

This PDF includes a chapter from the following book:

# **The Cognitive Animal**

## **Empirical and Theoretical Perspectives on Animal Cognition**

© 2002 Massachusetts Institute of Technology

### **License Terms:**

Made available under a Creative Commons  
Attribution-NonCommercial-NoDerivatives 4.0 International Public License

<https://creativecommons.org/licenses/by-nc-nd/4.0/>

### **OA Funding Provided By:**

The open access edition of this book was made possible by generous funding from Arcadia—a charitable fund of Lisbet Rausing and Peter Baldwin.

The title-level DOI for this work is:

[doi:10.7551/mitpress/1885.001.0001](https://doi.org/10.7551/mitpress/1885.001.0001)

---

## Index

- Abstraction in pigeons, 176–177
- Acoustic unit, defined, 265
- Action, observation and understanding of, 454–458
- Adaptation to novel stimulus, 239
- Adapted cognition hypothesis, 364, 367  
testing the, 365–367
- Agency, proto-understanding of, 356–357, 361
- Aggression, redirected, 374–375
- “Aggressive mimicry,” 28
- Alarm calls  
aerial, 316, 317  
ground, 318, 320, 321
- Alarm call system in prairie dogs, 257–263
- Amygdala, 446–447, 466–467, 467n1
- Animal behavior, “romantic” vs. “killjoy”  
interpretations of, 73
- Ant dipping, 390
- Anthropocentrism, 8, 35
- Anthropomorphic sense of what a mind is, 54
- Anthropomorphism, 8  
by omission, 10–11  
case histories, 12–15  
types of, 9–10  
will always be with us, 9–10
- Anticipation, 50, 101  
by males, 37–38
- Antinociception, 77–81
- Antiphonal calling, 269, 271
- Aposematic coloration, 12
- Apostatic selection (predation), 144
- Art, 53
- Artifacts, understanding relevant features of  
children’s, 205–206  
nonhuman primates’, 206–209
- “Artificial fruit,” 386, 387
- Artificial intelligence (AI), 157–159, 447
- Artificial life, 155
- Aspect dependence, 184
- Associative learning, 320
- Associative processes, 381
- Attempt turnovers (ATOs), 168
- Autism, and mindblindness, 445
- Awareness. *See also* Self-awareness  
reflected, 438, 439
- Baboons  
“clever” behaviors, 395  
Guinea (*Papio papio*), laboratory studies with, 239–241
- olive (*Papio anubis*), 163, 305, 386 (*see also* Consort turnover)  
greetings among male, 301–304  
studies in natural setting, 241
- Papio cynocephalus ursinus*, 380
- Baldwin effect, 115
- Bees, 47–48  
honey bees (*Apis mellifera*), 14, 41, 44–45  
cognition, 41–42, 44  
concept formation, 43–44  
route planning, 42–43
- Behaviorism, 175–176  
decline of, 70–71  
methodological, 176
- Bird abilities, specific, 248–250
- Bird cognition, studying, 247–248
- Bird intelligence  
from a human perspective, 250–251  
studying, 247
- Birds. *See also specific species*  
communication and cognition, 250, 319–321
- Blue jays (*Cyanocitta cristata*), 144–146
- Bovine, defined, 35
- Bumblebees, 48
- By-product mutualism, 416–417
- Cache location, 132
- Cache recovery, 129, 130
- Caching, 251
- Calling, antiphonal, 269, 271
- Calls. *See also* Alarm call system; Referential signals;  
Vocal communication  
“coo,” 293  
food, 318, 320, 321  
multisyllabic, 266
- Capuchin monkeys (*Cebus apella*), 405, 408–410  
cooperation, 408–410  
tool use, 405–408
- Cat and mouse, 13
- Categorization, 213, 234, 236  
assessment of, 239–240  
in birds, 248–249  
based on functional similarity, 241  
levels of, 239  
in nonhuman primates, 239–243  
of predators, 259–260  
prospects for future work, 243
- Categorizing strategies and procedures, 242  
in monkeys vs. humans, 243

