
Index

- Accommodation, 126–128, 129
Activation function, 29–30, 33, 39, 67, 93
Active memory, 14, 134. *See also* Working memory; Short-term memory
ACT-R, 8, 136–137
Agent-based modeling, 251, 263
Analog representations, 117
Anderson, J. A., 44, 66, 68
Anderson, J. R., 8, 250
Applications to education, 2, 251, 260–263
Asigmoid function, 31, 33
Assimilation, 126–129
Attention-mediation theory, 243
Auto-associator, 15, 16, 26, 63, 66–67, 97, 103, 135, 156
Automatization, 131, 134
- Back-propagation, 16, 18, 25–26, 37, 41–50, 57–64, 66, 68, 70, 72, 95–96, 98–99, 103, 108, 110, 116, 129, 132, 143–144, 146, 162, 164, 185, 205–206, 211, 214–216, 231, 237, 243–244, 247–251, 254, 259, 267
Backward reasoning, 81
Balance scale, 84, 111, 115–116, 136, 143–144, 146, 152, 170, 185, 202, 212–213, 216, 223–224, 244
Bale, A. C., 66, 156, 223
Batch training, 43
- Bates, E. A., 9, 100, 110, 125, 218
Biological plausibility of models, 41, 48, 58, 247–250, 254–258
Brain imaging, 258
Buckingham, D., 63, 67, 126, 203, 205, 210
- C4.5, 71, 73, 125, 136–140, 142–144, 146, 148–152, 156–159, 171, 247
Cascade-correlation, 23, 26, 33, 45–52, 54, 56–64, 66, 72, 116, 118–119, 121, 125, 127–129, 133, 135, 137, 142, 144–150, 152, 156, 159, 161, 163–165, 168, 170–171, 179, 194–195, 201, 204–207, 210, 219, 221, 225–226, 233, 238–239, 243–245, 247–250, 252, 254, 256–263, 270
- Case, R., 125–126, 130–131, 159, 244
Challenge of computational sufficiency, 11
Chauvin, Y., 108, 185, 232
Child-centered education, 262
Chomsky, N., 236
Christiansen, C. H., 156–157, 236–237
Clark, E. V., 106, 209
Cleanup of unit activations, 102, 135
Complementary learning systems, 256
Compositionality, 90, 229–231, 233–234, 259

- Computational power, 46, 57, 61, 63, 90, 128, 161–163, 200, 204, 206, 219, 248, 253, 269
- Computational psychology, 8–9
- Concept learning, 67
- Concept-mediation theory, 242
- Conceptual mediation, 229, 239–244
- Conceptual precursors, 133, 213–216
- Conservation, 21, 77, 79, 81, 83–85, 87, 111, 116, 119, 120–121, 125, 143, 149, 150, 152, 158, 179–180, 185–186, 189, 191, 195, 197, 201–202, 206–207, 212–213, 223, 244
- Constructivism, 161, 229, 245, 252
- Content-addressable memory, 91
- Contextual cues, 261
- Continuous development, 173, 185
- Contradictory tendencies, 93, 104–106, 122, 252
- Contributions in networks, 119–121
- Corrigan, R., 188–189, 194, 200
- Cortical layers, 257
- Crispness of representations, 229, 237–239, 247
- Critical period, 265, 268
- Dayan, P., 254–255, 257
- Decision tree, 71–72, 113, 136–137, 140, 142, 147–148, 151, 157–158
- Declarative knowledge, 78, 91, 130
- Delta rule, 37, 40–41, 67, 247
- Developmental tractability, 123
- Discontinuous development, 173
- Disordered development, 2, 251, 267, 269
- Distance, velocity, and time cues, 170, 202–205, 223–224
- Distinguishing individuals, 234
- Distributed representations, 17, 104
- Double dissociation, 268
- Dynamic systems, 270
- Dyslexia, 102, 104, 260, 267
- Elman, J. L., 9, 18, 61, 64, 98, 125, 156–157, 161, 164, 166–169, 172, 217–218, 226, 236–237
