

Index

A

AC, mustached bats
 echolocation, functional organization 162–163
 neural mechanisms
 call representation 164–165
 pulse–echo representation 163–164
 acoustic meaning, perception 90–92
 acoustic patterns continuums, categories 100–106
 frequency sweeps, direction 104–105
 information-bearing elements, duration 105–106
 spectral (formant) structure 102–103
 acoustic signal design, mustached bats and call types 77–80
 motivation–structure hypothesis 79–81
 active electrolocation 271, 276
 adaptations
 behavioral
 meaning perception 117–119
 physiologic
 and anatomic 115–117
 audiovocal, blind mole rat 116
 aggression, caged bats
 experimentally elicited 74–77
 natural 73–74
 AI responses, vocalized sounds 195
 amplitopy 164
 amplitude modulation, vocal source 11–14
 androgen expression 231–232
 anterior forebrain pathway, song
 control system 234, 275, 277, 280

area, cortical

anterior (A) 190, 192
 anterior primary auditory (A1a) 158
 CF/CF 158, 159, 163, 165, 172, 178, 198
 DF 159
 DIF 159
 DM 158, 159
 Doppler-shifted constant frequency (DSCF) 158, 159, 162 165, 167, 168, 169, 170, 172, 178
 dorsal (D) 190, 192, 193, 195, 197, 198, 200
 dorsoanterior (DA) 192, 193, 199
 dorsocaudal (DC) 191, 192, 193, 194, 197, 198, 200
 dorsocaudal belt (DCB) 192, 193
 dorsoposterior (DP) 192, 193, 197, 198, 199
 dorsostral belt (DRB) 192, 193
 FM–FM 158, 159, 163, 169, 172, 175, 178
 H₁–H₂ 159
 posterior (P) 192, 193, 197, 198, 199, 202
 primary auditory (AI) 160, 173, 189, 191–200
 anterior (AIa) 158, 159
 posterior (AIp) 158, 159, 161, 172, 173, 175, 178
 rostral belt (RB) 192
 small field (S) 192
 TE 158, 159
 ventroanterior (VA) 159, 192, 193, 197, 198, 199
 ventrocaudal belt (VCB) 192, 193
 ventroposterior (VP) 159, 192, 193, 197, 198, 199
 ventrostral belt (VRB) 192, 193

- area, cortical (*contd.*)
 - VF 159
- arousal and emotions level, acoustically
 - expressed 92–93
- attraction, perceived meaning 96–98, 106
- audible parameter space
 - broadband group 96
 - high-frequency group 96
 - low-frequency group 96–97
- audiograms 87, 95
- auditory belt projections
 - to prefrontal cortex
 - rhesh monkeys 217–218
- auditory brainstem and midbrain, bats
 - structure
 - brainstem pathways 136
 - isofrequency contours 137
 - tonotopic organization 135
- auditory communication, cortical
 - plasticity 294
- auditory cortex, experience-dependent
 - plasticity
 - adult animals 301–304
 - during early development 297–301
- central auditory system, cortex-oriented
 - plasticity
 - corticofugal modulation 304–309
 - cortical plasticity perspectives
 - vocalization, cortical coding 309–313
- auditory communication, in primates
 - coding/decoding 205–206
 - pattern recognition problem 205–206
- auditory concept learning
 - category learning
 - Aristotelian view 319
 - new animal model 323–3291
 - theoretical underpinnings 319–320
- auditory cortex, experience-dependent plasticity
 - adult animals
 - cortical plasticity, after localized hearing
 - loss 303–304
 - cortical representation, enhanced 301–302
 - cortical representation, enhancement 301
 - during early development 297–301
 - cortical IBEs/IBPs, normal development
 - 298–299
 - distorted acoustic environment, cortical
 - development 299–300
 - inner ear ablation impact, cortical
 - development 300–301
 - sensory experience, critical role 225, 297–298
 - tonotopic maps, normal development
 - 298–299
- auditory cortical fields 158
- tonotopic organization 191–193
- auditory feedback 230, 234, 252
- auditory nerve 132
- auditory nerve fibers 135
- auditory pathways
 - brainstem 136
- aversion, audible parameter space 97
- avian communication, vocal mechanisms
 - avian vocal systems
 - integration with respiration 7–9
 - labia 5–6
 - syringeal membranes 6–7
 - syrinx 3–5
 - bipartite syrinx, lateral independence
 - 14–20
 - acoustic specialization 19–20
 - song lateralization, patterns 19–20
 - two-voice vocalizations 17–19
 - unilateral dominance versus bilateral
 - parity 16–17
 - future directions 29–30
 - production, propagation, and perception
 - 28–29
 - vocal learning 9–10
 - vocal source, controlled and intrinsic
 - modulation 10–14
 - amplitude modulation 11–13
 - frequency modulation 13–14
 - vocal tract filtering 24–28
 - vocalizations, nonlinear dynamics 20–24
- avian vocal systems
 - integration with respiration 7–9
 - labia 5–6
 - syringeal membranes 6–7
 - syrinx 3–5