- Chickadees, black-capped (*Poecile atricapillus*), 124–126
- Chicken alarm calls, 317
- Chimpanzee behavior as guide to experimental design, 364–365
- Chimpanzee society, 399–400
- Chimpanzees (*Pan troglodytes*)  
at Bossou, 189–190  
Ai project, 190–191, 192, 194  
Ayumu's first attempt at the computer, 193–195  
infants reared by their mothers, 191–193  
cultural variation of wild, 388–390  
hunting and intelligence, 400–402  
self-recognition, 325, 336  
signing  
Cartesian delusions and, 290  
Darwinian realities and, 285–290  
future research, 290  
similarity to humans, 399
- Coalition formation, 374
- Coding, frequency modulation (FM), 28
- Cognition. *See also specific topics*  
animal  
conceptual framework, implications, and future directions, 22–23  
constructing, 105, 108–109, 111  
defined, 22, 105, 106  
functions, 135, 163–164  
as independent variable, 148 (*see also* Virtual ecology)  
nature of, 135
- Cognitive ability(ies). *See also specific topics*  
evolution of, 115  
variation in  
according to context, 365–366  
according to evolutionary history, 366–367
- Cognitive defender. *See* Squirrels
- Cognitive ethology (CE), 59, 63, 71–75  
contrasted with CDEP, 60–63  
at the end of neuroscience, 69–75  
and folk psychological explanation, 71–72  
future prospects, 62–64  
history, 69–71
- Cognitive ethology movement, 11
- Cognitive states, animal, how we can discover the content of, 72–73
- Cognitive systems, 158
- Coloration, warning, 12–13
- Color patterns, 143
- Color test, new, 207
- Communication. *See also* Vocal behavior; *specific topics*  
and cognition, in birds, 250, 319–321  
demonstrating the evolution of, 152–155
- Comparative developmental evolutionary psychology (CDEP), 59, 60  
contrasted with cognitive ethology, 60–63  
defined, 59  
future prospects, 62–64  
similarities between cognitive ethology and, 59
- Comparative ethology and psychology, roots of, ix
- Comparative psychology, 393. *See also* Evolutionary psychology
- Composite palatability score (CPS), 100
- Computational models, 107
- Concept formation in honey bees, 43–44
- Concept learning. *See* Categorization; Same-different (S-D) concept learning
- Conceptual identity, 241
- Conditional discrimination, 220–222
- Conditioning. *See also* General signs  
instrumental, 82–84
- Conscious action, 3, 7–8
- Consciousness, subjective animal, 471–472
- Conservation planning, 14–15
- Consort turnover (CTO), 163, 165–168  
future research directions, 168–169
- Context  
conversational, 288–289  
variation in cognitive ability according to, 365–366
- Control, and cognition of no control, 82–84
- Conversational context, 288–289
- “Coo” calls, 293
- Cooperation, 303, 408–410, 413, 417–418  
evolution, 417  
reasons for, 432–433
- Cooperative-communicative paradigm, 364–366
- Corvids, 129, 130
- Country Blue, story of, 9
- Courtship  
in fruit flies, 13  
in pronghorn antelopes, 37–38
- Coyotes (*Canis latrans*), 36, 37, 429–431, 433. *See also* Prairie dogs
- Critical anthropomorphism (CA), 10
- Cross-fostering, 285–286
- Cross-modal matching, 276–277

