

Index

- absolute recency, 434
- absolute threshold, 319
 - reflex, 43
- absolute threshold, reflex, 64
- Acosta, G. B., 411
- action
 - behavioral variation and, 512–15
 - guidance of, 516
 - priority of, 512
- active responses, 275
- activity level, 179
- Adams, A., 572
- adaptation, 29, 32, 47, 445
- adaptive behavior. *See also* behavior
 - analysis of, 26
 - niche and, 1
 - physiology and, 26
- adaptive toolbox, 275
- adjunctive behavior, 352
- adolescence, 2
- adolescence in animals, lengthening of, 2
- adventitious reinforcement, 507, 510. *See also* reinforcement
- “Adventures of the Black Girl in Her Search for God, The” (Shaw), 154
- Aega, 74
- aerotaxis, 32. *See also* direct orientation
- aggression, 135
- Allais paradox, 275
- allied reflexes, 54
- Allison, J., 186
- Alloway, T. M., 439–40
- Alsop, B., 251, 258
- altricial birds, 446
- Amaroucium*, 69
- Ambystoma tigrinum*, 10
- Ammophila campestris*, 315
- analog coding, 318–19
- analogous structures, 13
- angelfish (*Pterophyllum scalare*), 10, 446
- anticipation, 118, 125, 127
- anxiety, 543
- aphagia, 180
- aphid (*Aphis fabae*), settling and flight behaviors in, 56–7
- Apis mellifera*, 458, 572–3
- Aplysia*, 48
- area-restricted search, 150, 294
- Argynnis paphia*, 447
- Aristotle, 135, 138–9
- Armadillium*, 72
- arousal, 517–19
- artificial intelligence, 40–1
- Ashby, W. R., 94–5
- assignment-of-credit problem, 165
- associations, 245
- associative learning, 124, 138, 457
- associative value, 490
- asymptotic behavior, 556
- Atkinson, R. C., 245, 370
- atomic acts, 459
- Attenborough, D., 338
- attention, 458
 - stimulus control and, 329
 - to stimulus dimensions, 329–33
- attitudes, 5
- Attneave, F., 334
- Augerinos, G., 340, 432
- Aust, U., 568
- autonomic responses, 505–6
- autoshaping, 235, 239, 320, 347–8, 503, 505, 510, 512
- auxins, 26
- averaging, 128–30
- avoidance, 544–8
 - reaction, 38, 107
 - schedule, 171
- Ayres, S., 206, 352, 526
- Azrin, N. H., 486
- babbling, 452
- backward conditioning, 472
- Bacotti, A. V., 207–8

- bacteria
 - adaptation in, 29
 - chemotaxis in, 26
 - Escherichia coli*, 29, 31–2
 - Oxytricha*, 34–5
 - Paramecium*, 33, 34–5, 38, 92, 176, 315
 - Salmonella*, 26, 29, 30
 - tumbling movement in, 29, 33
- Baddeley, A., 274, 319, 419
- Baerends, G. P., 318, 447
- Balanus*, 91
- Baldock, M. D., 439
- Baratti, C. M., 411
- Barrera, F. J., 522
- Barreto, M., 258
- Barron, A. B., 572–3
- Bartlett, E., 567
- Battalio, R. C., 229
- Bauhaus, 179
- Baum, W. M., 139, 245, 258
- Bayes, T., 466
- Bayes' rule, 466–7
- Bayesian inference, 466–7, 487, 490. *See also* inference
- Beautiful Mind, A* (movie), 91
- bees, 458
 - atomic acts in, 459
 - attention in, 458
 - learning in, 457
 - sensitivity to near-UV light, 317
- behavior
 - adjunctive, 352
 - allocation, 205–41
 - Darwinian fitness and, 214–15
 - income effect, 211–13
 - minimum-distance model, 218–23
 - optimal allocation, 215–18
 - rate and time measures in, 206–9
 - reinforcement contingencies, 209
 - response functions and, 223–6
 - substitution effect, 211–13
 - time constraints, 206
 - value and, 214
 - allocation of, 209–11
 - asymptotic, 556
 - emitted, 513
 - explanations of, 95
 - information hypothesis for, 553
 - innate, 2
 - learned, 2, 99
 - mechanical/functional explanations of, 133–4
 - morphological changes and, 12–13
 - neurophysiology and, 35–7
 - operant. *See* operant behavior
 - purpose of, 96
 - repertoire of, 120
 - reversible, 132
- risk-seeking, 268
- schedule-induced, 351–3, 526–9
- situation-induced, 513
- superstitious, 351, 395–6, 506–11
- systems, 512
- Behavior of Organism, The* (Skinner), 36
- behavioral contrast
 - definition of, 386
 - discrimination performance and, 347, 348–51
 - positive, 350
 - post-discrimination phase, 386
 - pre-discrimination phase, 386
- behavioral diversity, 229
- behavioral ecology, 184
- behavioral economics, 269–76
- behavioral integration, 90–5
- behavioral momentum, 387
- behavioral polymorphism, 91–2
- behavioral variation, 511–29. *See also* variation
 - action and, 512–15
 - feedback function, 525–6
 - guidance of action, 516
 - inducing situations in, 513
 - inference and, 512–15
 - initial state, 516–19
 - misbehavior, 514
 - operant conditioning and, 512–15
 - sampling and, 515–16
 - schedule-induced, 526–9
 - selection rules, 519–29
 - shaping, 523–5
 - species-specific defense reactions, 514
- Békésy, Georg von, 86, 88, 570
- Bekoff, M., 452
- beliefs, 5
- Benson, W. W., 303
- benzene, cyclic structure of, 566
- Beran, M. J., 573–4, 576
- Bernard, C., 176
- Bernheim, J. W., 371
- Bernoulli, D., 270–1
- Berryman, R., 161
- Betta splendens*, 237
- between-group method, 62, 128, 477
- biased matching, 278
- Bickel, W. K., 267
- big data, 341
- Bigelow, J., 96
- Bing (search engine), 2
- Birch, D., 370
- birds
 - altricial, 446
 - calls, 20–1
 - imprinting in, 15
 - intention movements, 473
 - learning in, 458
 - migratory, 16–17

- motivational change in, 92–3
- nonpasserine, 454
- precocial, 15, 21, 446, 450
- bisection procedure, 416
- bit, 115, 116
- Black, A. H., 340, 432
- black-box analysis, 95–6
- Blake, M. G., 411
- Blass, E. M., 199
- Blatta orientalis*, 92
- blending, 55
- bliss point, 225
- blocking
 - conditioning model, 492
 - cue competition and, 497
 - definition of, 474
 - taste-aversion learning and, 487
 - unconditioned stimulus and, 488
- Blough, D. S., 304, 328, 374, 570
- bluegill sunfish (*Lepomis macrochirus*), 290
- bluejays (*Cyanocitta cristata*), 303
- Boakes, R. A., 469
- bobolink (*Dolichonyx oryzivorus*), 16
- Boccia, M. M., 411
- Bode plot, 82
- body weight, 179, 191
- Bogdany, F. J., 481–3
- Bolhuis, J. J., 428
- Bolles, R. C., 515–16, 530
- bond, 140
- Bond, A. B., 301
- Boneau, C. A., 358, 362
- Boren, J. J., 231
- Boring, E. G., 139, 577
- Bothus lunatus*, 10
- Bower, G. H., 136
- Boyle's law, 384–7, 393
- Bradshaw, C. M., 226
- brain lesions, experiments, 181–2
- Bray, G. A., 195, 199
- Breland, K., 514
- Breland, M., 235, 239, 514
- Bremner, J. G., 427
- Brobeck, J. R., 199
- Brower, L. P., 467
- Brown, E. T., 465
- Brown, M. F., 431
- Brown, P. L., 320, 503
- Browne, M. P., 522
- Brownian motion, 29
- Bruce, R. A., 321
- Buchman, I. B., 232
- Buck, S. L., 373
- Burgess, P., 431
- Burghardt, G., 452
- Burstein, K. R., 358, 362
- Bush, R. R., 246
- Butler, S., 273
- butyric acid, 317
- Bygrave, D. J., 474
- Caenorhabditis elegans*, 48
- calluses, 13–14
- camouflage, 449
- Campbell, B. A., 474
- canalization, 3–4, 19
- Cannon, W., 176
- capuchin monkeys (*Cebus apella*), 575–6
- Carey, S., 567
- carmine, effect on *Stentor's* behavior, 104–7
- Carterette, E. C., 304
- Casey, J., 280
- Castro, J. M. O., 258
- Cataglyphis*, 337–8
- Catania, A. C., 245, 292, 362, 372, 405, 501, 533
- Catocala relicta*, 303
- causal explanation, 6
- cause
 - efficient, 138–9
 - final, 138–9
- Cebus apella*, 575–6
- ceiling effect, 82
- Central Dogma* (Crick), 11
- central nervous system (CNS), 36
- Cerella, J., 323
- Cerutti, D. T., 245, 268, 405, 571
- chaffinch (*Fringilla coelebs*), 16
- chain reflexes, 107, 108
- chained schedule, 532, 533
- changeover delay, 242, 258, 285
- characteristic space, 226
- Charnov, E. L., 277, 287
- Chaser (border collie), 567–8
- Chavarro, A., 251, 258
- chemotaxis, 25, 26, 32–3. *See also* direct orientation
- chess programs, 5, 6
- chickens, 454
- children, language learning in, 567
- chimpanzees, 564–6
- Chino, K., 249
- choice, 242–86
 - architecture, 274
 - behavioral economics, 269–76
 - concurrent VI and, 257–9
 - concurrent VI–VR and, 285–6
 - concurrent VI–VI and, 278–85
 - delayed outcomes and, 263–8
 - dynamics, 244–6
 - human, 269–76
 - identical random ratios, 249–56
 - marginal value and, 277–8
 - matching and maximizing, 276–7
 - momentary maximizing, 277–8
 - non-exclusive, 291

