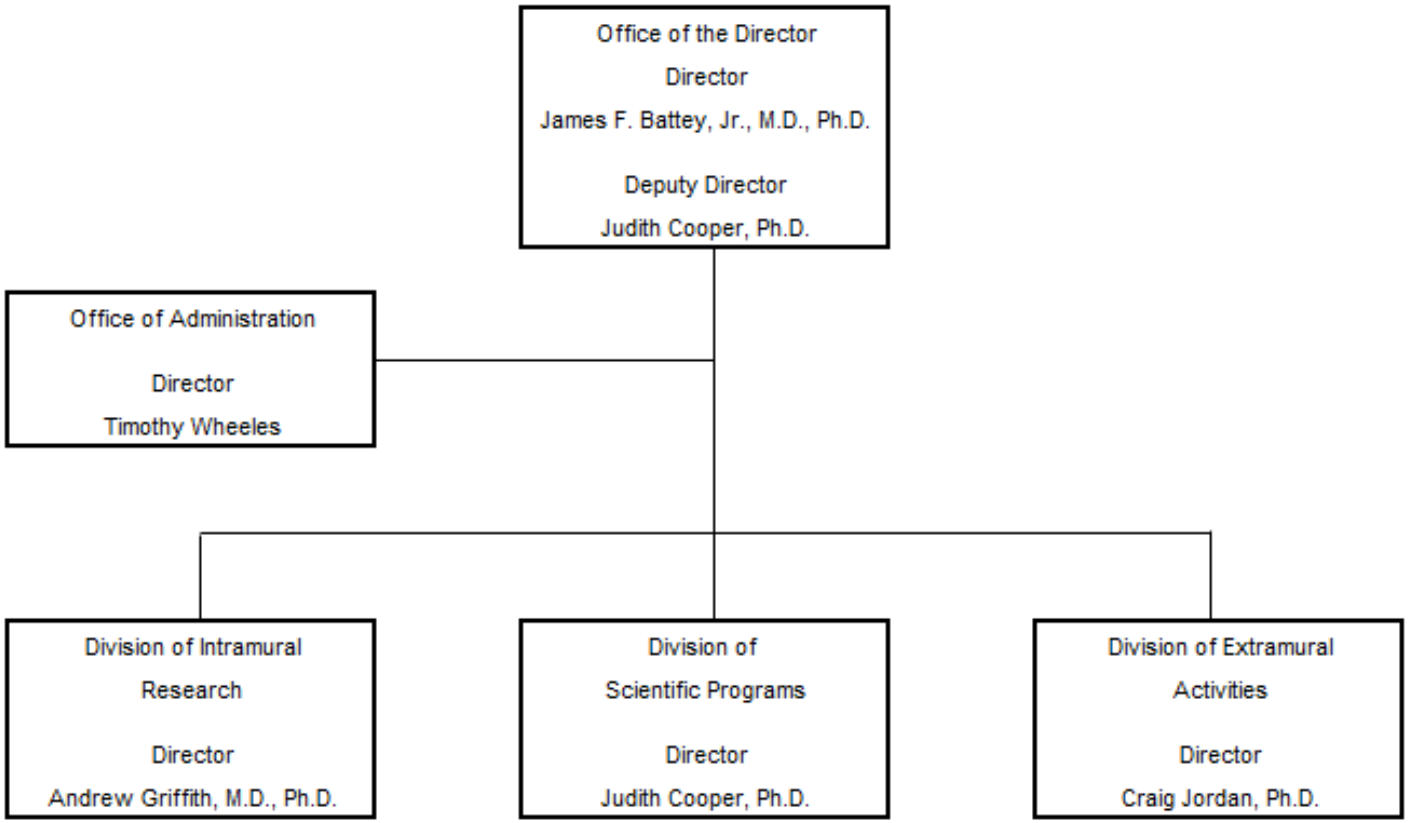
DEPARTMENT OF HEALTH AND HUMAN SERVICES

NATIONAL INSTITUTES OF HEALTH

National Institute on Deafness and Other Communication Disorders (NIDCD)

NATIONAL INSTITUTES OF HEALTH

National Institute on Deafness and Other Communication Disorders



NATIONAL INSTITUTES OF HEALTH

National Institute on Deafness and Other Communication Disorders

For carrying out section 301 and title IV of the PHS Act with respect to deafness and other communication disorders, $325,846,000.

