Consciousness (cont.)
Cartesian theater, 316–317
dynamic core, 315, 320–321, 323–324
hard problem, 316, 323
neural correlate of, 317
self, 323
Contingency, 13, 20, 247–248, 250–253
Correlation dimension. *See* Dimensionality, correlation
Correlation integral, 230, 240–241, 243
Critical point, 104–105
Cross, D. V., 68, 97–98
Cycle, 21, 29, 32, 35–36, 40, 73–75, 160, 181, 203, 208, 219, 266, 294, 303

Darwin, C., 55, 285–287
DeCarlo, L. T., 68, 97–98
Delay map, 220
Delay vector, 220–221, 223–224, 230, 240, 243–244
Dennett, D., 75, 315–316, 320–321, 323
Derivative, 33, 56, 64, 274, 276–277, 306
Determinism, 83, 264–265
Deterministic versus stochastic plot, 224, 226, 232, 234, 271–272
Difference equation, 66–67, 82–83, 101–102, 118, 205, 291, 305, 308
logistic, 7, 66–67, 83, 104, 138, 209–210, 214–216, 235–236, 264–266, 269, 271, 288, 313
Differential equation, 64–67, 83, 85, 108, 157, 194, 208, 214, 220, 273–274, 276, 280, 292, 302, 305–307
linear, 292
nonlinear, 51, 83, 202
ordinary, 305–307
partial, 56–57
Dimension. *See* Dimensionality
Dimensional complexity, 241–242, 244
Dimensionality, 213–214, 220, 227, 230, 235, 240–244
box-counting, 214, 227
correlation, 240–241, 243–244
embedding, 220, 223, 240, 243–244
point D2, 243–244
Directed graph. *See* Graph theory, directed graph
Double-well potential, 22–24, 176–177, 208
Douglass, J. K., 184–186
Dukas, R., 285–286, 291–292, 294
Dunne, J. W., 9–11

Ecology of cognition, 291
Economics, 7, 68
Edelman, G., 283, 315, 320–321
Edge of chaos. *See* Chaos, edge of
Electricity, 57–58
Electroencephalogram, 150, 153, 208, 226, 237–238, 240–242, 295–299, 301, 303, 318, 324
Emergence, 49–50, 288, 320
Ergodicity, 105–106
Error, 5–6, 8, 30, 32, 47, 59, 63, 68, 82–84, 97, 115–116, 139, 181–182, 205, 215, 223–224, 226, 231–232, 307, 311
Euler method, 306–307
Event-related potential, 150–151, 153, 242–244, 298
Evolution, 4, 20, 26, 28–29, 43, 47, 55, 110, 112, 116, 118, 190, 214, 216, 251, 285–289, 291, 294, 306, 323
fitness, 252, 287–288, 291
genes, 252, 287–289, 291
macro, 288
natural selection, 55, 285–287, 291
punctuated equilibrium, 288
Exceedance, 179, 182
Explicit memory. *See* Memory, explicit
Exponential distribution. *See* Probability, exponential distribution
Eye movements, 38, 318

Falmagne, J-C., 86
Fast Fourier transform, 122, 124, 126, 129, 150, 153, 157, 166, 184
Feedback, 65–66, 257–260, 262, 264–266, 269
positive, 45
Feller, W., 100, 102, 106, 119, 168, 247, 253
Feurstein, M. C., 156–157
Feynman, R. P., 4, 25–26, 29, 53, 55, 57–58, 61, 99, 111, 201, 314
Finite state machine, 33, 35, 38, 40, 42, 72–73, 79
Fitness. *See* Evolution, fitness
FitzHugh-Nagumo model. *See* Model neuron, FitzHugh-Nagumo
FitzHugh, R. A., 273, 280–281, 306
Fluctuations, 5–7, 24, 29, 32, 47, 87, 90–91, 107, 110, 115, 117, 119, 122, 124–126, 129–132, 135–136, 139–140, 146–148, 150, 158–162, 167, 169–170, 173, 175–177, 182, 296–297
Fourier analysis, 305
Fourier transform, 122, 126, 150, 157, 165–166, 184
Fractal, 110, 213–214, 242
Fraser, J. T., 19, 29
Freeman, W. J., 237–240, 242–243
Frequency, 15, 29, 32, 122, 124, 126, 129–130, 132, 135–136, 147, 155, 159, 166–167, 171, 177–178, 183–188, 196, 238, 244, 260, 278, 297, 300, 303, 317, 320

