SUMMARY OF RESEARCH INTERESTS OF PARTICIPATING FACULTY
RESEARCH TRAINING IN OTOLARYNGOLOGY AND COMMUNICATION SCIENCES

HEATHER S. BONILHA, PhD: The central goal of Dr. Bonilha’s research is to improve diagnostic accuracy and treatment effectiveness in voice and swallowing disorders, which is driven by clinical needs identified from working with patients diagnosed with these disorders. The current focus is an R01-funded study investigating the influence of pulse rate on diagnostic accuracy, treatment recommendations and radiation exposure from Modified Barium Swallow Studies (MBSS). Other ongoing projects, all of which include roles for predoctoral and postdoctoral trainees, are related to predicting patient swallowing outcomes post-stroke using MRI and MBSS; efficacy of deleterious and ameliorative mucus clearing behaviors; the effect of coughing and throat clearing on mucosal lesions of the vocal folds; and improving the reliability of structural and functional findings from laryngeal endoscopy.

JUDY R. DUBNO, PhD: Dr. Dubno’s research focuses on auditory perception and speech recognition in adverse listening conditions, and how perception changes with age, hearing loss, hearing aids, and training. Current projects related to the effects of cochlear hearing loss are designed to test hypotheses within the framework of the active process of the cochlea (“cochlear amplifier”), which is responsible for many fundamental properties of audition. Current projects studying age-related hearing loss assess age-related changes in auditory function related to metabolic, sensory, and neural pathologies. These projects are designed to validate audiometric phenotypes using suprathreshold measures of cochlear and neural function beyond the audiogram that characterize metabolic and sensory presbyacusis, and the additive effects of morphologic and functional neural loss. In collaboration with Core Mentors Eckert, Lang, and Schulte, morphologic and physiologic changes characterizing metabolic, sensory, and neural presbyacusis provide a framework for assessing and interpreting age-related changes in human auditory function. Dr. Dubno also directs the longstanding P50-supported research program on presbyacusis, which supports, in part, an ongoing longitudinal study of age-related changes in auditory function in adults. She has a long history of mentorship of graduate students, otolaryngology residents, postdoctoral fellows, and junior faculty investigators.

MARK A. ECKERT, PhD: Dr. Eckert’s neuroimaging research examines individual differences in neurobiology that limit or enhance auditory perception, cognitive ability, and response to intervention. Neuroimaging is used to examine the impact of hearing loss on the central auditory system and the impact of hearing loss of the engagement of attention systems that support speech recognition. He has major projects involving human post-mortem imaging and optogenetic fMRI of the locus coeruleus attention system. The development of methods, particularly for a large scale study on multi-site retrospective studies of dyslexia, also is a focus of Dr. Eckert’s laboratory. In conjunction with building an understanding of individual differences in auditory perception and cognition, the long-term goal of Dr. Eckert’s research is to develop strategies and interventions for auditory-, attention- and language-related difficulties that are grounded in neurobiology. Graduate students and postdoctoral trainees therefore have basic and translational research opportunities, as well as opportunities for multi-site research professional development owing to Dr. Eckert’s international collaborations. Dr. Eckert has provided training for junior faculty, postdoctoral fellows, graduate students, undergraduate students, and a high school student who won a statewide research completion related to her research in Dr. Eckert’s laboratory.

DANIEL FOGERTY, PhD: Dr. Fogerty’s research at the University of South Carolina (USC) is focused on identifying primary acoustic properties most important for speech recognition and how perceptual weighting of these cues may change under certain environmental and/or linguistic contexts, when altered by adverse listening conditions, and by listener-specific characteristics, such as age or hearing loss. Results of these investigations will inform the design of assistive listening devices that dynamically adjust signal processing to preserve and enhance acoustic cues of high perceptual salience that are within the processing capabilities of individual listeners. Results may also assist in the development of auditory training protocols to enhance the benefit of these important speech cues. Ongoing research (which currently supports one predoctoral trainee at MUSC) is conducted in collaboration with Dr. Dubno at MUSC for the study of temporal processing and speech understanding abilities in older adults with normal or impaired hearing. A clear benefit of this multi-site
relationship is the ability to support collaborative training opportunities that capitalize on the strengths of each site. Mentored students and postdoctoral fellows acquire theoretical and methodological skills in research related to auditory processing and speech understanding in younger and older adults and develop proficiency in digital signal processing and programming. Additional training support is available through USC’s Institute for Mind and Brain, which offers group meetings for predoctoral and postdoctoral trainees on professional issues, as well as colloquia. Dr. Fogerty is a member of the Graduate Faculty in the MUSC College of Graduate Studies.