- Crotalomorphism, 11–12
- Cryptic prey polymorphism, 143, 144, 147
- Cultural transmission, 286–287
- Cultural variation of wild chimpanzees, 388–390
- Culture, social learning and, 385–389
- Darwinian revolution, 175
- Deception, 353
- agency, inhibition, and, 356–357, 361
- building blocks, 355–356
- defined, 353
- “hardwired,” 354
- intentional, 355
- involving behavioristic learning, 354–355
- lemur, 358
- Menzel paradigm and, 356–358
- observations in primates, taxonomic distribution of, 358
- three categories of, 353–355
- Decoding, frequency modulation (FM), 28
- Deer, 12
- Dementia, testosterone, 37
- Detouring behavior, 31
- Discrimination
- conditional, 220–222
- same-different (S-D), 231–234
- Disruption (DSR), 166, 167
- Distributed cognition (DCog), 163–166, 168, 169
- Dogs (*Canis familiaris*), 366, 429, 430, 432. *See also* Play, social
- Dogs, prairie. *See* Prairie dogs
- Dolphins, 183–187, 277
- bottlenosed (*Tursiops truncatus*), 183
- brain, 275
- cognitive world, 275–281
- location of studies of, 281
- Dominance asymmetry, 422–423
- Dominance-subordination relations, 242–243, 373, 380
- Dualism, 69
- Eagles, 36
- Earthworms
- creation of basketlike structures, 6–7
- Darwin on inner life of, 3–8
- intelligence, 3–5
- Echolocation, 183–187
- Echo spectra, 185
- Emergent matching, 221
- Emotion and cognition, 97–98
- measuring, 99–101
- Environmental complexity thesis (ECT), 135–137
- Equivalence classes, 381–382
- Equivalence relations, 222–225
- Estrus, 37–38
- Ethology, 105–106. *See also* Cognitive ethology; Neuroscience
- comparative, ix
- laboratory learning vs., 109
- Event-related potentials (ERPs), 465–466
- Evolution, ix. *See also specific topics*
- Evolutionary psychology (EP), 59, 62. *See also* Comparative developmental evolutionary psychology
- and primate cognition, 393–397
- Exclusion rule, 221
- Expectancy violation experiment, 207, 209
- Experimental design. *See* Methodologies
- Extrastriate cortex, 446–447
- Eye direction detector (EDD), 459n1
- Eye gaze information-processing theory (EGIPT), 443–448
- neurobiology, 446–447
- state of play in, 444–445
- Eyes, observing, 443
- Fair play. *See* Playing fairly
- Fast mapping, 221
- Fear barks, 380
- Flexible strategy, 138
- Flowers, bee behavior and, 47
- Follow gaze, 443
- Food calls, 318, 320, 321
- Foods, understanding relevant features of
- children’s, 209–210
- nonhuman primates’, 210–212, 241
- Food storage, 124–127
- Foraging, in snakes, 12, 118–119
- Frequency modulation (FM) coding and decoding, 28
- Fruit flies (*Drosophila*), 13, 157
- Game theory models, 417
- Gaze avoidance, 443
- Gaze-following response (GFR), 452–454, 458. *See also* Eye gaze information-processing theory
- General purpose intelligence hypothesis, 363–364, 367
- General signs, 178
- button pecks as, 180–181