Frey, B., 138–139, 141, 144, 213, 235
Fries, P., 318, 320
Function, iteration of, 138, 156–157, 202–205, 208–210, 216, 269, 305
Functional magnetic resonance imaging, 299

Gambling, 99–102, 106, 245
Gaussian distribution. *See* Probability, Gaussian distribution
Gene. *See* Evolution, genes
General relativity, 55, 61
Gilden, D. L., 136–139, 141, 143–144, 235
Gluckman, B. J., 199
Goss-Custard, J. D., 252
Gottman, J. M., 9, 15–16, 235
Graph theory, 4, 22, 66, 72–75, 78, 86, 121, 147, 151, 173, 182, 185, 196, 199, 203, 210, 219, 224, 240, 255, 265, 279, 288, 307, 309
 directed graph, 72, 74–75
 weighted graph, 73, 75, 79
Grassberger, P., 230, 240
Greenwood, P. E., 74, 99, 141, 170, 173, 179, 182, 187
Gregson, R. A. M., 7, 69, 89, 229, 308

Haken, H., 21, 282
Hall, E. T., 17–19, 29
Herrnstein, R. J., 247–248
Heuristic, 266, 269, 271–272
HKB model. *See* Model, HKB
Hodgkin, A. L., 194, 273, 280–281
Hodgkin-Huxley model. *See* Model neuron, Hodgkin-Huxley
Hurst exponent, 131
Huxley, A. F., 194, 273, 280–281

Implicit memory. *See* Memory, implicit
Infinite regress, 9, 11
Information, 6–7, 10, 13, 29, 33, 37–38, 46–47, 55, 58–59, 62, 72, 74–75, 85, 107, 116, 141, 145–147, 150, 178, 182–183, 187, 193, 196, 214, 238, 239, 257–58, 265, 283, 287–288, 291, 295, 297–298, 300, 313–314, 316, 321, 323
Instability, 20–21, 23, 51, 158, 178, 251, 253
Integrate-and-fire neuron. *See* Model neuron, integrate-and-fire
Integration, 11, 24, 64–65, 90, 108, 119, 179, 197–198, 306, 315, 317, 320
Interneuron, 183, 193, 196–97

James, W., 28–29, 282, 315
Jaynes, J., 315, 317, 323
Jourdain, R., 19–20

Kahneman, D., 29, 40, 250, 257, 323
Kareev, Y., 257, 260
Kauffman, S. A., 33, 55, 155, 213, 291
Kelso, J. A. S., 7, 20–22, 50, 282
Kubovy, M., 249–251

Langevin equation, 117–118, 216
Language, 15, 46, 55, 58, 99, 285, 291, 323
Lashley, K. S., 11–12, 28, 237, 240, 311
Law
 general system, 49
 of large numbers, 246–247
 matching, 247–248
 power, 4, 87, 97, 157, 159
 statical, 4
 stationary, 79, 103–106
Learning, 9, 12, 14, 21, 38, 41–42, 58, 84, 91, 238–239, 266, 269, 300, 309, 311–312
Linear regression, 97–98, 115, 229–230
Lockhead, G. R., 250, 255, 261–262, 264
Logic, 40, 46, 234, 312–313
Logistic. *See* Difference equation, logistic
Logothetis, N. K., 317–318
Longtin, A., 196, 199, 281
Luce, R. D., 85
Lumer, E. D., 321