- Encoder networks, 26, 63–67, 154, 231–232, 234, 247, 252, 260
- Encoding, 26, 91, 132–133, 135, 204, 214
- End of development, 24, 218
- Equilibration, 127–128
- Equilibrium, 127–128, 175
- Equipotentiality of cortex, 167
- Evolution, 46, 61–62, 162–163, 166–167, 169, 171, 175, 216–217, 219, 252, 267, 269–270
- Exceptions, 76, 93–95, 99, 100–101, 104–105, 122, 252, 256, 268
- Fahlman, S. E., 45, 49–50, 57, 59, 62, 64, 257
- Feature mapping, 26, 72, 252
- Firing-rate coding, 255
- Fischer, K. W., 130, 173, 188, 191, 200
- Flavell, J. H., 75, 125, 173, 201, 259
- Fodor, J. A., 160–165, 171, 229, 231, 233
- Forward reasoning, 81
- Fractals, 199
- Frames, 9, 18, 228, 230
- French, R. M., 47, 66, 153, 170, 231, 239
- Functional data analysis, 219, 244
- Functionalism, 20
- Gage, F., 48, 248, 256
- Generalization, 17, 62, 133, 135, 138–139, 154, 159, 162, 169, 229, 239, 248, 261–262, 265
- General-purpose learning device, 269
- Generative networks, 23, 47, 63, 161, 163, 170, 218, 252, 262
- Goldilocks, 46, 61
- Gould, E., 48, 175, 248
- Graded representations, 21
- Graham, P., 81
- Habituation, 26, 66, 67, 126, 143, 152–157, 159, 211, 231
- Hebb, D. O., 40–41, 67, 111, 247, 265

- Herd effect, 45, 50, 59
- Hertz, J., 14, 34, 49, 154, 248, 261
- Hinton, G. E., 9, 230, 278
- Hyperbolic-tangent function, 30
- Imitation, 265–267
- Imprinting, 265
- Incompleteness of computational models, 222, 227–228
- Information gain, 140, 148
- Innate determinants, 2, 11, 24, 126, 161, 166–169, 172, 212, 245, 251–252, 266–267
- Input phase training, 51–54, 57–58, 128, 165, 249
- Integration of inputs, 29
- Intentionality, 9, 222, 226, 228
- Interference, 44, 47, 63, 229, 239, 258–259
- Issues in psychological development, 1–2
- Johnson, M. N., 9, 20–21, 170, 218, 258, 265, 269
- Jordan, M. I., 64
- Kail, R., 131, 244
- Kaplan, A., 222
- Karmiloff-Smith, A., 9, 21, 133, 165, 218, 269
- Kempermann, G., 48, 248, 256
- Klahr, D., 8, 19, 83–84, 110, 113, 123, 126, 132–133, 143
- Knowledge and learning, 24, 251, 258–260
- Kohonen, T., 66, 69, 153
- Latencies of response, 67, 97–98, 102, 135
- Learning and development, 2, 126, 164–165, 172, 217
- Learning speed, 45–46, 49–50, 58–62, 261
- Length bias, 85, 87, 150, 207, 213
- Lesions, 268
- Lexical development, 188
- Linearly nonseparable problems, 25, 27, 206
- Linearly separable problems, 25, 27–28, 51, 67, 243
- Ling, C. X., 99, 136, 143–144, 146, 148, 150, 239
- Local representations, 17
- Long-term memory, 15, 18, 77, 164, 256
- MacWhinney, B., 19, 110
- Map reading, 222, 225–227, 253
- Marchman, V., 95, 98–100, 105, 218, 267–268
- Marcus, G. F., 96, 100, 105, 154–158, 161, 167, 169, 234, 239, 245
- Mareschal, D., 14, 21, 49, 50, 63, 66, 116, 126, 143–144, 153, 161, 163, 170–171, 205, 207, 211, 216, 231, 264
- McClelland, J. L., 15, 21, 36, 64, 66–67, 95, 101–102, 126, 129, 132, 143–146, 170, 206, 214, 244, 256, 264
- Minsky, M. L., 8, 47, 59, 228, 246
- Models
 - atomic, 4–8
 - in other disciplines, 8