- Genetic basis of individual differences in cognitive abilities, 115
- Genetic contributions to cognition, future directions in, 119–120
- Genetic programming, 158
- Genetics  
and avoiding predation, 116–118  
and finding prey, 119
- Gestural communication, primate, 295–297  
flexibility in, 295–297  
in olive baboons and domestic dogs, 301–306
- Gestures, defined, 301
- Goals, 168
- Group selection, 415–416
- Group travel, 372
- Habituation, 117
- Hamilton's rule, 414
- Head movements relative to body orientation (HMBO), 167  
as information processing, 167–168
- Heterochrony, 61
- Hiding (from predator), 35–36
- Hierarchies. *See* Dominance-subordination relations
- Hippocampus, 126
- Honey bees. *See under* Bees
- Human cognition as a standard, 111
- Humanism, 69, 70  
and antihumanism, 70
- Hunting, 29, 31. *See also* Predation  
and intelligence, 399–402  
by searching image, 143
- Hyena, spotted (*Crocuta crocuta*), social cognition in, 371  
comparative analysis of group travel, 372  
field experiments and controlled observations of, 372–375  
social lives, 373
- Illusion, Ponzo, 177, 179–180
- Imitation, 277–278, 339, 340, 345–348
- Incentive value, 97–98
- Incentive value system, sensitivity of, 101–102
- In-group biasing, 416
- Inhibition  
deception, agency and, 356–357, 361  
latent, 80
- Instinct, 7
- Instrumental learning, 82–84
- Intelligence  
definitions and meanings, 247, 251, 281  
evolution of, 131
- Intelligence hypothesis  
general purpose, 363–364, 367  
Machiavellian, 385, 394  
social, 35, 137
- Intelligence theory, lapsed, 115
- Intentionality, 55, 310–311, 355, 451  
first- vs. second-order, 355
- “Intentional stance,” 73, 355
- Intentional systems, 262
- Intentions  
neurobiological bases of sharing, 431–432  
underlying play signals, 431–432
- Internal psychological states, 132, 164  
from a systems perspective, 167–168
- Jays, 130, 131, 144, 147  
blue (*Cyanocitta cristata*), 144–146  
Mexican (*Aphelocoma ultramarina*), 130, 131  
pinyon (*Gymnorhinus*), 130, 131
- Judgment, 4–5
- Juncos (*Junco hyemalis*), 124–126
- Junglefowl, ancestral red (*Gallus gallus*), 316
- Killdeer (*Charadrius vociferus*), 37
- Kinesthesia, 346, 347
- Kinesthetic-visual matching, 345–350
- Kin recognition, 226–227, 413, 417
- Kin relations, social knowledge of other animals', 379–380
- Kin selection, 414–415
- Kismet, 447
- Lamarckian views of scientists, 115
- Landscape modeling, 15
- Language, 178, 180, 278–279  
communication, 31  
evolution, 315  
human and nonhuman, 13–14  
from language to logic, 219–225
- Language learning in sea lions, 217–219
- Lapsed intelligence theory, 115
- Latent inhibition, 80
- Learned helplessness, 82–83
- Learning. *See also specific topics*  
associative, 320  
by exclusion, 220–221

- (how) to learn, 43–44, 222
- and unlearning, 30
- Learning curve, 43
- Learning psychology, 106
- Legitimate peripheral participation (LPP), 168
- Lemurs, ring-tailed (*Lemur catta*), 315–316
  - deceptive tactics, 357–360
- Life cycle transitions, 168–169
- “Liking,” 98
  - defined, 98
  - measuring, 99–100
  - and “wanting,” 101
- Linguistics, 71
- Lions (*Panthera leo*), hunting behavior of, 417
- Macaques
  - long-tailed (*Macaca fascicularis*), 346, 347
  - pig-tailed (*Macaca nemestrina*), 452–457
- Machiavellian intelligence, 385, 394
- Maps, cognitive, 42–44, 123, 124
- Mark test, 336–338
- Mark touches, 328
- Marmosets, 349
- Matching-to-sample (MTS), 193–195, 220–223
  - delayed, 225
- Mathematical ability, 197. *See also* Numerical abilities
- Mating behavior, 37–38, 301. *See also* Sexual behavior
- Memory, 218–219, 417. *See also* Short-term memory; Spatial memory
  - long-term, 225
  - within spinal cord, 77–80
- Mental imagery. *See also* Representation(s)
  - in pigeons, 180
- Menzel paradigm, 356–358
- Methodological behaviorism, 176
- Methodologies
  - chimpanzee behavior as guide to experimental design, 364–365
  - failure of traditional, 335–338
  - nonexperimental observations conflicting with controlled studies, 339–341
- Mice (*Mus musculus*), 13, 15
- Mimicry. *See also* Imitation
  - aggressive, 28
- Mindblindedness, 445
- Mind-reading abilities, 451
- Mind(s)
  - animal vs. human, 55–57, 178
  - defined, 53–54
  - problem of, 157
  - what they do, 53–55
- Mirror self-recognition (MSR). *See also* Self-recognition
  - by gorillas, 336–338, 345
- Mirror test, 325
  - attempts to discredit, 327–328
- Models, 137–140
- Mode-rival (M/R) procedure, 248
- Modularity, 123, 124, 126
- Monkeys, 325. *See also* Capuchin monkeys; Vervets
  - rhesus (*Macaca mulatta*)
    - domain-specific knowledge, 207, 211–212
    - numerical processing, 197–203
    - social lives of Old World, 373
- Moral agency, 439–441
- Morality, social, 433–434
- Morals of animal minds, 437–441
- Mothers, and predation on young, 35–37
- Motivational systems, 97–99
- Mounting behavior, 37–38
- Multiple-choice environment, 102
- Mutual exclusivity, 221
- Mutual gaze, 443
- Naltrexone, 84
- Negotiation (NGT), 166–168
- Neocortex, size of, 394–395
- Neoinnatists, 62
- Neurobiology. *See also specific topics*
  - motivational systems and, 98–99
- Neuroethology, cognitive, 443–447
  - comparative perspective, 445–446
- Neurons, mirror, 454–459
- Neuroscience
  - can inform ethology, 464
  - cognitive ethology at the end of, 69–75
  - ethology can inform, 463–464
  - and study of social perception, 465
    - electrophysiological studies, 465–466
    - neuroimaging studies, 466–467
  - as threat to cognitive ethology, 73–74
- New configuration (NCN), 166, 167
- Nociceptive signals and reactions, 77, 78
- No control, cognition of, 82–84
- Novel gestural cue, 220
- Novel stimulus, adaptation to, 239