B

- behavioral context, mustached bats
 - simple syllabic calls 67–69
- behavioral postures, captive mustached bats
 - and associated calls 64–67
- behavioral tests
 - binaural deafening 43
 - head drumming behavior 46
 - blind mole rats 43–46
 - vibratory stimuli effect 45
- belt fields 199
- bipartite syrinx, lateral independence

- acoustic specialization 19–20
- song lateralization 19–20
- two-voice vocalizations 17–19
- unilateral dominance versus bilateral parity 16–17
- birdsong, learning and production
 - anterior forebrain pathway
 - learning pathway 234
 - neural circuit
 - song system 232–236
- birdsong development 227
 - sensitive periods, learned behavior 227
 - sensorimotor learning 229
 - song crystallization 231–232
 - variability and plasticity 230–231
 - zebra finch song development 228
- birth cry 96
- blind mole rat
 - behavioral tests 43–46
 - electrophysiologic experiments 42–43
 - lower jaw 49
 - middle ear 48
 - morphology 46–49
 - seismic communication, via acoustic channels 36
 - seismic signals, perception 40–41
 - somatosensory or auditory system 41–42
 - vibratory signals 38, 40, 45
 - properties 38–40
- boxing and poking behavior, captive mustached bats 65
- BPN, selectivity
 - sound processing, neuronal responsiveness 207–208
- brain-derived neurotrophic factor (BDNF) 244
 - BDNF-induced variability 247
 - developmental declines 247
 - roles 245
 - synapse, structure and function 248–249
- brainstem auditory evoked responses (BAER) 40
- broadband group 95, 96
- C
- caged bats
 - aggression
 - experimentally elicited 73–76
 - natural 73–74
 - social interaction
 - recording procedures 71–73
- call representation, neural mechanism
 - basis functions 164–165
 - single unit call response data 164
- call responses, mustached bats 165–175
 - CF/CF combinations, high-frequency domain 172, 178
 - FM–CF combinations 167–169
 - FM–FM combinations, time domain 169–171
 - harmonic complexity, low-frequency domain 172–175
- call types, mustached bats 77–81
- calls, cortical representation
 - multiparametric distributed 175–180
 - versus perception 180–182
- Cape mole rat
 - vibratory signals 49
- captive free-flying bat
 - experimental results
 - behavioral postures and associated calls 64–68
 - inspection and appeasement 69–71
 - social dominance 70–71
 - social interaction 63–64
- social behaviors
 - maintenance and recording procedures 60
 - scoring system 60–62
- captive mustached bats 57–59
- catbird song 18
- categorization
 - eco-ethologic aspects 320–321
 - vervet monkeys 321
 - and generalization 321–323
 - learning curves 321
- category learning 322
 - new animal model
 - frequency-modulated tones 324–326
 - physiologic correlates 326–329
 - theoretical underpinning 319–320
- central auditory system, cortex-oriented plasticity
 - corticofugal modulation 304–305, 306
 - combination-sensitive neurons, response properties 308
 - species-specific differences 308–309
- frequency tuning, frequency-specific modulation
 - and tonotopic 305–307
- frequency-specific neural plasticity 304–305
- IBEs/IBPs modulation 307–308