McDonald, J. J., 151, 153
Magic, 1–2, 4
Magnetism, 57–58
Magnetoencephalogram, 147–148, 298–299, 318, 320, 324
Mallon, M. W., 136–138
Mandelbrot, B., 124, 165, 171, 173, 213
Markov chain, 13, 33, 35, 58, 106, 250–251, 257
Markov process, 13, 106, 108
Markov property, 106
Master equation, 108, 110, 118
Mathematics, 7, 13, 15, 57–58, 73, 87, 99, 103, 113
Maxwell, J. C., 56–58
Meme, 53, 315, 323
Memory, 12–13, 19–20, 26, 28–29, 38, 40–43, 46, 55, 63–64, 67–68, 131, 138–139, 141, 143, 146, 160, 162–163, 235–236, 252–253, 260–261, 269, 271–272, 278–279, 285, 287, 303, 313
 explicit, 63–64, 261, 291
 implicit, 63–64
 sequence, 42
Mesoscopic description, 107–108, 110
Meter, 19–20
Method of delay coordinates, 210
Metzger, M. A., 266, 269, 271
Microgenesis, 38, 41

Model
deterministic, 82, 84, 87, 235–236
dynamical, 8, 43, 64, 66–69, 71–72, 74–75, 78–79, 82, 86–87, 89, 273, 283, 285, 292–294, 306, 309, 314
empirical, 82, 84, 97–98
HKB, 21–22, 24, 282
neural network, 79, 309, 311–312
statical, 62–63, 67–69, 71, 81–82, 85–86
stochastic, 84, 86–87, 99–100, 103, 233
structural, 71, 73, 78
theoretical, 82, 84–85, 97
Model neuron, 160–162, 186, 195–199, 208
FitzHugh-Nagumo, 281
Hodgkin-Huxley, 273, 280–281
Integrate-and-fire, 160, 194–198, 321
Molnar, M., 243–244
Morrison, F., 65, 81–83, 87, 202
Moss, F., 175, 178, 186–187, 190–191
Moving average, 90–92, 94, 96. *See also* ARIMA
Musha, T., 132–133, 136, 146–147
Music, 2, 4, 12, 19–20, 24, 63, 75, 135–136, 238, 287, 300

Nagumo, J., 194, 281
Natural selection. *See* Evolution, natural selection
Neural circuit, 239
Neural network, 79, 160, 163, 208, 301, 308–309, 311–314, 321
Neural network model. *See* Model, neural network
Neuringer, A., 112, 257–259, 263–266, 269
Neural correlate of consciousness. *See* Consciousness, neural correlate of
Neuron, 11–13, 42, 46, 79, 145–148, 150–151, 153, 160, 162–163, 169, 175, 178, 183–188, 190, 193–199, 208, 238–240, 242, 278, 280–283, 292, 295–296, 298–301, 306, 308–309, 311–315, 317–318, 320–321, 323–324
Noise
1/f, 7, 125, 129, 130, 132, 139, 141, 157, 159, 166, 169, 170–171, 173, 233
black, 129–131
brown, 126, 129, 131
characteristic, 115, 118
colored, 116, 119, 126, 129, 131–132, 155
current, 117, 167–168, 170
dynamical, 215–216
electrical, 165, 199, 261
essential, 116
external, 116–117, 160, 215
ignorance, 116
independent, identically distributed, 90, 119, 126, 156, 216, 227, 231–232, 251
internal, 116–118, 156, 186, 188, 215, 261
measurement, 215, 226
multiplicative, 110, 157
noncharacteristic, 118–119
pink, 126, 129–132, 139
quantum, 116, 118
shot, 115–116
thermal, 115, 117–118
tuning, 158, 178, 182, 300
water, 184, 186
white, 7, 90–91, 94, 125, 129, 131, 137–141, 143, 146, 157, 162, 166, 170, 184, 234–235, 242
Normal distribution. *See* Probability, Gaussian distribution
Norwich, K. H., 37, 55, 62
Novikov, E., 145, 148
Numerical integration, 305–306
Nunez, P. L., 295, 300–301, 324
Nyquist frequency, 32