JULIUS FRIDRIKSSON, PhD: Dr. Fridriksson is the director of the Aphasia Lab and the Co-Director of the McCausland Center for Brain Imaging at the University of South Carolina (USC). He also conducts extensive research at MUSC, including data collection for a U01-supported clinical trial focused on aphasia recovery in acute and chronic stroke patients, in ongoing collaborations with MUSC faculty. The primary goal of the research in the Aphasia Lab is better understanding and treatment of aphasia in adult stroke patients. Much of this work focuses on neuroplasticity associated with aphasia recovery, transcranial brain stimulation to treat aphasia, and lesion-symptom mapping to understand normal speech and language processing. Graduate students have ample opportunity to be involved in all aspects of this research and gain hands-on experience with methodologies such as structural MRI, functional MRI, transcranial magnetic stimulation, and transcranial direct current stimulation. During the past 13 years, Dr. Fridriksson has directed several predoctoral students and postdoctoral fellows and mentored five junior faculty members. His work has been continuously funded since 2002 and the Aphasia Lab is currently supported by two grants from the NIDCD. Dr. Fridriksson is a member of the Graduate Faculty in the MUSC College of Graduate Studies.

KELLY C. HARRIS, PhD: Dr. Harris is an emerging mentor whose research focuses on age-related changes in auditory function along the central auditory pathway and their contributions to changes in communication abilities of older adults. Her research examines age-related and individual differences across behavioral and electrophysiological measures of temporal processing and the underlying changes in brain structure and metabolism that contribute to these effects. From a clinical standpoint, understanding temporal resolution in the auditory system and its underlying neural processes may help explain the large variance in speech understanding in older adults. These studies provide complementary new information to ongoing research in several otolaryngology laboratories, in particular the research being conducted by Dr. Dubno and Dr. Eckert. Interdisciplinary opportunities include advanced training in collection and analysis of measures of auditory electrophysiology and structural and metabolic imaging, especially as they relate to age-related declines in neural function.

HAINAN LANG, MD, PhD: Dr. Lang’s research focuses in two major areas. One is the role of cochlear stem cells in degeneration of the cochlear lateral wall in metabolic presbyacusis. Adult stem cells are present in a variety of tissues and organs including the cochlea, where they contribute to tissue homeostasis and plasticity by repairing injured cells throughout life. The experiments aim to reveal fundamental cellular and molecular mechanisms responsible for cochlear lateral wall dysfunction in aged mice with a focus on extracellular proteins and their associated microRNAs. In parallel, postmortem human temporal bones from aged donors are examined to validate key regulatory candidates identified from mice. A second focus is the role of cochlear glial cells in the regeneration of auditory nerve using a cochlear injury model and stem cell transplantation. Acute injury in cochlear neurons induces up-regulation of Sox2, a transcription factor that is highly expressed in undifferentiated neural progenitor cells during development and adult neurogenesis. This up-regulation, along with the proliferation of Sox2+ glial cells in the injured adult cochlear neurons, suggests that mature glial cells can revert to a less differentiated phenotype and re-enter the cell cycle following acute injury. The experiments aim to reveal the key regulatory factors associated with glial cell phenotypic changes in response to cochlear injury and the molecular mechanisms promoting the survival of transplanted stem cells by Sox2 expressing glial cells. Dr. Lang has directed several predoctoral students in the interdisciplinary Molecular and Cellular Biology and Pathobiology (MCBP), Pathology, and Neurosciences graduate programs, otolaryngology residents, and postdoctoral fellows, providing training in cellular and molecular procedures using animal models and human cochlear tissues, gene regulation, and regenerative medicine. Dr. Lang’s mentees have won numerous awards for their research, including top prizes at MUSC Student Research Day, first and second place awards at otolaryngology meetings, and published first-authored papers in high-quality journals.
BONNIE MARTIN-HARRIS, PhD: Dr. Martin-Harris’s research centers on the physiology and pathophysiology of voice and swallowing disorders. The specialty areas of study include: (1) cross system interactions between respiratory and swallowing function and impairment; (2) patient outcomes related to standardization of training methods in swallowing assessment and targeted treatments; (3) classification of dysphagia phenotypes and associated recovery patterns in neurologic, pulmonary and oncologic diseases and conditions; (4) voice and swallowing impairment in patients with Chronic Obstructive Pulmonary Disease; and (5) dynamic model development to predict the effects of simulated interventions on swallowing impairment. In addition to directing the Evelyn Trammell Institute for Voice and Swallowing, Dr. Martin-Harris also directs the PhD Program in Health and Rehabilitation Sciences in the College of Health Professions, which is an interdisciplinary research degree program that emphasizes curriculum and research on function, factors, and interventions that disable or enable people. Dr. Martin-Harris’s research laboratory incorporates predoctoral students and postdoctoral fellows in mentored research opportunities. She has a Mid-Career Investigator Award (K24) that is specifically designated for protected time and resources to facilitate training and mentorship of junior clinician-scientists aspiring toward independent research careers.