- central nucleus of the inferior colliculus (ICC)
 - 50, 143
 - CF/CF combinations, high-frequency domain
 - 172
 - characteristic frequencies (CFs) 50
 - SAM tones 51–52
 - cochlear tonotopy 137
 - cohesion, audible parameter space 97
 - communication sound perception, common
 - rules 85–86
 - psychoacoustical measures and relations 87
 - audiograms 87
 - duration discrimination 88
 - frequency discrimination 88
 - intensity discrimination 88
 - pitch, perception and discrimination 89–90
 - spectral resolution 89
 - spectral summation 89
 - temporal summation 87–88
 - six rules 90
 - acoustic meaning, perception 90–92
 - acoustic patterns continuums, categories 100–106
 - arousal and emotions level, acoustically expressed 92–93
 - audible parameter space 93–99
 - individualized perception 90
 - urgency of response 99–100
 - communication sounds
 - lower auditory nuclei
 - convolution process 139–141
 - Tadarida* 137
 - waveforms 138
 - processing, inferior colliculus
 - heterogeneity 143–145
 - inhibition 147
 - response selectivity 143–145
 - spatio-temporal pattern
 - functional advantage 148–149
 - in ICC 147
 - population response 150
 - communication sounds, in primates
 - auditory belt projections
 - to prefrontal cortex 217–218
 - auditory communication
 - pattern recognition problem 205–206
 - auditory cortex
 - early parallel processing 206–207
 - hierarchic processing 205
 - human imaging studies 218–219
 - sound processing
 - with intermediate complexity 207–214
 - species-specific calls
 - responses 214–217
 - complex sounds, acoustic structure
 - in mustached bats
 - echolocation signals, structure 161
 - social communication calls, structure 161–162
 - constant frequency (CF) 156, 161, 163
 - corollary discharge signal 283, 284
 - cortical coding, of vocalizations
 - cortical plasticity perspective 309–313
 - three envelopes 310–311
 - cortical development
 - distorted acoustic environment 299–300
 - inner ear ablation, impact 300–301
 - cortical IBEs/IBPs, normal development
 - and tonotopic 298–299
 - cortical plasticity, after localized hearing loss
 - 303–304
 - cortical representation, enhancement
 - acoustic signals induced 301
 - corticofugal modulation 304–305, 306
 - combination-sensitive neurons, response properties 308
 - species-specific differences 308–309
 - critical bandwidth (CBW), properties 89
 - crouching behavior, captive mustached bats 64
- D
- direct motor pathway, song control
 - system 277
 - distorted acoustic environment
 - cortical development 299–300
 - distress calls, pups 96
 - Doppler-shifted constant frequency (DSCF)
 - area 158
 - neurons 167
 - dorsal lateral geniculate nucleus (dLGN) 50
 - duration discrimination 88–89
- E
- early parallel processing, in primates
 - auditory cortex 206–207
 - echolocation 134
 - calls, common features 162
 - echolocation signals, mustached bats 61
 - functional organization 162–163
 - structure 161

electric fish sensory processing 273
 electric organ discharge (EOD) 271–276, 284
 electrocorticograms
 category learning, single trial analysis 328–329
 electrophysiologic experiments
 blind mole rat 42–43
 electrosensory lateral line (ELL) 273, 274
 electrosensory processing 271–276, 284–285
 enhanced cortical representation 301–302, 313
 error-correction function
 LMAN activity patterns
 song related 236
 supports
 experimental directions 235
 excitatory response areas 137, 160, 167, 169