- choice (*cont.*)
 - optimal, 259–60
 - probability learning, 260–3
 - random-ratio, 247–9
 - risk and, 268–76
 - self-control and, 263–8
 - variable outcomes and, 268–9
- Chua, J. Y. M., 400
- Chung, S.-H., 540
- Church, R. M., 400, 402–3, 474
- Cicoria, Tony, 16
- ciliates, 33
- circadian rhythm, 73–4, 133
- circumnutation, 24
- circus movements, 72
- Clark, S. L., 180, 287
- classical (Pavlovian) conditioning, 119–20, 154–5.
 - See also* operant conditioning
 - association and, 457
 - definition of, 562
 - framing and, 274–5
 - inference and, 486–90
 - long-delay, 468–9
 - mathematical theories of, 98
 - models of, 486–500
 - new learning model, 496–9
 - open-loop procedure, 147, 148
 - operant behavior and, 503–6
 - vs. operant conditioning, 512
 - taste-aversion learning and, 467–8
 - trial-level models, 499–500
 - unconditioned stimuli, 117
- classical economics, 97
- classification, 478–84
- Cleaveland, J. M., 280
- “Clever Hans” effect, 567
- clock, fixed-interval, 535
- clock space, 281
- closed economies. *See also* open economies
 - definition of, 175, 393
 - regulation in, 189
 - reinforcement in, 394
- cognition
 - comparative, 563–78
 - fast mapping, 567–8
 - insight, 564–6
 - metacognition, 569–77
 - stimulus control and, 313–44
- cognitive maps, 338, 433
- Cohen, D., 249
- Cohn, J., 569
- Collier, G., 175, 182, 186, 188, 394
- color, 463–4
- color perception, 325
- comfort calls, 450
- Commons, M. L., 397
- comparative cognition, 563–78
- fast mapping, 567–8
- insight, 564–6
- metacognition, 569–77
- comparative psychologists, 4
- competition, 93
 - behavioral, 206
 - contrast and, 353
 - reflexes, 53–4
- compound stimulus, 474
- concurrent chain schedule, 264
 - VI–FI, 292
- concurrent variable-interval variable ratio, 285–6
- concurrent VI–VI, 278–85, 380
- concurrent-chained schedules, 536–9
- conditional probability, 160
- conditioned emotional response, 156, 163, 164, 501, 542–4
- conditioned reinforcement, 532–5, 536
- conditioned response (CR), 120, 154, 163
- conditioned stimuli (CSs), 120, 154, 163–5, 467, 473, 474, 476, 544
- conditioned suppression, 156, 474
- conditioning
 - backward, 472
 - candidates for, 489
 - classical. *See* classical (Pavlovian) conditioning
 - delay, 154
 - excitatory, 162
 - inhibitory, 163
 - models for, 490–6
 - to novel tastes, 488
 - operant. *See* operant conditioning
 - selection of candidates for, 512
 - superconditioning, 474, 476, 493
 - temporal, 155, 163–5, 507
 - trace, 155, 163–5, 489
 - confusion effect, 118
 - conjoint stimulus control, 359–69
 - Conover, K., 266
 - constraints, 235–40
 - context, 134
 - contextual cues, 492
 - contiguity, 507–9
 - vs. contingency, 511
 - detection of, 520
 - vs. predictability, 158
 - response-reinforcer, 519–23
 - selective action and, 520–1
 - contingency, 320
 - vs. contiguity, 511
 - fixed-time, 535
 - molar, 509
 - negative, 162, 170
 - positive, 162
 - punishment and, 156–61
 - response, 165–7, 172–4
 - rewards and, 156–61

Index

583

- space, 161–3, 298, 487
- superstitious behavior and, 507
- table, 158
- contingent effect, 211, 505
- contingent response, 209–10
- continuous pressure model (CPM), 390–2, 393, 395
- continuous reinforcement, 146, 556
- contrast
 - behavioral, 347, 348–51
 - competition and, 353
 - local, 371
 - matching and, 379–84
- control
 - by consequences, 121
 - discriminative, 121
 - excitatory, 345–6
 - function, 76, 146
 - inhibitory, 345–6
 - intra-dimensional, 364
 - synchronous, 132–3, 399
 - system, 84–5
 - temporal, 132–3, 398–403
- convergence, speed of, 152
- Cook, R. G., 431
- cooperation, 54–5, 93
- correlated condition, 157–8
- Cosmides, L., 553
- cost-of-deviation, 236–7, 240
- Coutinho, M. V. C., 576
- covert abilities, 16
- cowbird (*Molothrus ater*), 21, 321, 325
- Cowie, R. J., 308
- CP/M operating system, 5
- Craig, W., 236
- Crick, Francis, 11
- cross elasticity, 237
- cross-extension reflex, 55
- Crovitz, H. F., 433
- Croze, H., 296–7
- Cruce, J. A. F., 195
- cryptis, 449
- cryptic preys, 296–7, 302–5
- Crystal, J. D., 571
- cuckoo (*Cuculus canorus*), 21
- cue competition, 490–1
- cumulative effects model, 255–6, 429–30
- cumulative record, 147
- curiosity, 135
- currency, 214
- Cyanocitta cristata*, 303
- cybernetics, 296–7
- cytoplasm, 11
- Dale, R. H. I., 434, 435
- Danio rerio*, 58–62
- Daphnia*, 92, 290, 308
- dark matter, 273
- Darwin, Charles
 - evolution theory, 1, 6, 9, 13
 - Expression of the Emotions in Man and Animals*, *The*, 53–4
 - on pangenesis, 17
 - on pros and cons of marrying, 242
 - on sexual selection, 449
- Darwinian fitness, 1, 214–15
- database management, 2
- Davey, G. C., 394
- Davidson, M., 245
- Davies, N. B., 220, 312
- Davis, D. G. S., 256, 429
- Davis, H., 206
- Davis, J. D., 186
- Davis, M., 473
- Davison, M., 258
- Dawkins, M., 296–7, 301, 447
- Dawkins, R., 510
- days off, 426
- de Sa, M. C., 258
- de Villiers, P. A., 233
- decision weights, 273
- delay
 - conditioning, 154
 - inhibition of, 155
 - reduction, 265
- delayed matching to sample (DMTS), 417–18
- delayed outcomes, 263–8
- delay-of-reinforcement gradient, 489
- delay-of-reward gradient, 471
- Delbrück, N., 251, 258
- Delius, J. D., 367
- Dennett, D., 570
- dependency, 509
- deprivation, 370, 408
- Descartes, R., 39
- detectability, 299
- development
 - environmental effects on, 11–12, 20–2
 - evolution and, 9–13
 - genetic effects, 11–12
- Dews, P. B., 349
- diabetes, 35
- Dickinson, A., 474, 476, 494
- diet choice, 290–2
 - state-space representation of, 299
- difference threshold, 319
- differential recency, 434
- differential threshold, 64
- digger wasp (*Ammophila campestris*), 315, 317
- digital coding, 318–19
- diminishing marginal utility principle, 205, 217
- direct orientation
- dynamic analysis, 78–80
- feedback analysis, 75–8
- frequency analysis, 80–5