- Numerical abilities, 250  
 evolution and ontogeny, 197–203  
 Numerical distance, 202  
 Numerical processing  
   independent of language, 202–203  
   neural circuitry, 203  
 Nutcracker, Clark's (*Nucifraga columbiana*), 129–131  
 Nut cracking, 189
- Object choice task, 365–367  
 Observational learning by great apes, 339–341  
 Old World primates, 373  
 Operant learning, 85  
 Orangutans, observational learning skills of, 340  
 Ordinal numerical ability. *See also* Numerical abilities  
   evolution and ontogeny of, 197–203  
*Origin of Species* (Darwin), ix  
 Overshadowing, 80
- Parietal lobule, inferior (PF), 455–457  
 Parrots, Grey (*Psittacus erithacus*)  
   cognitive and communicative abilities, 247–250  
 Pavlovian conditioning, and attention, 80–82  
 Perceptual identity, 241  
 Perceptual-motor relations, physiology of, 106–107  
 Phrase development and phrase tokens, 286–287  
 Phylogenetic appropriateness, 160  
 Phylogenetics, 169  
 Piagetian framework, 61, 63  
 Pigeons (*Columba livia*), same-different (S-D) concept  
   formation in, 229–236  
 Pinnipeds, 217  
 Planning, 49–50, 168  
   by males, 37–38  
   route, 42–43  
 Plasticity, 115, 119, 120, 139–140  
 Play, social  
   dogs, 304–305  
   ethology, philosophy, and, 429–431  
   rats, 421–425  
   and social morality, 433–434  
   value of, 429  
 Playback experiments, field, 268  
   on vocal recognition, 373–374  
 Play fighting, 421, 424–425  
   rules underlying, 423  
   and social information, 421–423  
   species comparisons, 423–424, 429  
 Playing fairly, reasons for, 432–433
- Play signals, meaning of, 431–432  
 Pleasure, 98  
 Polymorphism, 143, 144, 147  
 Ponzo illusion in pigeons, 177, 179–180  
 Prairie dogs  
   cognition and communication in, 257–263  
   Gunnison's (*Cynomys gunnisoni*), 257  
 Predation, 27–31  
   avoiding, 116–118  
   and escape behaviors, 257–258  
   and prey types, 143–147  
   on young, and what mothers can do, 35–37  
 Predators  
   categorization of, 259–260  
   hiding from, 35–36  
   knowledge about, 19–22  
 Predatory behavior, chimpanzee, 400  
 Predatory subsystem of rat feeding behavior system,  
   109, 110  
 Predictive cognitive ability, 35  
 Prey, finding, 116, 118–119  
 Prey polymorphism, cryptic, 143, 144, 147  
 Prey types, predation and, 143–147  
 Problem-solving behavior, 50–51, 191  
   in nature, 225–226  
 Pronghorn antelopes (*Antilocapra americana*), 36–37  
 Protocognitive mechanisms, 135–136  
 Prototype effects and prototypical representations,  
   240–241  
 Psycholinguistic inference, 221
- Quail (*Coturnix japonica*), 89  
 Quantitative trait locus (QTL) methods, 116
- Raiding behavior, 416  
 Ranks. *See* Dominance-subordination relations  
 Rat (*Rattus norvegicus*), 56. *See also* Play, social; Play  
   fighting  
   predatory subsystem of feeding behavior system of,  
   109, 110  
 Rattlesnakes (*Crotalus horridus*), 11–12, 20, 21  
 Ravens (*Corvus corax*), 47–51  
   cognition, 49  
 Reciprocity, 413–414  
 Recognition. *See also* Self-recognition; Vocal  
   recognition  
   individual and kin, 226–227, 413, 417  
 Reconciliation, 374–375  
 Referential signals in birds, 315–319