F

fast Fourier transform (FFT) 38
 females, defensive calls 96
 fly-by behavior, captive mustached bats 67
 FM–CF combinations 167–169
 Doppler-shifted constant frequency, data 167
 FM–FM combinations, time domain 169–171
 frequency discrimination 88, 295, 302, 304
 frequency jumps, bird vocalizations 23
 frequency modulated (FM) pulses 163
 frequency modulation, vocal source 13–14
 air sac pressure 13, 14
 songbirds 13, 15
 syringeal muscles 13
 frequency sweeps, direction
 acoustic patterns continuum 104–105
 frequency sweeps parameters,
 selectivity 210–214
 DS index 210
 FM rates, preferred 213–214
 frequency tuning, frequency-specific modulation
 and tonotopic maps 305–307
 frequency-modulated tones 156, 193, 324–325, 328–332
 modulation direction, categorization
 apparatus and training paradigm 324–325
 behavioral results 325–326
 stimuli 324

G

Georychus capensis see Cape mole rat
 guinea pig
 auditory cortical
 binaural response 199
 neural recording 190, 194, 197
 principal component analysis 201
 tonotopic map 191, 192
 Gulf toadfish, natural behavior
 steroids 125–126

H

hallmarks, sensorimotor learning
 song
 plasticity 230
 variability 230
 harmonic complexity, low-frequency domain 172–175
 multi-peak response areas, tuning 173
 hearing 133–134
 importance, bats
 echolocation 134
 via lower jaw
 bone conduction 46–47
 higher auditory fields, neural activity spreads 197–198
 hormone-dependent plasticity
 teleost fish 129
 human imaging studies
 Heschl's gyri 218–219

I

IBEs/IBPs modulation 310
 in different domains 307–308
 individualized perceptions, level of matched groups 90
 inferior colliculus (ICC) 50, 133, 135, 137, 143, 145–150, 305–309
 information-bearing elements (IBE) 85, 295, 307, 310
 duration, acoustic patterns continuum 105–106
 information-bearing parameters (IBP) 296, 307, 310
 inhibitory response areas 160
 inner ear ablation, impact
 cortical development 300–301
 monocular dominance plasticity 300

inspection behavior, captive mustached bats 66–67
 intensity discrimination 88
 isofrequency contours 137

J

Japanese macaque monkeys 91
 just meaningful differences (JMDs) 86, 90, 91, 100, 101
 just noticeable difference (JND) 88, 91, 94, 96, 101
 juvenile
 sensitive period 226
 -time window 224
 juxtalar nucleus (JLN) 273

K

kissing behavior, captive mustached bats
 arching back 66
 kitten
 auditory cortical
 response to vocalizations 311, 312
 tonotopic plasticity 303
 auditory development 298
 vocalization 295

L

labia 5–6, 12
 learned behavior
 birdsong development, sensitive period 227–232
 sensitive period 223
 transfer, to novel stimuli 323

M

mammalian AC 157–161
 belt, parabelt areas 158
 core-belt–parabelt organization, *Rhinolophus* 158
 cortical areas 157
 non-neurophysiologic strategy, complex sounds 157–158
 organization 158–160
 primary auditory cortical neurons, response properties 160–161
 role, understanding 157
 tonotopic organization 158

marking behavior, captive mustached bats 64, 69
 mesoscopic neurodynamics, auditory cortex
 auditory concept learning categorization
 eco-ethologic aspects 320–321
 and generalization 321–323
 category learning
 new animal model 323–329
 theoretical underpinnings 319–320
 Mexican free-tailed bats 80
 auditory brainstem and midbrain structure 135–137
 communication sounds
 inferior colliculus 143–147
 lower auditory nuclei 137–143
 spatio-temporal pattern, ICC 147–150
 importance of hearing 133–134
 neural response profiles 142, 144, 146
 neural responses 139, 149
 species-specific vocalizations
 processing 132
 vocalizations 138
 middle latency responses (MLR) 40, 42, 44
 midshipman fish
 auditory communication 334–335
 vocal-auditory coupling 127
 vocal communication 123
 vocalizations 124
 molecular effectors
 molecular signals 244
 synaptic and vocal plasticity 244–249
 monkey calls 199, 211, 214
 mormyrid electric fish 265
 electrosensory processing 271–276
 active electrolocation 271
 AND-gate 272, 274
 corollary discharge signal 282–284
 electric organ corollary discharge (EOCD) 271, 272
 electric organ discharge (EOD) 271, 272
 electrosensory lateral line (ELL) 273, 274
 novelty response 272
 sensory processing, neuronal substrates 265
 sensory system 266
 songbirds, comparison 282–285
 sensorimotor processing systems 269
 morphology, blind mole rat 46
 lower jaw articulation 49