- direct orientation (*cont.*)
 - klinotaxis, 67–70
 - light-compass reaction, 73–4
 - telotaxis, 74–5
 - tropotaxis, 70–3
- discomforter, 141
- discontinuous pressure model (DPM), 385, 387, 388–9
- discounting, temporal, 266–8
- discrete-time model, 125, 128
- discriminated avoidance, 545
- discrimination
 - definition of, 123–4
 - feature-negative, 346
 - feature-positive, 346
 - performance, 347, 348–51
 - phase, 349
 - of recency, 415–16
 - reversal, 423–9
 - stimulus equivalence and, 316
 - successive, 331
 - temporal, 399
- discriminative control, 121
- discriminative stimulus, 103, 117, 121, 314–16.
 - See also* stimulus
- dishabituation, 117. *See also* habituation
- disinhibition, 361, 413
- distance receptors, 27
- distress calls, 450
- dogs
 - fast mapping in, 567–8
 - language learning in, 568
 - learned helplessness in, 550–4
 - time-marking in, 398–9
- Dolichnyx oryzivorus*, 16
- dolphins, 570
- Donaldson, W., 419
- “Dr. Dolittle research,” 563
- drives, 135–6
 - primary, 135
- Drosophila melanogaster*, 11, 13
- ducklings, 20–1
- Dukas, R., 296–7
- Dunham, P. J., 206
- Dunn, R., 265
- Dutch Hunger Winter, 19
- Dworkin, B. R., 505–6
- dynamic analysis, 78–80
- dynamic phase, 184
- Eastzer, D. H., 321
- eating. *See also* feeding regulation
 - effects of hypothalamic lesions on, 182–5
 - frequency, 179
 - rate, 186, 189–90
- Ebbinghaus, H., 428
- ecology, 97
- effect, law of, 112, 139–40
- reinforcement and, 137–42
- trans-situationality of, 141
- effective stimulus, 52
- efficient cause, 138–9
- Ekman, G., 335
- elasticities, 237
- electric shocks, 544–8
- Elliffe, D., 251, 258, 394
- Ellison, G. D., 502
- emitted behavior, 513
- emotions, expression of, 53–4
- encoding, 22
- energy intake, net rate of, 287
- Engelmann, W., 26
- English robin (*Erithacus rubecula*), 22
- environment
 - early, 20–2
 - effect on behavior, 11–12
- Ephemera*, 72, 91
- epigenesis, 13–17
- epigenetic effects, 19–20
- Epstein, A. N., 187, 195
- equilibrium states, 151–3
- equivalent histories, 125, 128, 134
- Erithacus rubecula*, 22
- escape, 544–8
- escape schedule, 171
- Escherichia coli*, 29
 - optimal foraging strategy, 31–2
 - swimming pattern, 31–2
- Estes, W. K., 130, 139, 156, 246, 354, 543
- Estes-Skinner procedure, 543
- Estle, S. J., 267
- ethologists, 4
- Ettlinger, R. H., 190, 197
- etymology, 97
- Euclidean space, 341
- Euglena*, 69, 92
- evolution, development and, 9–13
- evolutionarily stable strategy (ESS), 91
- evolutionary epistemology, 41
- evolutionary psychology, 449
- excitatory conditioning, 162
- excitatory control, 345–6
- excitatory temporal control, 403–5
- expectancy, 125, 127
- expectation, 120, 441, 478–84
- explanations, of behavior, 95
- exploitation, 551
- exponential discounting, 267
- exponential lag, 101
- Expression of the Emotions in Man and Animals, The* (Darwin), 53–4
- expressions of emotions, 53–4
- extension phase, reflex, 45
- extension reflex, 55

- extensor muscles, reciprocal innervation of, 53
- extinction, 322, 350, 395, 554–62
- extinction curve, 324
- eyewitness testimony, 577
- facultative activities, 353–6, 528
- faculty psychology, 577
- failure modes, 179, 181, 182
- Fantino, E., 251, 258, 264, 265, 537, 538, 539, 542
- fast mapping, 567–8
- fatigue, 47
- fear, 5
- feature effects, 346–8
- feature-negative effect, 347
- feature-positive discrimination, 346
- feedback
 - analysis, 75–8
 - behavioral sequences and, 88–9
 - function, 76, 146, 165–7, 276–7
 - behavioral variation and, 525–6
 - characteristics of, 307
 - for common schedules, 168–72
 - natural, 307–9
 - loop, 76
 - negative, 243
 - phase lag and, 90
 - punishment and, 156–61
 - rewards and, 156–61
 - system, 145
 - use of, 86, 88–90
- feeding regulation, 175–204
 - analogy with cross-country travel, 178
 - body weight effects on work schedules in, 197–8
 - factors in, 179
 - finickiness and, 191
 - homeostasis and, 175–9
 - human obesity and, 200–2
 - improved defense of low settling weights in, 194
 - linear model
 - derivations, 202–3
 - limitations, 199–203
 - meal availability and, 178
 - motivational effects in, 198–9
 - obesity and, 179–81
 - poor adaptation to work requirements in, 194–7
 - regulatory model, 185–91
 - reinforcement and, 175–9
 - response to diet dilution, 191–2
 - taste effects on work schedules in, 197–8
 - weak defense of settling weight in, 192–3
- Fenton, M. B., 468
- Fersen, L. von, 367
- Ferster, C., 245
- Fields, L., 251
- fight or flight reactions, 506
- fighting, shock-induced, 486–90
- final cause, 96, 138–9
- finickiness, 191
- finite-state systems, 125–7
- Fitch, F. B., 98
- fixed-interval clock, 535
- fixed-interval responding, 410
- fixed-interval schedule, 150, 151, 268–9
- fixed-ratio schedule, 147, 408–9
- fixed-time contingency, 535
- fixed-time schedule, 155
- Flavell, J. H., 569, 577
- flexion, 45
- flexor muscles, reciprocal innervation of, 53
- flight, in aphid, 56–7
- flounder (*Bothus lunatus*), 10
- food rate, as function of loop gain, 190
- Foote, A. L., 571
- foraging, 287–312
 - in depleting food source, 312
 - diet choice and, 290–2
 - ecological implications, 302–5
 - effect of prey density on prey risk, 310–11
 - functional response, 288–90
 - misses and false alarms in, 300
 - natural feedback functions in, 307–9
 - nutrient constraints and sampling in, 305–7
 - profitability of food item, 290
 - rate, 279
 - ROC analysis, 297–301
 - search image and, 296–7
 - selection/variation and, 8–9
 - switching and, 292–6
- Ford, E. B., 303
- forgetting, 445
- Fourier, J., 82
- Fourier analysis, 81
- Fraenkel, G., 29, 67, 68, 73–4
- framing, 274–5
- Franck, D., 303
- Frank, J., 424
- Fredericks, S., 267
- free reinforcers, 396–7
- free-behavior point, 210, 212, 213
- freedom, 135
- freezing (behavior), 547, 550
- frequency analysis, 80–5, 86, 88–90, 100
- frequency-dependent selection, 91
- Freud, S., 577
- Friedman, M. P., 304
- Fringilla coelebs*, 16
- frogs, prey-catching response of, 45
- fruit flies, 11, 13
- frustration effect, 402
- frustrative nonreward, 402
- functional explanation, 6, 7–8
- functional response, switching and, 311
- Gade, C., 251

- gain plot, 82
- Galanter, E., 419
- Galef, B. G., Jr., 468
- Galton, Francis, 20
- game theory, 91
- gap procedure, 413
- Garcia, J., 468, 483
- Garrulus garrulus*, 295
- Gasterosteus aculeatus*, 22, 446
- gemmules, 20
- Gendron, R., 298
- generalization
 - definition of, 123
 - gradients, 319, 323, 374
 - decremental, 324
 - excitatory, 324
 - testing, 322, 324
- genes, protein coding by, 11
- genetic assimilation, 13–17
- genome, 11
- genotype, 11–12
- geotaxis, 92–3
- gestalt theory, 366
- Gharib, A., 251
- Gibbon, J., 161, 400, 439, 503
- Gibbs, C. M., 558
- Gigerenzer, G., 275
- Gill, C. A., 372
- Gleick, J., 338
- global optimizing, 262
- glucostats, 177
- goals, 96
- Gold, L., 439
- golden hamsters (*Mesocricetus auratus*), 238
- golden plover (*Pluvialis dominicus*), 16
- goldfish, 262, 263
- good, definition of, 135
- Google, 2
- Gottlieb, Gilbert, 20–1
- Gould, C. G., 458–60
- Gould, J. L., 458–60
- Gould, S. J., 10
- Grace, R. C., 259, 384, 397
- gradient descent/ascent, 28–9, 262, 441
- great tits (*Parus major*), 308, 464–5
- Green, L., 229, 264, 267
- Greene, S. L., 568
- Greenwood, M. R. C., 195
- Grindley, G. C., 144
- Grossberg, S., 397
- Guilford, T., 301, 447
- Gunn, D. L., 29, 67, 68, 73–4
- Guthrie, E., 137, 141, 345
- Guttman, N., 324, 365, 472
- habit, 99, 530
- habitat preference, 135
- habituation, 47–52, 445
 - conditioning model and, 491
 - definition of, 322
 - dishabituation and, 117
 - equations, 50
 - latent learning and, 461, 462
 - learning and, 116–17
 - memory element in, 108
 - rate sensitivity, 48–52
 - recovery, 48
 - short-term memory and, 48
- Haecckel, Ernst, 10
- Haematopus ostralegus*, 295
- Hake, D. F., 486
- Haldane, A., 441
- Hall, G., 474, 476, 483, 494, 495, 540
- Hall, M., 98
- Hamilton, B., 280, 372
- Hamlin, P. H., 394
- Hammer, M., 458–60
- hammerhead sharks, 72–3
- Hampton, R. R., 570, 574–5
- handling time, 290
- hand-shaping, 503
- Hanna, E. S., 258
- Hanson, S. J., 517
- Harlow, H. F., 423
- harmonics, 82
- Harrison, R., 418, 433
- Harsanyi, J., 91
- Harzem, P., 251, 394
- Hassell, M. P., 290
- Hatten, J. L., 411
- Hawaiian honeycreepers (*Loxops virens*), 309
- Hearst, E., 522
- heat shock, 15
- heat stress, venation effects of, 14
- hedgehog, 472
- hedonic stimuli, 517–18
- helplessness, learned, 550–4
- Hemimysis lamornei*, 74
- Henton, W. W., 206, 508
- hermit crabs, 74
- Herrnstein, R. J., 207–8, 243, 244, 245, 268, 323, 380, 381, 383, 384, 394–5, 537
- Hetherington, A. W., 181
- Higa, J. J., 400, 408, 427
- Hilgard, E., 136
- hill climbing, 28–9, 262, 441
- Hinde, J., 235, 239
- Hinde, R. A., 235, 239, 323
- Hineline, P. N., 546
- Hinson, J. M., 206, 280, 355, 359
- Hirsch, E., 182, 186, 188, 394
- Hirsch, J., 195
- histones, 20
- historical systems, 125