 - qualities of, 3
 - versus reality, 9–10
- Momentum, 43–45, 50, 168
- Moving-target problem, 45, 50–51
- Munakata, Y., 21, 170, 215, 264
- Neurogenesis, 48, 52, 169, 218, 248, 256
- Neurons, 13–14, 16, 20, 23, 30, 48, 111, 167–168, 235, 248–249, 254–255, 257
- Newell, A., 8, 11–12, 76, 78, 125, 130, 136, 143, 228
- Objections to connectionism, 228–247
- Objections to learning from error reduction, 247

- Objections to modeling, 222, 227–228
 Object permanence, 68, 162, 170, 214–216
 Ocular-dominance columns, 111
 Online sampling of inputs, 263
 O'Reilly, R. C., 48, 256, 265
 Oshima-Takane, Y., 120–121, 209–210
 Output-phase training, 50–51, 53, 56, 58, 119–120, 128, 165
 Overextension of meaning, 106–107, 109
 Overfitting, 44, 138
 Overregularization, 94–96, 100, 105
 Oversimplification, 224–227
- Parisi, D., 9, 166, 217, 263, 267
 Parity problem, 59, 162
 Past tense, 91, 93–95, 97–102, 104–105, 267–268
 Pattern training, 43
 Perceptual-differentiation theory, 243
 Perceptual effects, 76, 93, 111–117, 122, 207, 209, 252
 Phoneme discrimination, 202, 210–213
 Physical growth, 174–175, 179, 195–197, 200–201
 Piaget, J., 26, 63, 75, 81–82, 126–129, 133, 152, 160–161, 165, 179, 202, 205–207, 214, 245, 252
 Pictorial realism, 222, 226–227, 253
 Pinker, S., 91, 94–96, 98, 166, 229, 233–237, 268–269
 Plasticity in brain development, 168–170, 212
 Plateaus in development, 2, 173, 175–178, 182, 185, 188–189, 194–195, 197, 200–201, 219, 244, 252–253
 Plaut, D. C., 101–102, 104
 Plunkett, K., 9, 19, 95, 99–100, 105, 110, 170, 185, 218, 232
 Pollack, J., 230
 Precursors, 2, 21, 133, 174, 213, 215–216, 253
 Principal-components analysis, 120
 Problem-size effect, 85, 111, 116, 150
 Procedural knowledge, 90
 Processing speed, 131, 135
 Production systems, 77–92, 222, 250
 Productivity, 229, 233, 247
 Pronouns, 202, 209–210, 223
 Propositions, 76–78, 90, 92, 156, 227, 229, 233–235
 Pruning, 53, 237, 248, 254, 256–257
 Pulse coding, 255
 Purpose of development, 216–219, 251
- Quartz, S. R., 48, 53, 161, 163–164, 169, 171, 218, 248, 270
 Quickprop, 49–50, 58–59, 247
 Quinlan, J. R., 71, 136–138, 140, 142
 Quinlan, P. T., 247–248
 Quinn, P. C., 66, 153, 231
- Raijmakers, M. E. J., 150, 180, 182, 185, 239, 242–244
 Ramsay, J. O., 176
 Readiness to learn, 133, 213–214
 Reading, 83, 101–102, 104, 136, 225, 260, 267
 Recognition memory, 67, 153, 157
 Recruitment of units or neurons, 50–52, 161, 163, 165, 212, 219, 238, 245, 257, 260–261
 Recurrent connections, 64, 134, 215, 232, 254–255
 Recursion, 229, 235–236
 Reflective abstraction, 127–129, 135
 Reinforcement, 260, 263, 266
 Repetition, 261
 Representational innateness, 166–169, 172
 Representational redescription, 133, 135, 165, 237
 Rivest, F., 258
 Robotics, 263–264
 Rosch, E., 237
 Rule-assessment methodology, 113–115, 117–118

- Rules, 8, 10, 18, 22–23, 26, 46, 50, 72–73, 76–85, 87–95, 99–101, 104–107, 111–113, 115–117, 119, 121–122, 129–130, 134, 136–137, 140, 142–143, 145, 148–149, 151–152, 155–156, 159–160, 167–168, 203–205, 222, 228, 234–237, 239, 246, 252, 268