JENNIFER K. MULLIGAN, PhD: Dr. Mulligan’s research is focused on understanding the mechanisms driving the dysregulation in Th1/Th2 balance associated with a number of airway diseases, primarily chronic rhinosinusitis (CRS). In patients with CRS this balance is disrupted with elevated levels of Th2 activation, thereby driving many of the physical symptoms of including hyperplasia, increased mucus production and rhinorrhea. A significant proportion of this research focuses on understanding how stromal cells, such as epithelial cells and fibroblasts, serve as upstream mediators promoting Th2 inflammation. Studies are conducted with primary human tissues obtained from patients with CRS, which is supplemented by studies using a murine model of atopic CRS. Collaborations are ongoing with Dr. Soler to investigate mechanisms underlying the association between Th1/Th2 cytokines and impaired olfaction in CRS using both human tissue and murine models. Pre- and postdoctoral trainees are exposed to a broad range of immunology methodologies and receive training in the principles of immunology, grant and manuscript writing, data presentation and experimental design.

CHANDRAKALA PULIGILLA, PhD: During embryonic development, multi-potent progenitors use cell-extrinsic and intrinsic signals to determine cellular fate and patterning. Elucidating the mechanisms by which they do so remains a challenge in developmental biology. The developing mammalian inner ear is comprised of multi-potent progenitor population of cells that gives rise to a diverse array of cell types, including mechanosensory hair cells, nonsensory supporting cells, and neurons. The overall goal of Dr. Puligilla’s research is to identify genetic regulatory networks involved in cell fate specification and understand how different cell types are assembled with stereotyped precision. This requires identification and detailed understanding of signaling pathways that impart positional identity to different cell types within the developing cochlea and to define the mechanisms that link precise coordination between fate specificity, positional identity, and cellular patterning. Dr. Puligilla’s goal is to understand fundamental developmental events and to use this knowledge to target or reinitiate the replacement of different cell types including spiral ganglion neurons in older adults and those with hearing loss. The laboratory offers a rich array of training opportunities for graduate students, residents, and postdoctoral fellows, including cell and molecular biology techniques.

RODNEY J. SCHLOSSER, MD: Dr. Schlosser’s areas of interest revolve around understanding aspects of immune dysfunction in chronic rhinosinusitis (CRS) in order to develop novel therapeutic agents that will impact patients’ quality of life, including olfactory function. As trainees gain important laboratory skills in a wide variety of basic science techniques, including immunohistochemistry, flow cytometry and cell culture, Dr. Schlosser emphasizes the correlation of these important immunologic results into clinically relevant findings, such as impact upon olfactory function, symptom scores, CT or endoscopic staging. He is also using both in vitro and in vivo models to actively investigate novel therapeutic methods to impact the immune dysfunction present in CRS. Additional studies are ongoing to investigate combinations of clinical and local immune biomarkers that will provide information needed to predict disease severity and treatment outcomes. All trainees also gain experience in critical review of existing literature, grant writing and publishing of manuscripts.
BRADLEY A. SCHULTE, PhD: Dr. Schulte’s laboratory conducts basic biomedical research aimed at defining the molecular and cellular mechanisms responsible for generating the unique ionic and electrochemical gradients in the inner ear. Biochemical and histochemical techniques are used to identify and determine the precise cellular distribution of ion transport mediators and their associated regulatory proteins. Emphasis is placed on relating changes in auditory function with alterations in the expression of key proteins promoted by mutations, disease, noise trauma, and aging. *In vivo* and *in vitro* studies are conducted using mouse animal models. A newly funded study within the P50 Clinical Research Center seeks to identify genetic variations associated with increased susceptibilities to age-related hearing loss. This work involves whole exome sequencing of over 1000 human subjects with well-characterized auditory phenotypes to identify genetic variants and biological pathways associated with specific phenotypes. Pathological and potential functional consequences of these variants are explored using human temporal bones. Dr. Schulte has a long history of training graduate students in the MCBP and Pathology programs, otolaryngology residents, postdoctoral fellows, and junior faculty investigators.