- Hoebel, B. G., 182
- Hogan, J. A., 237
- hold procedures, 261
- Holland, P. C., 403
- Holling, C. S., 288, 302
- Holling's disk equation, 288
- Holman, G. L., 186
- Holt, D. D., 267
- homeostasis
 - definition of, 176
 - feeding regulation and, 175–9
- homologous structures, 13
- honeybees (*Apis mellifera*), 572–3
 - learning in, 458
 - signal-learning in, 481–3
- Honig, W. K., 182, 188, 358, 362, 542, 546
- Honzik, C. H., 461, 462, 564
- hop (*Humulus lupulus*), 24
- horizontal-line stimulus, 413
- Horner, J. M., 255
- Horton, G. P., 141
- Houston, A., 206, 226, 263, 305, 312
- Hovland, C. I., 98, 422
- Huber, L., 568
- Hughes, C. E., 259
- Hull, C. L., 98, 137, 370
- Hullian neobehaviorism, 138
- Hulse, S. H., 433
- human choice, 269–76
- Humulus lupulus*, 24
- hunger, 135
- Hurwitz, H. M. B., 206
- Hutchings, C. S. L., 237
- Hutchinson, R. R., 486
- Huxley, Thomas H., 274
- hyperbolic discounting, 267
- hyperphagia, 180
- hypothetico-deductive method, 125, 128
- hysteresis, 65
- IBM, 341
- immediate induction, 55
- Impekooven, M., 303
- imprinting, 15, 21, 446–50
- incentive, 175, 215
- income effect, 211–13
- indifference curves, 226–8
- indirect orientation, 26
- induction, 125, 128
- inductive method, 125, 128
- infancy in animals, lengthening of, 2
- infants, reversal learning in, 426–8
- inference, 463–7, 486–90
 - Bayesian, 466–7, 487, 490
 - behavioral variation and, 512–15
 - transitive, 367–8
- information hypothesis, for observing behavior, 553
- information theory, 115–16
- inheritance, Lamarckian, 14, 17, 20
- inhibition, 62–6
 - below zero, 64
 - lateral, 70
 - in nervous system, 63
 - reflex strength and, 62–6
- inhibitory conditioning, 163
- inhibitory control, 345–6
- inhibitory gradients, 356–9
- inhibitory temporal control, 403–5
- initial conditions, 77
- initializing event, 261, 262
- innate behavior, 2
- innate releasing mechanisms (IRMs), 323
- Innis, N. K., 280, 373, 400, 415
- input, feedback analysis, 76
- insight, 564–6
- instrumental learning, 121. *See also* learning
- instrumental response, 209–10
- insulin, 35
- integral control, 77
- Integrative Action of the Nervous System, The* (Sherrington), 39
- intelligence, incompatibility with determinism, 40–1
- intention movements, 473
- intentional systems, 4
- intercalation, 411
- interim activities, 352, 509
- interim responses, 347–8
- interlocking schedules, 169–71
- intermittent reinforcement, 143
- internal state, 125, 127, 134
- interresponse time (IRT), 170
- interstimulus interval (ISI), 48, 51–2, 63
- intertemporal effects, 353
- intertemporal utility maximization, 356
- intertrial interval, 163
- interval schedules, 168–9
- isopreference curve, 227
- isosensitivity curve, 299
- isotropy, 29
- Iversen, I. H., 206, 508
- jays (*Garrulus garrulus*), 295
- Jazz (dog), 398–9
- Jenkins, H. M., 320, 346, 503
- Jennings, H. S., 34, 35, 104
- Johnson, D. F., 175
- Johnson, R. R., 195
- Jones, C. D., 319
- Jost-Mach concept, 422
- Jost's Law, 422, 555
- Weber-Jost principles, 428
- Jozefowicz, J., 268, 400, 405, 571
- Junco oreganus*, 451
- just noticeable differences (JNDs), 319

- Kacelnik, A., 249, 464–5, 566
 Kagel, J. H., 229
 Kahneman, D., 270, 271, 272, 273, 275
 Kalat, J. W., 307
 Kalish, H. I., 324
 Kamil, A. C., 296–7, 300
 Kamin, L. J., 474
 Kanarek, R., 182, 188
 Keasar, T., 249
 Keesey, R. E., 195
 Keith-Lucas, T., 472
 Kekulé, A., 566
 Kelleher, R. T., 542
 Kello, J. E., 373, 402, 517
 Kennedy, G. C., 184
 Kennedy, J., 36
 Killeen, P., 301, 400, 504, 505, 517, 519, 527,
 539
 Kimeldorf, D. J., 468
 kinesis, 26
 behavior, 35–7
 indirect orientation, 26
 neurophysiology, 35–7
 simple orientation mechanisms, 24–6
 King, A. P., 321
 King, B. M., 182
 Klaes, M. A., 273
 Klein, F. F., 321
 klinotaxis, 67–70
 Kluge, L., 182
 knuckle calluses, 13–14
 Koch, W. K., 139
 Koelling, R. A., 468
 Koffka, K., 421
 Köhler, W., 564–6
 Kolata, G. B., 201
 Konishi, M., 451
 Konorski, J., 502
 Koshland, D. E., 29
 Kraly, F. S., 199
 Krames, L., 439–40
 Krebs, J. R., 249, 464–5
 Kreith, M., 451
 Kroodsma, D. A., 452
 Kuo, Zing-Yang, 20
 Kurashige, N., 249
 Kuwata, S., 249
 Kwok, D. W. S., 469
 Lakshminarayanan, V. R., 274
 Lamarck, Jean-Baptiste, 17
 Lamarckian inheritance, 14, 17, 20
 Lancaster, K., 226
 Landauer, T. K., 471
 language learning
 in children, 567
 vs. learning in animals, 568
 Laplace transform, 99–100
 Lashley, K., 88
 latency, 125
 distribution, 44
 reflex, 44–5
 latent inhibition, 488, 494
 latent learning, 461
 lateral inhibition, 70
 Laties, V. G., 501
 Lavoisier, Antoine, 17
 law of effect, 245, 246, 258–9
 Le Fanu, J., 181
 Lea, S. E. G., 307
 learned behavior, 2, 99
 learned helplessness, 236–7, 240, 550–4
 learning, 3, 485, 501–31
 associative, 124, 457
 Bayes' rule, 466–7
 in bees, 458
 behavioral variation and, 511–29
 classification and, 478–84
 in dogs, 568
 dynamics, 429–43
 expectation and, 478–84
 habituation, 116–17
 inference and, 463–7
 instrumental, 121
 memory and, 459
 methodology, 477–8
 operant behavior and, 112–15
 order of, 472
 partial reinforcement and, 465–6
 vs. performance, 445, 460–3
 probability, 260–2, 263
 procedures, 532–62
 concurrent-chained schedules, 536–9
 conditioned emotional response, 542–4
 conditioned reinforcement, 532–6
 extinction, 554–62
 learned helplessness, 550–4
 quasi-reinforcement, 539–41
 response-produced shock, 548–9
 second-order schedules, 541–2
 as program assembly, 459–60
 pseudoconditioning, 118–19
 reinforced, 446. *See also* inference
 reinforcement and, 460–3
 reversal, 255
 sensitization, 117–18
 serial-position effect and, 428
 spatial, 430–43
 superstitious behavior, 506–11
 surprise and, 473–7
 taste-aversion, 467–73
 template, 445–56
 types of, 116
 without errors, 365