middle ear, structure 48
 Morton's rule 94
 modified 97
 motifs 229
 mouse vocalizations 92, 95
 multiple auditory fields, functional differences 198–200
 mustached bats
 AC 162–165
 neural responses 166, 168, 170, 174
 agonistic vocalizations 75
 audiovocal communication and social behavior 57, 78, 79
 acoustic signal design 77–81
 behavioral context, simple syllabic calls, 67–69
 behavioral postures and associated calls 64–67
 caged bats, social interaction 71–73
 call representation, neural mechanisms 164–165
 call types 77–80
 captive free-flying bats, social behavior 60–62
 echolocation, functional organization 162–163
 experimentally elicited aggression 74–77
 inspection and appeasement 69
 natural aggression 73–74
 pulse–echo representation, neural mechanisms 163–164
 roosting structure, activity patterns and social interaction 63–64
 territoriality and social dominance 70–71
 auditory cortical fields 159
 behavior measurement 71
 call–emotion relationship 79
 call responses 165
 CF/CF combinations 172
 FM–FM combinations 167–171
 harmonic complexity 172–175
 calls 58
 call-type representation 176
 complex sounds, acoustic structure
 echolocation signal 159
 echolocation signals, structure 161
 male–female interaction 73
 roosting behavior 62
 social communication calls 161–162

N

Nanospalax ehrenbergi *see* blind mole rat
 neural circuit correlates, model 248
 neural circuit plasticity
 diverse systems
 common themes 225
 sensitive period 224
 neural correlates
 nucleus RA 237
 song plasticity
 sensorimotor learning 236–237
 synaptic connectivity, projection neurons 237
 vocal plasticity
 nucleus RA 237
 neural mechanism
 call representation 164–165
 pulse–echo mechanism 163–164
 vocal–communication 123–130
 neuroendocrine mechanisms 123
 future prospects 129
 vocal–auditory coupling 126–129
 vocal communication, interfacing 123
 vocalization
 hormonal control 123–126
 neuron's response region 140–141
 neuronal sensitive periods
 and behavioral 224, 226, 241, 245
 common themes 224
 nipping behavior, captive mustached bats 65
 nonlinear dynamics
 in vocalizations 20–24
 non-neurophysiologic strategy 157
 notes 11, 12, 229, 239
 nucleus RA 237
 cellular analysis
 sensorimotor learning 240–241
 functional synaptic analysis
 sensorimotor learning 241–244
 neuronal codes, for song 237–238
 subregion
 structure and function 239
 synaptic connectivity
 extrinsic and intrinsic patterns 238