SU-HUA SHA, MD: Dr. Sha’s laboratory focuses on investigation of the molecular mechanisms of acquired hearing loss, primarily noise-induced hearing loss. The primary goal is to elucidate the molecular mechanisms that dictate the fate of inner ear sensory cells, determined by whether the pathways signaling to cell death or cell repair and survival prevail. Currently, the lab is pursuing novel hypotheses based on their recent finding of energy depletion-induced changes in the activity of small GTPases in sensory hair cells and resultant actin cytoskeleton rearrangements. While Dr. Sha’s research projects provide valuable insights into the molecular events responsible for inner ear damage, her laboratory is also addressing translational questions with the goal of designing novel, rational pharmacological or molecular/genetic therapeutic interventions to ameliorate noise-induced hearing loss, which provide excellent opportunities for training predoctoral students and postdoctoral fellows.

ANN-CATHERIN SIMPSON, PhD: Dr. Simpson is a biostatistician and health services researcher with extensive biostatistical modeling and programming experience. Her research is focused on using statistical methods to maximize the use of observational data to answer comparative effectiveness questions, particularly in the study of treatment of complex chronic disease and communication disorders. She has a recently funded NIDCD R21 examining the extent to which hearing loss affects the process of care for other chronic conditions and/or is associated with poor health outcomes and higher healthcare costs using Propensity Scores. Dr. Simpson is also the analyst for the economic portion of the Interventional Management of Stroke III (IMS III) clinical trial (NINDS) and the Evaluating Predictors and Interventions in Sphincter of Oddi Dysfunction (EPISOD) clinical trial (NIDDK) where she performs cost-effectiveness analysis as a “piggy-back” method on top of clinical trial findings. She is also a co-investigator of the evaluation team examining critical-care outcomes during the implementation and dissemination of a new tele-ICU program across South Carolina (Duke Endowment). Her primary research is focused on the development and application of Propensity Scoring methods for causal inference, which is a groundbreaking technique aimed at moving observational study design up the evidence level hierarchy. She is currently mentoring six predoctoral trainees in the use of these methods to answer speech, swallowing, and movement disorder questions as a primary instructor in the PhD Program in Health and Rehabilitation Science.

ZACHARY M. SOLER, MD, MSc: Dr. Soler’s research is aimed at a better understanding of the clinical impacts of chronic rhinosinusitis (CRS) and predicting responses to treatment. Ongoing studies involve prospective collection of detailed clinical data on patient cohorts with CRS, along with analysis of harvested sino-nasal tissue. These studies are often multi-institutional with the lab serving as the lead institution. One primary focus is olfactory dysfunction, supported by an R03 from NIDCD. Dr. Soler is currently working to develop more specific measures with which to predict olfactory dysfunction, including assessing the inflammatory cytokine profile of the olfactory cleft and refining radiographic and endoscopic measures. Another focus is better quantifying less appreciated outcome measures such as sleep and cognitive function. Dr. Soler’s lab routinely has short-term predoctoral and postdoctoral trainees and otolaryngology residents working on several aspects of this research at any one time. The breadth and depth of current projects provides outstanding opportunities for translational research for trainees at all levels.
M. RITA YOUNG, PhD: Dr. Young’s research focuses on understanding how tumors manipulate the host to facilitate tumor development. The specific areas of study are: (1) identifying how tumors avoid immune destruction, and (2) developing immune therapeutic approaches for the treatment of cancer. These studies are accomplished through strong collaborations with clinicians, including otolaryngology-head and neck surgeons, oral pathologists, and oral surgeons. More recently, research has expanded to studying the progression of premalignant oral lesions toward malignancy. These studies have included determination of when, in the course of cancer development, premalignant lesions express tumor antigens and if these lesions can be used as a source of tumor antigen to develop tumor vaccines that would protect against head and neck cancer. The laboratory offers outstanding interdisciplinary training opportunities and Dr. Young has directed numerous dissertations and mentored several postdoctoral researchers, including otolaryngology residents.