- learning curves, 139
- learning set, 423–9
- Leas, S. E. G., 234–5
- Lee, R., 251
- Lehrman, D. S., 235, 239
- Lepomis macrochirus*, 290
- lesions
 - effects on eating, 182–5
 - experiments, 181–2
 - TV-set problem analogy, 181–2
- ventromedial hypothalamus, 180–1, 182–5, 186, 191, 195–7, 199, 201
- Lett, B. T., 439–40
- lever pressing, 238
- Levine, D., 206
- Levine, M. W. A., 186
- light-compass reaction, 73–4
- lightning strike, 16
- Lindzey, G., 245
- linear systems, 81
 - analysis, 99–101
- linear waiting, 408
- lipostats, 177
- Littorina*
 - behavioral variation in, 134
 - Fraenkel's behavior analysis of, 92–3
- Livesey, E. J., 469
- local contrast, 371
- local memory, 98, 132
- local optimizing, 262
- Lockhead, G. R., 334
- Locurto, C., 439, 503
- locusts, walking behavior in, 56–7
- Loewenstein, S., 267
- Logan, F. A., 465
- Logue, A. W., 251, 258
- Lolordo, V. M., 544
- long-term memory, 114, 124
 - synchronous, 132–3
 - temporal, 132–3
- lose-shift pattern, 261
- loss, 270
- Lourenço, O., 427
- Loveland, D. H., 244, 323, 381
- Lowe, C. F., 226, 251, 394
- Loxops virens*, 309
- Luce, R. D., 245
- Lucilia sericata*, 67–9
- Ludvig, E. A., 266, 408
- macaque monkeys (*Macaca mulatta*), 573–4
- MacCorquodale, K., 139
- Macdonall, J. S., 249
- MacEwen, D., 266
- Macfadyen, A., 302
- Mach, E., 421, 422
- Machado, A., 256, 400, 427, 429
- Mackintosh, N. J., 474, 476, 494, 495, 556
- Macnab, R. M., 29
- Madden, G. J., 267
- magazine training, 146
- maggots, 67–9
- Magnus, D., 447
- Maier, S. F., 550
- Malinowski, B., 42
- mallards, 448
- Malone, J. C., 372
- mammalian brain, 180
- mammals, motivational change in, 92
- Manabe, K., 249, 545
- Mangel, M., 287
- mantids, 89–90
- maps, 337–40
- marginal utilities, 97
- marginal value, 229–31, 277
- Marino, L., 570
- Markowitz, H., 272
- Marler, P., 21, 451, 452
- Marshall, A., 226–8
- matching
 - absolute density changes and, 293
 - biased, 278
 - contrast and, 379–84
 - definition of, 278
 - effectivity and experience in, 295
 - minimum-distance and, 378–9
 - molar laws and, 377–9
 - molaw, 377–9
 - nonrandom spatial distribution, 294
 - optimality and, 377–9
 - probability and experience in, 294–5
- matching law, 244, 278, 384
- mate selection, 448
- maternal calling, 450
- mazes, 142–3
 - radial, 431–8
 - route-finder, 441–3
 - spatial code, 433
 - spatial effects, 435–7
 - spatial situations, 438–41
 - temporal code, 433–4
 - temporal effects, 437–8
 - T-mazes, 142–3, 260, 435, 439–40, 463, 569
- Mazur, J. E., 248, 258, 572
- McCleery, R., 215
- McCloud, C., 571
- McFarland, D. J., 206, 226, 305
- McGeorge, L. W., 321
- McGinty, D., 187
- McKearney, J. W., 548
- McLean, A. P., 259, 391
- McMillan, J. C., 544
- McNamara, J., 263
- McSweeney, F. K., 384

meal moth (*Ephesia*), 72, 91
 measurement error, 129
 mechanistic explanation, 6
 Meck, W. H., 400
 Meehl, P. E., 139
Melospiza georgiana, 15
Melospiza melodia, 16, 451
 Melville, C. L., 384
 memory
 conditioned reinforcement and, 532
 definitions of, 398
 discrimination reversal and, 423–9
 extinction and, 555
 habituation and, 48
 learning and, 459
 learning set, 423–9
 local, 98, 132
 long-term, 114, 124, 132
 metamemory, 575
 probability learning and, 262
 prospective, 431
 reference, 419
 retrospective, 431
 short-term, 32, 48
 spatial learning and, 430–43
 strength of, 421
 temporal control and, 398–403
 temporal resolution of, 421
 time and, 398–420, 421–44
 working, 419
 Menezes, C. F., 212
 Menzel, R., 458–60
Mesocricetus auratus, 238
 metacognition, 569–77. *See also* cognition
 attaching value and, 576–7
 logic of, 572
 vs. schedule control, 573
 metamemory, 575
 metastability, 152
 metastable equilibrium, 152
 methodological behaviorism, 6
 methyl-accepting chemotaxis proteins (MCPs), 32
 Mexican axolotl (*Ambystoma tigrinum*), 10
 migratory birds, navigational ability of, 16–17
 Milgram, L., 439–40
 Milich, R. S., 201
 Miller, G. A., 419–40
 Miller, M., 186
 Miller, N., 505–6
 mind–body problem, 40–1
 minimum-distance hypothesis, 218–23, 378–9
 misbehavior, 514
 Mittelstaedt, H., 86, 88
 mixed variable-interval, variable-time (mix VI VT)
 schedule, 172
 mnemonics, 433
 molar contingencies, 509

molar dependency, 520
 molar feedback function, 147–50
 molar laws, 377–97
 Boyle's law, 384–7
 continuous model, 390–2
 contrast and, 379–84
 matching and, 377–84
 matching law and, 384
 resistance to change and, 387
Molothrus ater, 21, 321, 325
 momentary maximizing, 262, 280–5
 momentum, behavioral, 387
 monarch butterflies, 314
 monkeys, 263
 behavior allocation in, 209–11
 learned helplessness in, 236–7, 240
 metacognition in, 570, 574–5
 monotonic functions, 65
 Moore, E. F., 131
 Moore, G. E., 135
 Morgan, C., 175
 Morgan, L., 137
 Morgenstern, O., 231
 Mosteller, F., 246
 Mostofsky, D., 262
Motacillidae, 309
 Motherall, S., 279
 motivation space, 231
 motives, 96
 Moura-Neto, H., 117
 Mozart, Wolfgang Amadeus, 15
 Mueller, C. G., 139
 Muenzinger, K. F., 569
 multidimensional scaling, 340–1
 multiple time-scale model (MTS), 51–2
 multiple VI–VI, 381, 391
 multiple VI–VI–VT, 391–2
 Murdoch, W. W., 288, 293, 302, 303
 Murph (monkey), 573–4
 Myerson, J., 267
Mysis, 92
 Napier, J., 99
 Nash, J., 91
 nature–nurture controversy, 16
 Navarick, D. J., 264
 Nazis, 19
 negative contingencies, 162, 170
 negative feedback, 243
 negative geotropism, 25
 negative peak shift, 365
 negative reinforcement, 212
 negative reinforcer, 117, 141
 neophobia, 450, 468
 nervous system, inhibition in, 63
 net present value, 267
 Neuringer, A. I., 540

- neurophysiology, 35–7
- neuropile, 36
- neutral equilibrium, 152
- Nevin, J. A., 281, 371, 384, 387, 388, 397, 466
- new learning model (NLM), 496–9
- Newton, Isaac, mathematico-deductive method of, 98
- niche, 1
 - adaptation and, 1
- Nicolaïdis, S., 186
- Nisbett, R. E., 182–5
- Nissen, H. W., 418, 433
- noise, 44
- non-exclusive choice, 291
- nonpasserine birds, 454
- Norborg, J., 542
- Nottebohm, F., 451
- novel tastes, conditioning to, 488
- Novin, D., 195, 199
- Nowicki, S., 449
- Oaten, A., 289, 302
- obesity, 179–81
 - human, 200–2
 - in rats, 191, 194–7
- objective function, 216
- occasion setting, 402–3
- Oceanites oceanicus*, 16
- octopi, 317
- O'Donoghue, T., 267
- Odum, L. L., 267
- Ogawa, T., 249
- Oliver J. C., 467
- Olton, D. S., 340, 433
- omission schedule, 171
- omission training, 503
- On Growth and Form* (Thompson), 11
- one-way avoidance, 545
- ontogeny, 9–10
- open economies, 175. *See also* closed economies
- operant, 52, 122
- operant behavior, 102–34. *See also* behavior
 - B. F. Skinner and, 102–4
 - causal analysis of, 104–7
 - classical conditioning and, 116, 503–6
 - control by consequences in, 103–4
 - definitions of, 102–4
 - finite-state systems and, 125–7
 - fixed-interval schedule and, 151
 - functional analysis of, 104–7
 - historical systems and, 125
 - homeostasis, role in, 176
 - information theory and, 115–16
 - learning and, 112–15
 - operant conditioning and, 116
 - origins of, 503–6, 511–29
 - parallel models, 108–12
 - in *Stentor*, 104–7
- operant conditioning, 120–1, 138, 457. *See also*
 - classical (Pavlovian) conditioning
 - behavioral variation and, 512–15
 - vs. classical conditioning, 512
- operant response, 121
- opportunity cost, 449
- Opsahl, C. A., 199
- optimal choice, 259–60
- optimal sequence, 262
- optimality analysis, 539
- optimality theory, 7, 216, 554
- Oregon junco (*Junco oreganus*), 451
- orientation reflex, 45
- orienting reflex, 490
- Osborne, S. R., 517
- Osgood, C. E., 98, 136, 556, 569
- Osorio, D., 319
- Oster, J. F., 215
- output, feedback analysis, 76
- overmatching, 394, 537
- overshadowing, 415, 470, 497
- Oxytricha*, 34–5
- oystercatchers (*Haematopus ostralegus*), 295
- paired-baseline conditions, 209
- paleontology, 125, 128
- Palmer, R. G., 256, 429
- pangenesis, 17
- Panksepp, J., 182
- parallel models, 108–12
- Paramecium*, 33, 34–5, 92, 315
 - avoiding reaction of, 38
 - operant behavior in, 176
- Parkinson, J. S., 31
- partial reinforcement, 465–6, 556
- partial-reinforcement extinction effect, 556, 558–60
- Parus major*, 144, 308, 464–5
- Pascal, Blaise, 15
- Passeriformes*, 454
- patches, depletion of, 276–7
- pattern, 463–4
- Pavlov, I. P., 154–5, 243, 501
- Pavlovian conditioning. *See* classical (Pavlovian) conditioning
- payoff, probability of, 285–6
- peak shift, 359–69
- peak-interval procedure, 413
- Pearce, J. M., 476, 495
- Pearce-Hall model, 495
- Peck, J. W., 184–5, 195
- pecking behavior, 207–8, 347–8, 404, 553
- Peden, B. F., 522
- Penney, J., 526
- Pennypacker, H. S., 358, 362
- performance, vs. learning, 445, 460–3
- performance measure, 552