NATIONAL INSTITUTES OF HEALTH
National Institute on Deafness and Other Communication Disorders

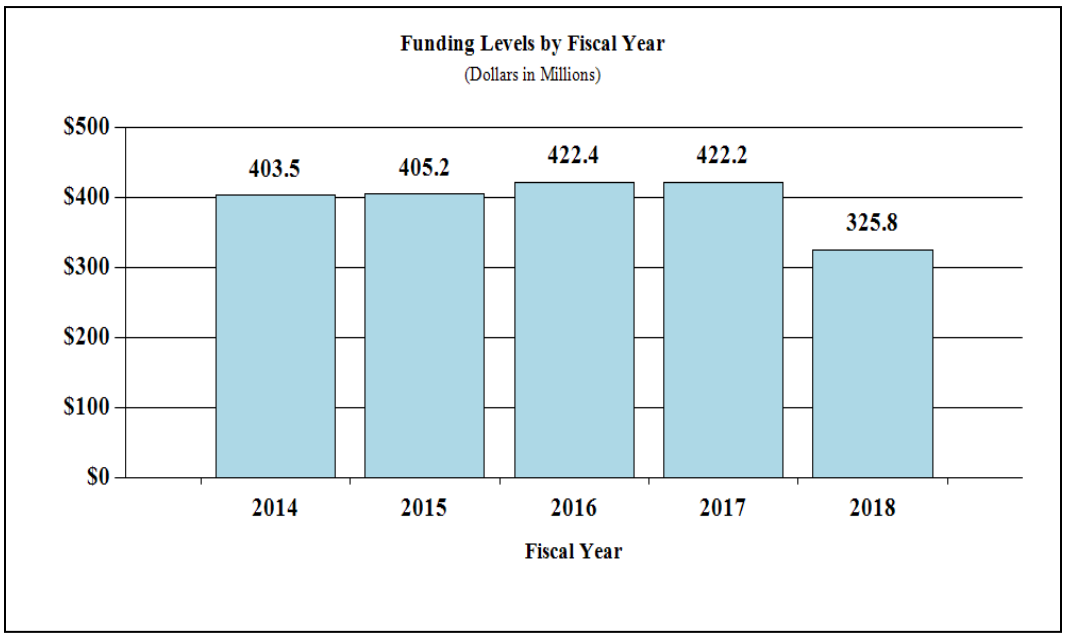
Amounts Available for Obligation[1]
(Dollars in Thousands)

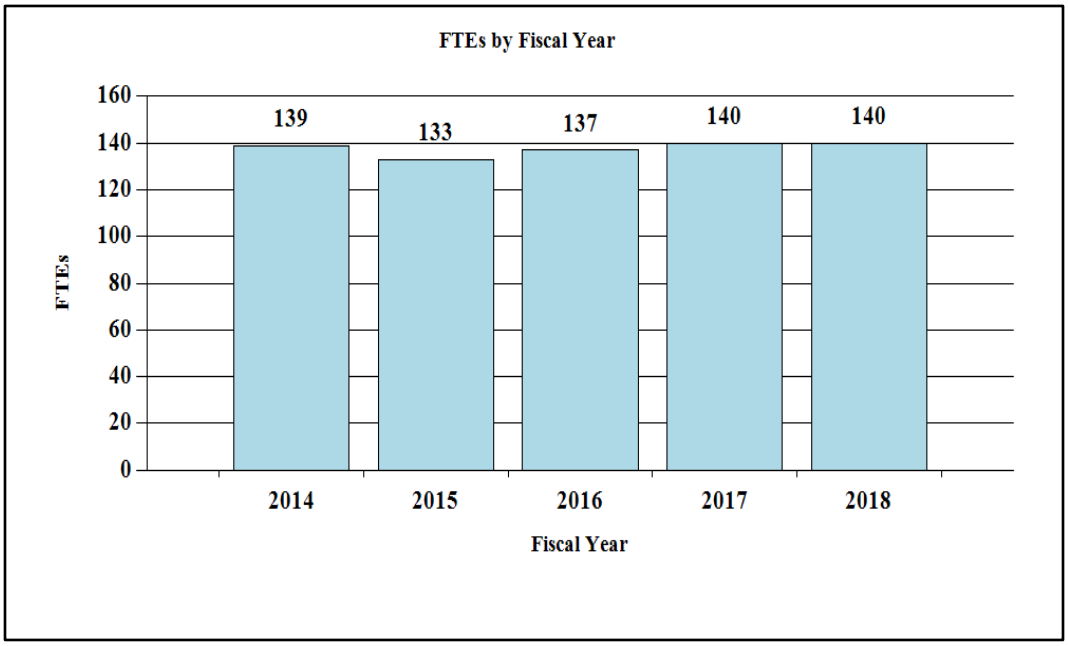
Source of Funding	FY 2016 Final	FY 2017 Annualized CR	FY 2018 President's Budget
Appropriation	$423,031	$423,031	$325,846
Mandatory Appropriation: (non-add)			
Type 1 Diabetes	*(0)*	*(0)*	*(0)*
Other Mandatory financing	*(0)*	*(0)*	*(0)*
Rescission	0	-804	0
Sequestration	0	0	0
Zika Intra-NIH Transfer	-585	0	0
Subtotal, adjusted appropriation	$422,446	$422,227	$325,846
OAR HIV/AIDS Transfers	-95	0	0
Subtotal, adjusted budget authority	$422,351	$422,227	$325,846
Unobligated balance, start of year	0	0	0
Unobligated balance, end of year	0	0	0
Subtotal, adjusted budget authority	$422,351	$422,227	$325,846
Unobligated balance lapsing	-39	0	0
Total obligations	$422,311	$422,227	$325,846