O

optical recording methods 189–191
 voltage-sensitive dyes 189

- optical signals, principal component analysis 200–202
- oscillation 6, 22, 179, 336
- oscine songbirds, vocal learning 9
- P
- parakeet syrinx 5
- patterns, song lateralization and acoustic specialization 19–20
- Pavlovian conditioning 326–327, 327
- principal component analysis (PCA)
 - advantages 202
 - optical signals 200–202
- perceptual processing, song 267–271, 276–282, 340
- periodotopy 164
- physiologic correlates, learning 323
 - electrocorticograms
 - single trial analysis 328–329
 - general aspects 326–327
 - stimuli utilized
 - neuronal representation 327–328
- pitch, perception and discrimination 89–90
- Plexiglas tube
 - mole rat, vibration 37
- Porichthys notatus* *see* midshipman fish
- posterior primary auditory (AIP) 158
- primary auditory cortex (AI) 160
- primary auditory cortical neurons, response properties
 - DSCF processing area 160
- psychoacoustical measures and relations
 - communication sound perception
 - audiograms 87
 - duration discrimination 88
 - frequency discrimination 88
 - intensity discrimination 88
 - pitch, perception and discrimination 89–90
 - spectral resolution 89
 - spectral summation 89
 - temporal summation 87–88
- Pteronotus parnellii* *see* mustached bats
- pulse-echo representation, neural mechanism 163–164
 - neural response, characteristics 163
- R
- RA subregions
 - song patterning 239
 - structure and function 239
- Rayleigh and Love surface waves *see* seismic communication
- response profile
 - DNLL neuron 142–143
- rhesus monkey
 - auditory cortical
 - connectivity 218
 - fields 208
 - responses 209, 212
 - response selectivity 215, 216
 - vocalizations 211
- ring dove 14, 23, 26
- S
- scoring behaviors
 - and calls
 - captive bats 60–62
- seismic communication
 - via acoustic channels, blind mole rat 36
 - auditory system 41–42
 - behavioral tests 43–46
 - electrophysiologic experiments 42–43
 - morphology 46–49
 - overview 36–38
 - seismic signals, perception 40–41
 - somatosensory system 41–42
 - vibratory signals, properties 38–40
- seismic signaling 37
 - perception, blind mole rat 40–41
 - see also* vibratory signals
- self-directed behaviors, captive mustached bats 64
- sensitive periods
 - learned behavior
 - birdsong development 227–232
- neural circuit plasticity
 - mechanisms 224–227
 - NMDA 225–226
- neuronal and behavioral
 - common themes 224
- zebra finch
 - song development 228
- sensory acquisition
 - sensorimotor learning 229
- sensory experience, critical role
 - cross-modal plasticity studies 297
 - early cortical development 297–298
- sensory processing, neuronal
 - substrates
 - mormyrid electric fish 265
 - electrosensory processing 271–276
 - sensory system 266

- song perception and learning
 - perceptual processing and memorization 276–282
 - songbirds 265, 267–271
- songbirds and electric fish, comparison 282–285
- sensory systems
 - auditory systems
 - bone conduction 41, 43, 47, 48, 50
 - somatosensory systems
 - mechanoreceptors 41–42
- sinusoidal amplitude modulated (SAM) tones 51–52
- social communication calls
 - cortical representation 156
 - hypothesis 175–182
 - mammalian AC 157–161
- mustached bats
 - AC 158, 159, 162–165, 175, 182
 - call responses 165, 338
 - complex sounds, acoustic
 - structure 161–162
 - divisions 162
 - structure 161–162
- social interaction, captive bats
 - roosting structure and activity patterns 63–64
- somatosensory or auditory system
 - seismic communication 41–42
- song control system 277–278
 - anterior forebrain pathway 277
 - direct motor pathway 277
 - features 278
- song crystallization
 - androgen expression 231, 232
 - mechanisms 232
 - vocal-paralysis study 231
- song learning 267–271, 340
 - nucleus RA
 - cellular analysis 240–241
 - functional synaptic analysis 241–244
 - neuronal codes 237–238
 - synaptic connectivity 238
 - vocal plasticity, neural correlates 237
- learned behavior
 - birdsong development 227–232
- molecular effectors
 - synaptic and vocal plasticity 244–249
- RA subregions
 - structure and function 239
- sensitive periods
 - for learned behavior 223–224
 - neural circuit plasticity 224–227
 - neuronal and behavioral 224
 - and synaptic mechanisms 223
- sensorimotor phase 268
- sensory phase 267–268
- song control system 277–278
 - features 278
 - pathways 277
- song plasticity
 - neural correlates 236–237
- song system
 - neural circuit for learning 232–236
 - vocal imitation 267–268
- song memorization 229, 230, 267, 276–282
- song perceptual processing 267–271
- song system
 - anterior forebrain pathway (AFP), lesions
 - learning pathway 234
 - direct-motor pathway 233
 - juvenile deafening 234
 - LMAN activity 236
 - neural circuit
 - birdsong, learning and production 232
- song variability 230
- songbirds
 - helium results mechanisms 25
 - labia 5, 12
 - mormyrid electric fish, comparison 282–285
 - perceptual processing 276–282
 - respiratory motor patterns 8
 - sensory-motor coupling 269, 275
- song
 - discrimination 278–279
 - learning 267–268
 - perceptual processing 266, 267–271, 280, 285
- song consolidation 248
 - plasticity 246
- song system of the brain 233
- syrinx 4, 13, 16
- vocal communication 266, 267
- vocal learning 9–10, 116, 227, 266, 271, 282
- sound processing 207–214
 - intermediate complexity 207
 - selectivity
 - BPN 207–210
 - frequency sweeps parameters 210–214
- Spalax ehrenbergi* *see* blind mole rat
- spatiotemporal processing, guinea pig
 - auditory cortex
 - activity spreads, higher auditory fields 197–198