Perkins, D. T., 98
 Perry, C., 572–3
 Peterson, C., 251, 258
 Peterson, N., 123
 Petrograd Military Medical Academy, 154
 Pfeffer, W., 26
 phase plot, 82
 phasic reflex, 45
 phonemes, 15
 photoreceptors, 325
 phototaxis, 70–3, 92–3. *See also* direct orientation
 phototropism, 25
 phylogeny, 9–10
 physics, 125, 128
 Piaget, J., 367, 427
 Picton, B. M. B., 474
 Pietrewicz, A. T., 300
 pigeons
 delayed gratification in, 264–5
 fixed-interval responding in, 410
 intention movements, 473
 metacognition in, 575
 Pavlovian conditioning, 274–5
 pecking behavior, 207–8, 404, 553
 quasi-reinforcement in, 29
 reinforcement-omission effect, 400
 response-reinforcer contiguity in, 519–20
 reversal learning in, 424
 sign-tracking in, 347–8
 superstitious behavior in, 351
 wing flapping in, 236, 239
 Pilley, J. W., 567–8
 Pinker, S., 449
 Pittendrigh, Colin, 7
 Pitts, R. C., 259
Pluvialis dominicus, 16
 polar cytoplasm, 11
 polydipsia, schedule-induced, 236, 239
Porcellio, 92
 position habit, 260
 positive contingencies, 162
 positive peak shift, 365
 positive reinforcer, 141
 postdiscrimination gradient, 364–5
 post-discrimination phase, 384
 postreinforcer preference pulses, 258
 post-response time, 327
 Poulton, E. B., 304
 Powley, T. L., 195, 199
 precocial birds, 15, 21, 446, 450
 predator-prey system
 cryptic preys in, 296–7, 302–5
 ecological implications, 302–5
 effect on prey density on prey risk, 310–11
 functional response of, 288–90
 misses and false alarms in, 300

predator rate, 288
 prey frequency, 300–1
 switching in, 292–6
 predictability, 158
 pre-discrimination phase, 349, 386
 preference
 isocline, 227
 pulses, 258
 revealed, 214
 structure, 136, 214, 227, 231
 Premack, D., 206, 209, 212
 Preston, R. A., 265
 preys. *See* predator-prey system
 Pribram, K. H., 419
 primary drives, 135
 proaction, 418, 421
 proactive interference, 411
 probabilistic insurance, 272
 probability distribution, 122
 probability learning, 260–2, 263
 program assembly, learning as, 459–60
 prospect theory, 271–5
 editing phase, 271–2
 evaluation phase, 272
 framing and, 274–5
 role of consciousness in, 273–4
 prospective memory, 431
 proteins, 11
 protozoans
 information processing in, 115, 116
 operant behavior, 104
 proximal causes, 96
 proxy measures, 552
 Prudic K. L., 467
 pseudoconditioning, 118–19. *See also* conditioning
 pseudodiscrimination, 493
 psychophysics, 319
Pterophyllum scalare, 10, 446
 Pulliam, H. R., 287
 punisher, 117
 punishment, 135–74. *See also* rewards
 classical conditioning and, 154–5
 contingency and, 156–61
 contingency space, 161–3
 equilibrium states and, 151–3
 experimental methods, 142–4
 feedback functions and, 156–61, 165–7
 response contingencies and, 165–7
 response to, 170
 temporal conditioning and, 163–5
 trace conditioning and, 163–5
 purpose, 96–7
 Pyke, G. H., 287
 Quartermain, D., 195
 quasi-reinforcement, 539–41

- rabbits, 472
- Rabbitt, P., 304
- Rachlin, H., 139, 229, 264, 372
- radial maze, 431–8
 - route-finder, 441–3
 - spatial code, 433
 - spatial effects, 435–7
 - spatial situations, 438–41
 - temporal code, 433–4
 - temporal effects, 437–8
- radiological behaviorism, 6
- random walk, 400
- random-interval schedule, 279, 406
- random-ratio choice, 247–9
 - identical, 249–56
 - preference patterns and, 251–4
- random-ratio schedules, 246, 406
- Ranson, S. W., 180, 181
- Rashkovich, E., 249
- Ratcliffe, J. M., 468
- rate sensitivity, habituation, 48–52
- ratio schedules, 168
- rats
 - adaptation to work requirements, 194–7
 - autonomic responses in, 505–6
 - autoshaping in, 320
 - behavior allocation in, 209–11
 - conditioned emotional response in, 542–4
 - discriminative stimuli and, 402–3
 - finickiness of, 191
 - food reinforcement in, 231–5
 - hyperphagia in, 180
 - insight in, 568
 - latent learning in, 461, 462
 - learned helplessness in, 568
 - neophobia in, 468
 - obesity in, 191, 194–7
 - order of learning in, 472
 - pseudoconditioning in, 119
 - radial-maze performance of, 431–8
 - ratio schedules, response to, 188
 - reinforcement-omission effect, 400
 - response to diet dilution, 191–2
 - response to ratio schedules, 234–5
 - schedule-induced behavior in, 526–9
 - self-reinforcement in, 97
 - shock postponement in, 546
 - shock-induced fighting in, 486
 - spatial insight in, 564
 - taste-aversion learning in, 467–73
 - time constraints and behavioral competition in, 209–11
 - ventromedial hypothalamus lesions in, 182–5, 191, 194–7, 199, 201
 - recall situation, 125, 127
- recency
 - absolute, 434
 - confusion effect, 416
 - differential, 434
 - discrimination of, 415–16
 - overshadowing effect, 416
 - reciprocal inhibition (competition), 53–4
 - reconditioning, 322
 - recovery, habituation, 48
 - Redford, J. S., 573–4
 - reductionism, 35–6
 - Reed, P., 540
 - reference memory, 419
 - reflex chains, 107
 - reflexes, 38–66
 - chain, 107, 108
 - definition of, 43
 - elicitability of, 62
 - errors caused by to time delays, 42
 - in higher animals, 38–9
 - individual, 43
 - interaction, 52–62
 - cooperation, 54–5
 - reciprocal inhibition, 53–4
 - successive induction, 55–62
 - phasic, 45
 - properties of
 - habituation, 47–52
 - latency, 44–5
 - momentum (after-discharge), 47
 - refractory period, 45
 - spatial summation, 46–7
 - temporal summation, 45–6
 - threshold, 43–4
 - receptive fields of, 46–7
 - Sherrington's concept of, 41–3
 - spinal, 39
 - strength, 43
 - inhibition and, 62–6
 - tonic, 45
 - volition and, 40–1
 - refractory period, 45
 - regression, 248
 - regulation, 176–7
 - Reid, A. K., 266, 338, 442, 513, 567–8
 - Reid, R. A., 442
 - Reid, T., 570
 - Reilly, S., 468
 - reinforced learning, 446, 463. *See also* inference
 - reinforcement, 97
 - adventitious, 507, 510
 - conditioned, 532–5, 536
 - constraints, 235–40
 - contingencies, 209
 - continuous, 146, 556
 - definition of, 140, 211

reinforcement (*cont.*)
 experiments, 142–4
 feeding regulation and, 175–9
 free, 396–7
 intermittent, 143
 law of effect and, 137–42
 learning and, 460–3
 matching and mixing, 245
 negative, 212
 partial, 465–6, 556
 principle of, 138
 punishment and, 170
 quasi-reinforcement, 539–41
 schedules, 144, 146
 response-based, 146–51
 time-based, 146–51
 Skinner box, 144–6
 stimulus control and, 326–9
 as time marker, 410
 weak, 238
 reinforcement-omission effect, 400–2
 reinforcers, 117, 141, 317
 conditioned, 532–3
 primary, 532
 proximity to, 532, 534
 secondary, 532–3
 relational database management system, 341
 relative affective value, 498
 repertoire, 512
 reproductive investment, 449
 requisite variety, law of, 94–5
 Rescorla, R. A., 156, 157, 161, 347–8, 490–1, 493–4,
 496, 507, 557
 Rescorla-Wagner model, 477, 490–1, 492, 494, 495
 response
 conditioned, 120, 154, 163
 definition of, 125, 127, 134
 feedback analysis, 76
 finite-state systems and, 125–7
 operant, 121
 origins of, 512
 unconditioned, 120, 154
 response contingencies. *See also* contingency
 response contingencies, 165–7, 174
 detection of, 172–4
 response function, 188, 219, 556
 bliss point, 225
 characteristic space, 226
 experimental applications, 231–5
 marginal value and, 229–31
 prediction of, 223–6
 reinforcement constraints and, 235–40
 substitutability, 226–8, 229–31
 response rule, 434–5
 response-cost model, 202
 response-initiated delay (RID), 148, 409
 response-produced shock, 548–9

