG, 98, 99

EEG field potentials, 98

human and animal studies, 99–100

learning-dependent enhancements, 100

neocortical neurons, 98

non-REM sleep stage 2, 98

nucleus reticularis, 99–100

SWS and non-REM, 100

- synaptic plastic changes, 99–100
- hippocampal ripples and memory reactivations
  - memory consolidation, 103
  - neocortex and striatal regions, 103
  - neuronal firing patterns, 103
  - odor–reward association task, 103–104
  - REM sleep, 103
  - sharp wave-ripple activity, 103
  - SWS, 103–104
- spindle-ripple events
  - brain structures, 104
  - CA1 neurons, 104
  - hippocampal and neocortical circuitry, 105
  - non-REM sleep, 104–105, 106
  - parahippocampal cortex, 104–105
  - temporal relationship, 104
  - thalamic generation, 104
  - thalamic spindle activity, 104
  - thalamocortical and hippocampal network activity, 104–105
- Slow-wave activity (SWA)
  - adolescence reflects, 67–69
  - amplitude, 112
  - anterior-posterior gradient, 20–22
  - cortical maturation
    - activity-dependent process, 71
    - posterior to anterior time course, 71
    - sex differences, 71
    - synaptic density, 71
    - topography, 71
  - EEG, 18
  - homeostatic regulation, 20–22
  - in NREM sleep, 21
  - plasticity-dependent changes
    - arm immobilization, 71–72
    - children and adolescents sample, 72
    - normal daily activities, 72
    - sleep-dependent performance, 72
  - reduction
    - declarative memory, 251
    - EOG signals, 247–248
    - implicit memory, 251
    - mean reaction times, 254
    - memory encoding, 253
    - polysomnographic recordings, 247–248
    - REM and non-REM sleep, 248
    - selectively, 252
    - sleep parameters, 250–251
    - vigilance task performance, 251
- sleep homeostasis, 23
- use, 112
- U-shape time course
  - age-dependent changes, 75–77
  - animal model, 77
  - cortical maturation, 75
  - network synchronization, 75–77
  - structural plasticity, 75
  - structural remodeling, 75–77
  - synapses number/density, 75–77
  - synaptic strength, 75, 76
- Slow-wave sleep (SWS)
  - declarative memory system, 94–95
  - EEG, 122, 123, 183
  - feed-forward control, 95–96
  - hippocampo-neocortical redistribution, 94–95
  - hippocampus-dependent declarative memories, 94
  - homeostatic plasticity, 134
  - membrane potential and LFP, 182–183
  - memory trace reactivation
    - cross-correlations, neuron pairs, 172–173, 174
    - hippocampal sharp waves, 173–175
    - K-complex/LVS epochs, 172–173
    - linear regression plot, 172–173
    - principal component analysis, 173–175
    - sharp-wave ripple events, 175
  - neocortical pyramidal cells, 95–96
  - spindles and ripples, 96
  - TC neuron, 122
- Social network image animator (SoNIA), 285
- Spontaneous fMRI activity
  - description, BOLD fMRI signal, 296
  - neuronal and nonneuronal contributions, 296
  - neuronal correlation, BOLD fMRI signal
    - electrophysiological recordings, 297
    - MEG, 297
    - metabolic contribution, 297
    - multimodal recordings, 297–298
    - perfusion signals recording, 297
    - sleep and anesthesia, 297–298

Spontaneous fMRI activity (*Continued*)

- nonneuronal contributions, BOLD fMRI signal
    - independent component analysis, 297
    - measurement, 296
    - separation, noise sources, 296–297
    - thermal noise, 296
    - variance regressors and low-frequency drift, 296–297
  - origin and role
    - “common source” hypothesis, 298–300
    - corticocortical communication, 298–300
    - hippocampal–cortical dialogue, 300
    - “off-line” periods, 300
    - synaptic downscaling/consolidation, 300
    - “up” and “down” states, 300
  - resting state activity, 296
  - signal fluctuations, 296
  - signals and temporal resolution, 295
  - sleep
    - baseline metabolic activity, 298
    - condition, reduced consciousness, 298
    - “REST” periods, 298
  - use, brain connectivity studies
    - correlation and network patterns, 300
    - DTI, 300
    - mental and neurological disorders, 300–301
- SWA. *See* Slow-wave activity
- SWS. *See* Slow-wave sleep
- Synaptic plasticity
- augmenting responses
    - EPSP, 127–129
    - short-term neuronal, 130
    - stimulus, 129–130
    - TC system, 127–129
  - description, 125
  - heterosynaptic interactions, 130
  - mid-and long-term plasticity
    - cortical network, 129, 131–133

## LTP, 130–131

- memory formation, 133
- synapses, 133
- transcranial magnetic stimulation, 133

## short-term

- activity-dependent modulation, 126–127, 128
- Ca<sup>2+</sup>, 125–126
- cooperative action, 127
- in vitro* and *in vivo*, 126–127
- mechanisms, 125–126
- synapse, 125–126

Thalamocortical (TC). *See* Sleep and waking oscillations

## Tumor necrosis factor alpha (TNF)

- injection, 40
- P2 receptors, 43–44
- sleep regulation
  - circulating levels, 42
  - injections, 40
  - noradrenergic/serotonergic neurons, 41
  - NREMS and REMS, 40–41
  - pathology, 42–43
  - physiological sleep regulation, 40–41
  - rheumatoid arthritis, 42–43
  - soluble receptors, 40–41

## Unresponsive wakefulness syndrome (UWS)

- characterization, 324
- multimodal neuroimaging techniques, 324

## Ventrobasal (VB), 156

## Williams syndrome (WS), 73–74