Olami, Z., 160
Olfaction, 237–240, 242
Order, 2–3, 9, 11–12, 27–30, 42, 48, 78, 90–92, 94, 98, 113, 141, 201, 207, 220, 246, 280, 291, 302, 306–307, 315
serial, 28, 282
temporal, 12, 20, 89, 90
Oscillation, 20, 30, 175, 207, 238, 273–274, 276–278, 280–282, 288, 296, 301–303, 317, 321, 323
global, 301–302
local, 301–302
relaxation, 273, 278–279, 281
sinusoidal, 276
Oscillator, 20, 27, 207–208, 273–274, 276–278, 280, 300
coupled, 278, 282, 312
damped, 207–208, 274, 276–277, 281, 294, 302
forced, 11, 32, 147, 176–178, 199, 207, 276, 278–281, 300, 312
linear, 274, 277
nonlinear, 208, 277, 296
relaxation, 194, 273, 278, 282–283, 294, 300, 302, 306, 312, 323
unforced, 274, 277–278

Pacut, A., 85
Perception, 1, 8, 20–21, 25, 38, 41–42, 55, 61–62, 64, 84, 135–136, 163, 175, 183, 188, 190–191, 237, 240, 245, 251–252, 261, 287, 297, 309, 323
Periodic orbit, 45, 107, 117, 175–177, 203, 205, 207–208, 291, 307
Periodic point, 104, 203–204, 209
Periodicity, 7, 126, 197, 203–204, 213, 221

Phase, 21–24, 111, 199, 204, 207–208, 210, 220–221, 223, 226, 230, 239–240, 242, 265, 269, 271–272, 274, 276–278, 280–281, 291, 307, 320
 anti, 21–23
 relative, 22, 155
Phase locking, 278, 281
Phase portrait, 220, 239–240
Phase space, 111, 204, 208, 210, 221, 223, 230, 239, 242, 274, 276, 280, 291, 307
Phrasing, 19–20
Physics, 4, 6, 11, 15, 25–28, 32–33, 50, 53, 55–58, 61–62, 68, 87, 99, 100, 107, 110–112, 115–116, 130, 145, 147–148, 155, 166–167, 201, 207, 242, 283
Pink noise. *See* Noise, pink
Platt, J., 58
Poisson distribution. *See* Probability, Poisson distribution
Positron-emission tomography, 298–299
Potential barrier, 22, 177
Power law. *See* Law, power
Power spectral density, 122, 129, 166
Power spectrum, 122, 124–126, 129–133, 135–139, 141, 144, 147–148, 150, 153, 155, 157, 159–160, 162, 165–166, 168–171, 173, 184–185, 188, 190, 210, 213, 219, 233
Precision, 26, 32, 57, 59, 82, 113, 116, 203–206, 265–266, 269
Predictability, 47, 59, 112, 206, 217, 232, 236, 263–264, 269
Prediction, 4, 7–8, 28, 40, 47, 59, 81, 86, 112–113, 116, 187, 202, 205–207, 210, 217, 221, 223–224, 226, 230, 232, 236, 248, 252, 255–256, 262–264, 266, 269, 272
Priming, 41, 63, 162–163
Probability, 6–7, 13, 15–16, 26, 29, 35–37, 40, 42, 47, 73–74, 84, 86, 99–104, 106–108, 110, 112, 117–119, 121, 124, 126, 146, 156, 158–159, 165, 168, 179, 187, 192, 206, 210, 213, 227, 231, 236, 244–253, 255–257, 260, 306, 311, 314
 density function, 119, 121, 159, 168, 179, 306
 distribution, 6, 13, 16, 47, 74, 84, 100, 102–103, 106–108, 110, 117–119, 121, 124, 126, 156, 158, 165, 168, 206, 210, 213, 227, 247, 249, 306, 311
 distribution function, 118, 121, 165, 179, 181
 exponential distribution, 168–170
 Gaussian distribution, 84, 103, 121–122, 126, 139, 226–227, 249
 matching, 248
 Poisson distribution, 121
 theory, 99, 101, 119, 179, 256
 uniform distribution, 119, 121–122, 157, 213
Problem solving, 40
Procaccia, I., 230, 240
Psychology, 4, 7, 13, 54–55, 61–62, 67–68, 73, 84, 86, 89, 115, 137–138, 143, 247, 249, 261–262, 286, 315–316
Psychophysics, 4–7, 55, 62–63, 68–69, 82, 84, 86–87, 96–97, 114, 190, 229, 250, 255, 295, 308