response-reinforcer contiguity, 519–23
 restriction effect, 211, 505
 retroaction, 418, 421
 retroactive interference, 413
 retrospective memory, 431
 revealed preference, 214, 231
 reversal learning, 255. *See also* learning
 days off, 426
 first reversal, 425–6
 in human infants, 426–8
 spontaneous, 425
 Revusky, S. H., 439–40, 459, 469
 rewards, 135–74. *See also* punishment
 classical conditioning and, 154–5
 contingency and, 156–61
 contingency space, 161–3
 delay reduction and, 266
 effect on animal's internal state, 460–1
 equilibrium states and, 151–3
 experimental methods, 142–4
 feedback functions and, 156–61, 165–7
 response contingencies and, 165–7
 single-assignment, 261
 temporal conditioning and, 163–5
 trace conditioning and, 163–5
 Reynolds, G., 349, 381, 391, 405
 Rhesus monkeys, 574–5
 Richardson, M. W., 334
 Rico (pet collie), 567
 Rider, D. P., 269
 Riley, A. L., 544
 Riley, D. A., 301, 431
 ring doves (*Streptopelia risoria*), 454
 risk, 268–9
 aversion to, 269, 571
 behavioral economics and, 269–76
 human choice and, 269–76
 risk-seeking behavior, 268
 Ritland, D. B., 467
 Roberts, S., 251
 Roberts, W. A., 434
 Roche, J. P., 571
 Rodin, J., 201
 Roper, T. J., 234–5, 237, 353
 Rosenbluth, A., 96
 Ross, R. T., 98
 Rothkopf, E. Z., 340
 Rothstein, B., 373
 route-finder, 441–3
 Rowland, N., 186
 Rozin, P., 307
 rudimentary organs, 9
 Rudy, J. W., 472
 Russek, M. A., 199
 safety signal, 487
 safety stimulus, 474, 476

- Sainsbury, R. S., 346–7
- salience, 421
- Salmonella*
 - adaptation in, 30
 - chemotaxis in, 26
 - movement in, 29
- sampling
 - behavioral variation and, 515–16
 - vs. exploitation, 551
- Sanabria, Y. M., 400
- Santi, A., 572
- Santos, L. R., 274
- satiation, 370, 408
- satisfaction, 140
- satisfier, 141, 155
- scalar timing, 400
- Schachter, S., 201
- Schachtman, T. R., 468
- schedules
 - activities, schedule-induced, 353–6
 - avoidance, 171
 - behavior, schedule-induced, 526–9. *See also* variable-interval schedule
 - chained, 532, 533
 - concurrent chain, 264, 292
 - concurrent-chained, 536–9
 - escape, 171
 - fixed-interval, 150, 151, 268–9
 - fixed-ratio, 147, 408–9
 - fixed-time, 155
 - function, 146
 - interlocking, 169–71
 - interval, 168–9
 - multiple, dynamic effects in, 369–74
 - omission, 171
 - random-interval, 279, 406
 - random-ratio, 246, 406
 - ratio, 168
 - second-order, 541–2
 - tandem, 533
 - variable-interval, 156, 207–8, 257–9, 265–6, 268–9, 278–85
 - variable-ratio, 147
 - variable-time, 211, 388–9
- Scheier, C., 427
- Schick, K., 134
- Schleidt, W., 117
- Schneider, B. A., 399
- Schoener, T. W., 287
- Schoenfeld, W. N., 139
- Schöner, G., 427
- Schull, J., 526
- Sclafani, A., 182, 202
- sea snail (*Littorina neritoides*), Fraenkel's behavior
 - analysis of, 92–3
- search engines, 2
- search image, 296–7
- incompatibility of, 302
- Searcy, W. A., 449
- Sechenov, I. M., 39
- second-order schedules, 541–2
- selection, 6
- kineses
 - behavior, 35–7
 - indirect orientation, 26
 - neurophysiology, 35–7
 - simple orientation mechanisms, 24–6
- measure, 552–3
- rules, 519–29
- self-control, 263–8
- self-fulfilling prophecy, 551
- Seligman, M. E. P., 550
- Selten, R., 91, 275
- sensitization, 46, 117–18, 370, 445, 472
- sensory adaptation, 70
- serial-position effect, 428
- servomechanism, 85–8
- settling, in aphid, 56–7
- Seward, J. P., 463
- sex, 135
- sexual dimorphism, 449
- sexual selection, 449
- Shallice, T., 431
- Shalter, M. D., 117
- Shannon, C., 94
- shaping, 523–5
- sharks, 72–3
- Shaw, E., 235, 239
- Shaw, George B., 155
- sheep dogs, 15
- Shepard, R. N., 334, 335, 340
- Sherrington, C. S., 39, 41–3
- Shettleworth, S. J., 235, 239, 308, 371, 506, 572
- Shimp, C. P., 280, 372
- Shizgal, P., 266
- Shmida, A., 249
- shock
 - conditional probability of, 160
 - response-produced, 548–9
- shock postponement, 171–2, 546
- shock-induced fighting, 486
- shocks, 544–8
- Shull, R. L., 397, 411
- Sidman, M., 244
- Sidman avoidance, 171–2
- sign stimuli, 316
- sign tracking, 347–8, 520
- signal-detection procedure, 416
- Silberberg, A., 280, 372
- silent responses, 275
- Silverman, A. C., 362
- similarity, 319, 334–7

- Simmelhag, V. L., 235, 239, 351, 509
 Simon, H. A., 433
 simple orientation mechanisms, 24–6
 single-assignment procedures, 261
 situation, 125, 128
 situation-induced behavior, 513
 Skinner, B. F., 6, 36, 134, 138, 144, 146, 156, 243,
 244, 245, 315, 501, 506–11, 543
 operant behavior and, 102–4
 Skinner box, 138, 144–6, 355
 skototaxis, 75
 Skuce, J. C., 557
 sleep, 135
 Slevin, J. R., 267
 Slobin, P., 438
 slugs, 93
 Smith, J. D., 573–4, 576
 Smith, J. M., 91
 Smith, L. B., 427
 Snow, C. P., 577
 Snowdon, C. T., 186
 sociology, 125, 128
sollwert, 96
 song learning, 451–5
 song sparrow (*Melospiza melodia*), 16, 451
 sowbug, 92
 space responding, 152
 spaced-responding schedules, 406
 Spalding, D. A., 446
 spatial code, 433
 spatial effects, in radial mazes, 435–7
 spatial insight, 564–6
 spatial learning, 430–43
 spatial summation, 46–7, 53
 spatial tasks, 143
 species identification, 21
 species-specific defense reactions, 514
 specific searching image, 295
 speech, learning, 15
 Spence, K., 138, 366–7
 Spencer, H., 137
 Sperry, R. W., 86, 88
 spinal contrast. *See* successive induction
 spinal reflexes, 39
 split-brain patients, 577
 spontaneous alternation, 260, 435
 spontaneous recovery, 248, 555
 spontaneous reversal, 425
 Springer, D., 182, 202
 Squires, E., 251
 Squires, N., 258, 539, 542
 squirrels, 548
 Srinivasan, M. V., 338
 stable equilibrium, 152
 Staddon, J. E. R., 179, 182, 188, 190, 197, 206,
 226–8, 235, 239, 245, 255, 256, 266, 268, 273,
 279, 280, 298, 315, 321, 338, 351, 352, 355,
 366, 367, 372, 373, 394, 397, 399, 400, 403,
 405, 407, 408, 410, 412, 414, 415, 424, 427,
 428, 429, 447, 460, 509, 510, 513, 522, 526,
 546, 571
 Starr, B., 414
 starvation, 19
 steady-state solution, 77
 steepest-ascent method, 28
 Steirn, J. N., 368
 stem cells, 10
Stentor, 93, 103
 avoidance behavior of, 108–9
 mechanisms, 111–12
 temporal decision rule, 110
 time-concentration decision rule, 111
 “breaking away” behavior, 108
 effect of carmine on behavior of, 104–7
 learning behavior of, 112–15
 operant behavior in, 104–7, 176
 poor long-term memory of, 114
 sensitization in, 118
 “turning away” behavior, 108
 step input, 86, 88
 Steurer, F., 568
 Stevens, S. S., 335, 422
 stickleback (*Gasterosteus aculeatus*), 22, 446
 stimulus, 140
 compound, 474
 conditioned, 120, 154, 163–5, 467, 473, 474, 476,
 544
 contingency, 159
 defining, 124–5
 definition of, 125, 134
 dimension, 325
 discriminative, 117, 121, 314–16
 effects, 374–5
 elements, 325–6
 eliciting, 314–16
 finite-state systems and, 125–7
 generalization, 53, 316, 323
 hedonic, 517–18
 hedonic and nonhedonic qualities of, 116
 horizontal-line, 413
 multidimensional property of, 414
 sign, 316
 supernormal, 447
 unconditioned, 117, 120, 141, 154
 stimulus control
 attention and, 326–9
 behavioral contrast and, 347, 348–51
 cognition and, 313–44
 conjoint, 359–69
 definition of, 460
 discrimination performance and, 347, 348–51
 dynamic effects in multiple schedules, 369–74
 excitatory, 332, 345–6
 feature effects, 346–8