- Reflected awareness, 438, 439
- Reflexes, nociceptive, 77
- Representation(s), 55, 56, 164, 279–280, 319. *See also* Maps  
 nominal, 320  
 and representational signaling, 320–321
- Research, cognitive, 164. *See also specific topics*
- Robotic models, 108, 159, 160
- Robots, humanoid, 447
- Rodents. *See* Play fighting
- Role reversing, 430–431
- Rule-based cognitive system, 260
- Same-different (S-D) concept learning, 233–234, 236, 249–250. *See also* Categorization  
 simultaneous S-D discrimination and transfer, 231–234  
 successive S-D discrimination and transfer, 233, 235
- Sea lions  
 California (*Zalophus californianus*), 217–226  
 Steller (*Eumetopias jubatus*), 227
- Self-awareness, 280, 327, 329–331, 439  
 and reflected consciousness, 438, 439
- Self-concept, 345
- “Self-friendliness,” 395
- Self-handicapping, 430–431
- Self-recognition, 325, 345, 348–349. *See also* Mirror self-recognition  
 comparative data on, 325–327  
 in humans, 328–329  
 individual differences in, 328–329  
 mental state attribution and, 329–330  
 neuropsychological correlates, 330–331
- Semantics, 278–279
- Sensory limitations of animals, 43
- Sexual anticipation, 92–93
- Sexual anticipatory behavior, conditioning of, 89–90  
 temporal encoding in the control of, 91–92
- Sexual behavior, 89, 301, 303. *See also* Courtship;  
 Mating behavior  
 cognitive modulation of, 89, 94  
 observational conditioning of, 93–94
- Sexual conditioning, stimulus-response (S-R) vs.  
 stimulus-stimulus (S-S) mechanisms in, 90–91
- Sexual consort dynamics, 165
- Sexual sign stimuli, modulation of responding to, 92–93
- Shape test, new, 207
- Shared attention mechanism (SAM), 459n1
- Sharing behavior, 48
- Sharing intentions, neurobiological bases of, 431–432
- Short-term memory (STM), 77–78, 225  
 in dolphins, 277
- Signal detection theory, 138–139
- Signaling, representational, 320–321
- Signal-making behavior, 28–29, 31
- Signal production. *See* Referential signals
- Signals, 28–29  
 play, 431  
 referential, 315–319
- Sign language in chimpanzees, 285–290
- Situated action, 168
- Size, assessing, 21, 202
- Sleeping near the enemy (SNE), 168
- Snake alarms, 319
- Snakes, 116  
 avoiding predation, 116–118  
 garter (*Thamnophis sirtalis*), 118  
 natricine (*Thamnophis*), 118  
 neonatal, 118, 119  
 northern water (*Nerodia sipedon*), 11–12  
 rattlesnakes (*see* Rattlesnakes)
- Social acuity, vocalizations and, 309–310
- Social categorization, 242
- Social cognition, 131, 132, 451  
 integrated approach for studying, 367
- Social-competition paradigm, 365
- Social complexity, 164–166
- Social complexity hypothesis, 371
- “Social concept,” 379
- Social facilitation test, 211–212
- Social function of intellect (SFI) hypothesis, 164, 165
- Social intelligence hypothesis, 35, 137
- Sociality, cognition demands of, 131
- Social knowledge in monkeys, 379, 383  
 evolution and, 381  
 of other animals’ dominance ranks, 380  
 of other animals’ kin relations, 379–380  
 underlying mechanisms, 381–383
- Social learning. *See also* Observational learning  
 comparative cognitive ethology of, 390
- Social manipulations, 394, 395
- “Social mind,” 385
- Social morality, 433–434
- Social perception. *See* Neuroscience, and study of social perception
- Social play. *See* Play, social
- Social skill, development of, 168