- Rumelhart, D. E., 9, 15, 36–39, 41, 64, 66–67, 95
- Sanger, D., 120
- Schlesinger, M., 263
- Schmidt, W. C., 116, 126, 136, 143–144, 146, 150, 205–206, 239
- Score-threshold, 56, 145, 238, 243
- Screening effect, 87, 150
- Searle, J., 9, 10, 226–227
- Seidenberg, M. S., 96–98, 101–102, 156–157
- Sejnowski, T. J., 48, 53, 163–164, 169, 218, 248, 270
- Selecting a network model, 71
- Self-organization, 18, 21, 26, 71, 111, 249
- Semantic-feature hypothesis, 106, 108
- Seriation, 84, 202, 207–209, 223–224
- Shastri, L., 93, 155–156, 235
- Shift learning, 238, 243–244, 247
- Short-term memory, 256. *See also* Active memory; Working memory
- Shultz, T. R., 18, 21, 62–63, 66–67, 116, 118–121, 126, 129, 135, 143–144, 149, 156, 161, 163, 165, 169–171, 179, 202–203, 205–207, 210, 223, 233, 238, 243–244, 258
- Sibling/descendant cascade-correlation, 257
- Siegler, R. S., 21, 83, 84, 91, 112–113, 116–117, 125–126, 130–133, 143, 145–147, 170, 173, 200, 205, 213–214, 247
- Sigmoid function, 30–31, 33, 67
- Simple recurrent networks, 26, 63, 64, 155, 156, 157, 236
- Sirois, S., 62, 67, 129, 156, 165, 169, 238, 243
- Soar, 8, 136–137, 143
- Social development, 251, 264–267
- Software packages, 44, 73
- Spelke, E. S., 166, 215
- Spurts in development, 173, 175–178, 180, 182, 185–186, 188–189, 191, 194–195, 197, 200–201, 219, 229, 244, 252–253
- SRNs, 26, 63, 64, 155, 156, 157, 236
- Stages, 2, 24, 63, 75, 84, 85, 91–92, 111, 113, 115–116, 118, 121, 136, 143, 145–147, 163, 173, 174, 179, 201–208, 210–214, 219, 223–224, 244, 251–253, 269
- Stage sequences, 202, 205, 210
- Starting small, 217, 262
- Static networks, 48, 58, 126, 161, 163, 168–171, 206, 217–219, 244–245
- Step-size problem, 45, 49–50
- Strong AI, 9, 226–227
- Supervised learning, 17, 25, 137, 260
- Symbols, 3, 76, 90, 92, 99, 154, 157, 222, 226–227, 253
- Synapses, 13, 14, 48, 52–53, 249, 256
- Synaptogenesis, 48, 52, 164, 169, 200, 218, 248, 256
- Synchrony in development, 155, 194, 235, 255
- Syntactic development, 189, 194
- Systematicity, 229, 231–233
- Takane, Y., 120–121, 238
- Teacher-centered education, 262
- Tetewsky, S., 63
- Thagard, P., 2, 19, 75, 227–228
- Time, velocity, and distance cues, 170, 202–205, 223–224
- Torque-difference effect, 111, 115–116, 118, 136, 143, 146–148, 224
- Transition, 2, 24, 99, 122–123, 125–127, 129–133, 135–136, 143–145, 152, 160, 244, 251–252
- Two-spirals problem, 59, 60, 232–233, 257

- Underextension of meaning, 108
Unsupervised learning, 18
- Van Geert, P., 188–189, 191, 193–194, 200
Van Gelder, T., 230
Variable binding, 10, 89–90, 93, 155, 247
Variables, 37, 89, 93, 113, 119–120, 122, 147, 155, 202–204, 229, 234–235, 255
Velocity, time, and distance cues, 170, 202–205, 223–224
Von der Marlsburg, C., 68, 235
- Weak AI, 9, 226–227
Weight adjustment, 34–36
Werker, J. F., 210, 212
Wilkening, F., 202–203
Word naming, 100–104
Working memory, 14, 26, 77–78, 80, 88–90, 92, 122, 130, 217. *See also* Active memory; Short-term memory