Quantization, 45, 215
Quantum computer. *See* Computer, quantum
Quantum electrodynamics, 26, 49, 111
Quantum mechanics, 6, 53, 55, 61, 116
Quantum wave function, 110–113, 314
Queuing, 166–169

Random walk, 85, 91, 100–102, 106, 126, 170
Randomness, 6–7, 47, 55, 68, 74, 78, 81, 83–87, 91–92, 94, 96, 99–103, 106, 114, 117, 121–122, 126, 137, 146, 155, 160–161, 165–167, 170–171, 175, 177–179, 182, 184, 186, 188–189, 194, 197, 199, 201, 203–210, 213–216, 226–227, 229–231, 233, 240, 245–247, 250–251, 253, 255–263, 265, 279, 306, 311, 318
Rapoport, A., 249, 250, 251
Rapp, P. E., 241–243
Rate coding, 300
Rate of change, 26, 51, 56, 64–66, 108, 112, 117, 274
Reentrant loop, 321
Relaxation, 41, 146, 169
Relaxation oscillation. *See* Oscillation, relaxation
Relaxation oscillator. *See* Oscillator, relaxation
Rhythm, 1–4, 17–21, 36, 40, 53, 150, 208, 279, 282, 294
 of life, 18
 poly, 19
Richard, C. M., 139, 235
Roy, A. K., 9, 15–16, 298

Scheier, C., 233–235, 324
Schrödinger equation, 111, 113
Schroeder, M., 129–131, 139, 140
Self-organization, 20, 24, 50, 157–160, 323
Self-consciousness. *See* Consciousness, self
Sensation, 1, 6, 35, 37, 41, 63, 68, 78, 85, 147, 150, 160, 162, 175, 183–187, 190–191, 197, 238, 240, 242–243, 249–250, 320
Sensitive dependence. *See* Chaos theory, sensitive dependence

Sequence, 9, 11–15, 17, 25, 27–28, 33, 36–38, 40, 42, 81, 96, 103–104, 106, 150, 205, 221, 245–247, 250–253, 255, 257, 260–262, 264–266, 269, 271, 294, 303, 313
 action, 11–12
 random, 96, 245, 247, 250, 255–257, 260–262
Signal detection theory, 6, 61, 85–86, 191–192, 248–251, 261
Simonotto, E., 188–190
Singer, W., 146, 198, 283, 287, 300, 317
Skinner, J. E., 243–244
Speech, 2, 4, 28, 62, 135–136, 187, 287, 312–313
State
 absorbing, 36
 change, 35, 176, 239
 cognitive, 14, 324
 transition, 13, 38, 42, 108
State vector, 111–112
Stationary law. *See* Law, stationary
Stemmler, M., 160, 192
Stevens, S. S., 4–5, 63, 68, 84, 87, 97
Stochastic model. *See* Model, stochastic
Stochastic process, 7, 79, 89–90, 92, 100, 102–108, 110, 165, 169, 210, 213–215, 221, 226–227, 247, 256, 282, 305
 linear, 102, 219, 224, 226, 235
 nonlinear, 99, 105, 221, 224, 226, 231, 233
Stochastic resonance, 175, 177–178, 182–193, 195–197, 199, 281
Strange attractor. *See* Chaos theory, strange attractor.
Structural model. *See* Model, structural
Structure, 12, 17, 19–20, 29, 45, 68, 72, 74–75, 78–79, 82, 87, 90, 96, 98, 116, 122, 135–136, 144, 161, 226–227, 230–233, 247, 264, 271–272, 276, 286, 288, 299–300, 303, 309
 temporal, 20, 82, 84, 90, 92, 96, 116, 124, 138, 165, 220, 251
Superposition, 112, 170
Surrogate data, 227, 231, 234, 242
Synaptic action density, 295, 301–302
Synchrony, 13, 41, 136, 146, 175, 199, 238–239, 242, 283, 300–301, 317–318, 320–321
System
 closed, 50
 cognitive, 47, 50, 78–79, 112, 114, 129–130, 273–274, 279, 285
 dynamical, 7, 20, 24, 29, 37, 50–51, 55, 59, 108, 110, 112, 121, 126, 129, 132, 156–157, 159, 169, 170, 175, 201–202, 205, 210, 213–217, 219–220, 227, 237, 239–240, 273, 291, 305, 307
 open, 50
 properties, 51
 state variables, 50–51, 59, 63, 81, 306
 trajectory, 51, 59, 217, 221, 306
System theory, 45, 50
 dynamical, 24, 37, 50, 55, 59
 general, 45–46, 48, 50, 173