- Sonar, 183
- Sound. *See* Echolocation; Vocal behavior
- Spatial cognition
  - in corvids, 123, 124, 126, 129–132
    - future work, 132–133
    - selection for, 132
- Spatial memory, 126, 129–130
  - specificity of, 130
- Spatial orientation, 123, 124, 126
- Spiders, jumping (*Portia*)
  - deceit, predation, and cognition, 27–31
  - signals, 28–29
- Spinal cord
  - and animal cognition, 84–85
  - instrumental conditioning and, 82–84
  - memory within, 77–80
  - nociceptive mechanisms, Pavlovian relations, and, 80–82
- Squirrels, California ground (*Spermophilus beecheyi*), 19, 22, 23
  - what they know about predators and how they know it, 19–22
- Squirrel-snake relationships, 20
- Stable configuration (SCN), 166, 167
- Strategy, selecting the optimal, 43
- Stress, social, 101–102
- Subjective experience, 471–472
- Superior temporal sulcus (STS), 455
- Superorganisms, 159
- Syntax, 278–279
- Synthetic ecology, 151–152, 155–156
  
- Tactical sense, 38
- Tail flagging, 23
- Tamarins, 349
  - cotton-top (*Saguinus oedipus*), 207
    - unit of perception in, 269, 271
    - unit of vocal production in, 269
- Taste reactivity patterns (TRPs), 99
  - hedonic vs. aversive, 99–100
- Television images, responses to, 279, 280
- Temperature, 47, 48
- Temperature cues, gaining access to, 21–22
- “Testosterone dementia,” 37
- Thermoregulation, 47, 48
- Thermomorphism, 105, 111
- “Tit for tat” (TFT), 414
- Tool use, 405–408
  - and tool-manufacturing skills, 189–190
- Trap-tube task, 406, 407
- Travel, self-propelled, 123
- Trial-and-error tactics, 29, 30
  
- Umwelt* of animals, 55, 105
- Ungulate mind, 35–38
- Unlearning, 30
  
- Vervets (*Cercopithecus aethiops*), 315–316, 319, 373, 379
- Videotaping, remote, 287–288
- Videotaping interactions, value of, 305–306
- Vigilance, nonhuman primate
  - and perception of social stimuli, 463–467
- Virtual ecology, 144–148
- Vision and cognitive capacities, 30
- Vocal behavior, primate
  - examples of multisyllabic calls, 266
  - future directions in the study of, 271–272
  - meaningful acoustic units in, 265, 267–272
    - observations and experiments in the field, 267–269
- Vocal communication, 307
  - implications for mind, 310–311
  - nonlinguistic approach to, 307–310
  - primate, 293–297
    - flexibility in, 293, 294, 296–297
- Vocalizations
  - direct effects on listener attention and affect, 307–309
  - indirect effects mediated through social acuity, 309–310
  - prairie dog, 257–258
- Vocal recognition, 373–374
  
- “Wanting,” 98
  - defined, 98
  - and knowing, 22
  - “liking” and, 101
  - measuring, 100–101
- Warfare, 416
- Water snakes, 11–12
- Web-building spiders. *See also* *Portia*
  - and web invasion, 28, 30–31
- White-footed mouse (*Peromyscus leucopus*), 15
- Wolves (*Canis lupus*), 366–367, 429, 430, 433
- Word learning experiment, 209–210
- Worms. *See* Earthworms
  
- Zoos as products of anthropomorphism, 14