- AI responses, vocalized sounds 195
 - multiple auditory fields, functional differences 198–200
 - optical recording methods 189–191
 - optical signals, principal component analysis 200–202
 - spatiotemporal representation
 - constant and frequency-modulated tones 193–195
 - functional significance 195–197
 - tonotopic organization, auditory cortical fields 191–193
 - spatiotemporal representation
 - constant and frequency-modulated tones 193–195
 - functional significance 195–196
 - species-specific calls, responses
 - MC
 - preference index 216
 - and spatial selectivity 216–217
 - nonlinear integration mechanisms 214–216
 - combination-sensitivity 215
 - species-specific communication sound 217
 - spectral (formant) structure, acoustic patterns
 - continuum 102–103
 - spectral resolution 89
 - spectral summation 89
 - subsongs 229
 - subsyllables 57, 59
 - syllables
 - mustached bat 57, 59
 - songbird 229
 - syringeal membranes 6–7
 - syrinx 3–5
- T
- Tadarida brasiliensis* see Mexican free-tailed bats
 - temporal summation 87–88, 216
 - territoriality and social dominance, mustached bats 70–71
 - tests, neural circuit model
 - alternative possibilities 249
 - developmental regulation 251
 - selection, RA 252
 - synaptic connectivity and vocal plasticity correlations 250
 - tonotopic organization
 - auditory system, fundamental 135
 - auditory cortical fields 191–193
 - tonotopic organization, guinea pig auditory cortex 191–193
 - characteristic frequencies (CFs) contours 192
 - tonotopy 160
 - two-voice vocalizations 17–19
- U
- unilateral dominance versus bilateral parity bipartite syrinx 16–17
 - urgency of response, audible parameter space 99–100
 - USVs, pups 96
- V
- vibratory dialogue 37, 38
 - vibratory signals
 - properties 38–40
 - temporal patterns, analysis 39
 - see also seismic signals
 - vocal communication
 - neural mechanisms
 - future prospects 129
 - neuroendocrine mechanism 123
 - vocal–auditory coupling 126–129
 - vocalization, hormonal control 123–126
 - vocal signature, mothers and pups 134
 - vocal imitation
 - sensorimotor phase 268
 - sensory acquisition phase 267–268
 - vocal learning 9–10, 116, 265, 266, 271, 282
 - vocal mechanisms, for avian communication 3
 - vocal source 10
 - amplitude modulation 11–13
 - frequency modulation
 - air sac pressure 13, 14
 - songbirds 13, 15, 16, 19, 29
 - syringeal muscles 13
 - vocal tract filtering 24–28
 - vocal–auditory coupling
 - steroid hormones 126–129
 - vocalizations 17, 23, 26, 28, 86
 - composite 57, 59
 - frequency jumps, bird 23
 - hormonal control, steroid modulation 124–125

nonlinear dynamics 20–24
simple syllables 57, 59
turtle-dove 21
two-voice 17–19

W

wing-flicking behavior 65, 76
wrestling and biting behavior 66

wriggling calls, pups 96, 102, 104
spectral (formant) structure 102–103

Z

zebrafinch
HVC-RA plasticity 244
inspiratory syllables 7
song development 228