- inhibitory, 332, 345–6
- inhibitory generalization gradients, 356–9
- intertemporal effects, 353
- maps, 337–40
- measuring, 320–3
- multidimensional scaling and, 340–1
- peak shift and, 359–69
- performance and, 345–76
- reinforcement and, 326–9
- schedule-induced behavior and, 351–3
- similarity and, 334–7
- spatial representation as data structure in, 341–3
- variation and, 326–9
- stimulus equivalence, data structure and, 316–20
- stopping rule, 28
- strength, reflex, 62–6
- Streptopelia risoria*, 454
- Stubbs, D., 416
- Sturmy, P., 251
- subjective value, 139
- subsong, 451
- substitutability
 - indifference curves and, 226–8
 - marginal value and, 229–31
- substitution, marginal rate of, 229–30
- substitution effect, 211–13
- successive discrimination, 331
- successive induction, 45, 55–62. *See also* reflexes
 - in aphid flight and settling, 56–7
 - extension reflex of dog's hind limb, 55
 - in larval zebrafish, 59–61
 - in locust locomotion, 57–8
 - model, 59–61
- sun-compass orientation, 73–4
- superconditioning, 474, 476, 493
- supernormal stimuli, 447
- superposition, 81
- superstitious behavior, 235, 239, 351, 395–6, 506–11
- suppression ratio, 157, 490
- surprise, 473–7, 490
- Sutherland, N. S., 317
- Sutton, J. E., 572
- Suzuki, S., 340, 432
- swamp sparrows (*Melospiza georgiana*), 15
- switch time, 282
- switching, 242, 292–6
 - definition of, 293
 - functional response and, 311
- switching rule, 281
- synapses, 42
- synchronous control, 132–3, 399
- system transfer function, 83
- systematic variation, 92, 93–4, 134
- Szabadi, E., 226
- Taeniopygia guttata*, 48
- Tamura, M., 451, 452
- tandem schedule, 533
- Tapp, J. C., 139
- taste, 178–9
- taste-aversion learning, 467–73
- taxis, 25, 67–75
 - klinotaxis, 67–70
 - light-compass reaction, 73–4
 - telotaxis, 74–5
 - tropotaxis, 70–3
- Taylor, P., 249, 464–5
- Teitelbaum, P., 182, 187, 195
- teleological explanation, 7
- teleonomic explanation, 7
- telotaxis, 74–5
- template, 21
- template learning, 445–56
 - imprinting, 446–50
 - song learning, 451–5
- temporal code, 433–4
- temporal conditioning, 155, 163–5, 507
- temporal contiguity, 139
- temporal control, 132–3, 398–403
 - conditions for, 405–8
 - definition of, 399
 - discrimination of recency in, 415–16
 - excitatory, 403–5
 - inhibitory, 403–5
 - proaction and, 418
 - retroaction and, 418
 - time estimation, 416–18
- temporal discounting, 266–8
- temporal discrimination, 399
- temporal effects, in radial mazes, 437–8
- temporal overshadowing, 411
- temporal summation, 45–6, 53, 370
- terminal response, 347–8, 352, 509
- Terrace, H., 365, 439, 503
- Thelen, E., 427
- theoretical behaviorism, 6
- thermotaxis, 32, 34. *See also* direct orientation
- Thielcke, G. A., 452
- thirst, 135
- Thompson, D'Arcy Wentworth, 11
- Thompson, R. L., 161
- Thorndike, E. L., 112, 137, 139–40, 245
- ticks, 316
- Timberlake, W., 571
- time, memory and, 398–420, 421–44
- time estimation, 416–18
- time marker, 399, 409–15
 - reinforcement as, 410
- Tinbergen, L., 296–7
- Tinbergen, N., 22, 117, 303, 318, 447, 562
- T-mazes, 142–3, 260, 435, 439–40, 463, 569
- Todorov, J. C., 258, 372
- Tolman, E. C., 137, 345, 433, 461, 462, 564, 569
- tonal frequencies, 325

- tonic reflex, 45
- Tooby, J., 553
- Torgerson, W. S., 334
- Torquato, R. D., 397
- Tota, M. E., 397
- total reinforcement probability, 256
- trace conditioning, 155, 163–5, 489
- training, 15
 - omission, 503
- transfer function, 100
- transfer testing, 321
- transient analysis, 86, 88–90, 100
- transitive inference, 367–8
- transitive interference, 367
- transposition, 366
- trauma-induced talent, 16
- threshold, reflex, 43–4
- trial-and-error learning, 69
- Trifolium*, 25
- Trobriand islanders, 42
- tropotaxis, 70–3
- truly random control condition, 157
- Tulving, E., 419
- turkeys, alarm reactions of, 117
- turning rate, 77
- Tversky, A., 270, 271, 273
- two-way avoidance, 545
- Uexküll, J. von, 296
- umwelt*, 296, 320, 326, 333
- uncertainty response, 571
- uncertainty-principle theorem, 131
- unconditioned response (UR), 120, 154
- unconditioned stimulus (USs), 117, 467
 - in classical conditioning, 120
 - in delay conditioning, 154
 - preexposure, 550
 - preexposure to, 488
 - reinforcers as, 141
- uncorrelated condition, 157–8
- undermatching, 284, 381
- unit impulse, 86, 88
- unsignaled avoidance, 171–2
- unstable equilibrium, 152
- urn problem, 466–7
- utility, economic concept of, 139
- utility theory, 270–1
- vagotomy, 199
- value, 214
 - associative, 490
- value-transfer hypothesis, 367
- van Kampen, H. S., 428
- variability
 - in behavior, 90
 - behavior integration and, 90–5
 - unpredictability and, 90
- variable outcomes, 268–9
- variable-interval schedule, 156, 207–8, 265–6, 268–9.
 - See also* schedules
 - concurrent, 257–9, 278–85
- variable-ratio schedule, 147
- variable-time schedule, 211, 388–9
- variation, 6
 - circumnutation, 26
 - kineses
 - behavior, 35–7
 - indirect orientation, 26
 - neurophysiology, 35–7
 - simple orientation mechanisms, 24–6
 - systematic, 93–4
 - unsystematic, 93–4
- vasoconstriction, 176
- vasodilation, 176
- Vaughan, W., Jr., 568
- venation, 13
- ventromedial hypothalamus (VMH), 180–1, 182–5, 186, 191, 195–7, 199, 201
- Verplanck, W. S., 139
- vestigial behaviors, 9
- vicarious trial and error (VTE), 569
- volition, 40–1
- von Neumann, J., 231, 273
- Wagner, A. R., 472, 490–1, 495
- wagtails (*Motacillidae*), 309
- Wallace, Alfred R., 6
- Wang, X. H., 212
- Washburn, D. A., 573–4
- Wason selection task, 553
- Watson (computer), 341, 570
- Watson, J. B., 137
- Watson, T. J., 570
- Way of all Flesh, The* (Butler), 273
- weak reinforcement, 238
- wealth, 270
- Weaver, J. E., 368
- Weaver, W., 94
- Weber, Eduard, 63
- Weber, Ernst, 63
- Weber fraction, 399
- Weber-Fechner law, 271, 335, 422
- Weber's law, 400
- Wedgwood, Emma, 242
- Wehner, R., 338
- Wells, H. G., 90
- West, M. J., 321
- West, S. A., 220
- Wheatley, K. L., 372
- White, K. G., 391, 418
- white-crowned sparrow (*Zonotrichia leucophrys*), 21, 451
- Whitlow, J. W., 472
- Wickens, C. D., 119

Index

599

- Wickens, D. D., 119
Wiener, A., 96
Wilcoxon, H. C., 139
Wilkie, D., 438
Wilkinson, N., 273
Williams, B. A., 136, 245, 354, 355, 373,
 395
Williams, D. R., 371, 502, 503
Williams, H., 503
Wilson, M. P., 231
Wilson, O. E., 215
Wilson's petrel (*Oceanites oceanicus*), 16
wing flapping, in pigeons, 236, 239
winner-take-all (WTA) competition, 65, 109, 248,
 255, 260–1, 370, 429
within-animal method, 61
within-subject method, 131
woodlouse, 92
working memory, 419
Wozny, M., 186
Wright, A. A., 428
Wynne, C. D. L., 367, 408, 563
Wyrwicka, W., 195, 199
Yates, F. A., 433
Yerkes-Dodson Law, 525
yoked-control procedure, 211
Zanutto, B. S., 179, 394
zebra finch (*Taeniopygia guttata*), 48
zebrafish (*Danio rerio*), 58–62
Zeiler, M. D., 232
zeitgeber, 133
Zener, K., 119, 157
Zentall, T. R., 368
Zhang, Y., 397, 522
Ziriax, J. M., 280
Zonotrichia leucophrys, 21, 451