Tang, C., 158–159
Teich, M. C., 156–157
Temporal coding, 283, 312
Theiler, J. T., 227, 241–242
Theory
 dynamical, 8, 42, 308
 evolution, 285, 287, 323
 formal, 45, 55–59
 optimal foraging, 252
 quantum, 32, 110–111
 queuing, 167–169
 statical, 7
Thinking, 35, 40, 42, 45, 111, 130, 265, 273
Thornton, T., 136–138
Threshold detector, 178–179, 192–193, 198
Thurner, S., 156–157
Time
 absolute, 26–27
 arrow of, 28
 biotemporal, 29, 321
 discrete, 33, 203
 eotemporal, 29, 51, 56, 96, 321
 estimation, 137, 139, 229–232, 258
 evolution, 71, 75, 108, 111–112, 118, 215, 303, 308
 explicit function of, 65
 implicit function of, 65–66
 measurement of, 30, 51
 monochronic, 18–19
 nootemporal, 29, 321
 period, 22, 27, 29–30, 32, 75, 130, 137, 146, 153, 178, 203–204, 246, 259, 274, 276, 278–279, 288, 292, 309
 polychronic, 18–19
 reaction, 30, 85–86, 90, 115, 125, 138–139, 143
 response, 85
 scale, 7, 29, 42, 82, 86, 126, 139, 140, 143, 155, 169–170, 229, 248, 251–252, 285–286, 298, 312, 315, 320, 324
Time series, 7, 17, 30, 32, 40, 68, 89, 90–94, 96–97, 122, 124–126, 130–132, 135, 137–141, 147–148, 150, 153, 155, 157, 161, 165–166, 168, 170–171, 184–185, 188, 190, 195, 210, 213–215, 219–221, 223–224, 226–227, 229–236, 240–242, 244, 258, 279, 288, 296–299, 320
 chaotic, 234, 240
 nonchaotic, 244
 rhythmical, 17

Time series analysis
 linear, 89–91
 nonlinear, 219, 230
Timing, 6–7, 30, 38, 40–41, 282, 300, 312
Tononi, G., 283, 315, 320–321
Transition matrix, 13–16, 35, 38, 106, 257
Treisman, M., 251–252, 261
Tschacher, W., 233–235
Turing, A., 45–46, 313
Turing machine, 45–46, 313
Tversky, A., 29, 73, 249–251, 257, 323

Unfolding, 4, 28, 33, 37–38, 41, 50, 67, 74, 78, 84, 86, 100, 102, 108, 117–118, 157, 235, 276, 282, 299, 314
Uniform distribution. *See* Probability, uniform distribution
Usher, M., 160

van der Pol, B., 273, 278
Variability, 6, 81–82, 84–87, 90, 92–94, 97, 104, 115, 117–119, 121, 129, 131, 138–140, 197, 217, 227, 229–231
 residual, 68, 98, 139, 229–230
 response, 6–7, 86, 116, 229
Variance. *See* Variability
Variety, 17–18, 45–47, 55–56, 58, 84, 119
Vigilance, 292–294
Voss, C., 263–266, 269
Voss, R. F., 112, 135–136

Ward, L. M., 25, 29, 41, 47, 63, 68, 94, 96–97, 114, 137, 139, 141, 151, 170, 173, 179, 182, 190–191, 198, 229–231, 235, 250–251, 253, 255, 261–262, 266, 269, 300
Weaver, W., 13, 46, 99, 100, 245, 247
Wefelmeyer, W., 179
Weighted graph. *See* Graph theory, weighted graph
Weinberg, G. M., 45–46, 59, 62, 69, 75, 87, 114
West, R. L., 266, 269
White noise. *See* Noise, white
Wiesenfeld, K., 158–159, 175