[1] Excludes the following amounts for reimbursable activities carried out by this account:
FY 2016 - $1,415 FY 2017 - $2,500 FY 2018 - $1,925

Fiscal Year 2018 Budget Graphs

History of Budget Authority and FTEs:





NATIONAL INSTITUTES OF HEALTH
National Institute on Deafness and Other Communication Disorders

Authorizing Legislation

	PHS Act/ Other Citation	U.S. Code Citation	2017 Amount Authorized	FY 2017 Annualized CR	2018 Amount Authorized	FY 2018 President's Budget
Research and Investigation	Section 301	42§241	Indefinite	$422,226,818	Indefinite	$325,846,000
National Institute on Deafness and Other Communication Disorders	Section 401(a)	42§281	Indefinite		Indefinite	
Total, Budget Authority				$422,226,818		$325,846,000

NATIONAL INSTITUTES OF HEALTH
National Institute on Deafness and Other Communication Disorders

Appropriations History

Fiscal Year	Budget Estimate to Congress	House Allowance	Senate Allowance	Appropriation
2008	$393,682,000	$400,305,000	$402,680,000	$394,138,000
Rescission				$7,008,000
Supplemental				$2,096,000
2009	$395,047,000	$408,587,000	$406,000,000	$407,259,000
Rescission				$0
2010	$413,026,000	$422,308,000	$414,755,000	$418,833,000
Rescission				$0
2011	$429,007,000		$428,331,000	$418,833,000
Rescission				$3,677,604
2012	$426,043,000	$426,043,000	$410,482,000	$417,061,000
Rescission				$788,245
2013	$417,297,000		$418,562,000	$416,272,755
Rescission				$832,546
Sequestration				($20,894,030)
2014	$422,936,000		$420,125,000	$404,049,000
Rescission				$0
2015	$403,933,000			$405,302,000
Rescission				$0
2016	$416,241,000	$412,366,000	$424,860,000	$423,031,000
Rescission				$0
2017[1]	$422,936,000	$434,126,000	$441,778,000	$423,031,000
Rescission				$804,000
2018	$325,846,000			

[1] Budget Estimate to Congress includes mandatory financing.

Justification of Budget Request

National Institute on Deafness and Other Communication Disorders

Authorizing Legislation: Section 301 and title IV of the Public Health Service Act, as amended.

	FY 2016 Actual	FY 2017 Annualized CR	FY 2018 President's Budget	FY 2018 +/- FY 2017
BA	$422,350,505	$422,226,818	$325,846,000	-$96,380,818
FTE	137	140	140	0

Program funds are allocated as follows: Competitive Grants/Cooperative Agreements; Contracts; Direct Federal/Intramural and Other.

Director's Overview

Over 80 percent of children experience ear infection (otitis media) by the time they are three years old.[1] Hearing loss is the most common workplace injury in the U.S.[2] Tinnitus (ringing in the ear) is the leading service-related disability among U.S. military veterans.[3] Dizziness, which can result from problems in the brain or the inner ear, is a primary cause for falls in the elderly.[4] The National Institute on Deafness and Other Communication Disorders (NIDCD) manages a broad intramural and extramural portfolio of both basic and clinical research focused on the above disorders and conditions, specifically human communication research in three program areas: hearing and balance; taste and smell; and voice, speech, and language.

NIDCD Research Advances: Extraordinary research opportunities have led to scientific breakthroughs in the study of genes, proteins, sensory and supporting cells, and molecular processes that directly affect our understanding of communication disorders. In the past year, NIDCD-supported research activities have led to advances in the following areas of communication science:

- **Treatments and Cures: Small Molecule Therapy Development for Usher Syndrome[5]:** Children with Usher syndrome type 3 (USH3) usually lose their hearing and vision by their teenage years and no treatment is currently available to slow this progression. Scientists funded in part by NIDCD have discovered a small molecule, BF844, that can slow progressive hearing loss and prevent deafness in an animal model with this syndrome. This small molecule targeted therapy could, in principle, be used to

[1] https://www.ncbi.nlm.nih.gov/pubmed/2732519
[2] https://www.cdc.gov/mmwr/volumes/65/wr/pdfs/mm6515a2.pdf
[3] https://www.ata.org/understanding-facts/demographics
[4] https://www.ncbi.nlm.nih.gov/pubmed/19468085
[5] https://www.ncbi.nlm.nih.gov/pubmed/27110679

prevent both deafness and blindness in children with USH3, and could even be started preemptively before the onset of their hearing loss and vision loss.

- **Fundamental Science: Rewriting the Rules of Odor Detection[6]:** A team of NIDCD-funded scientists has identified a new class of odorant receptors in mice that are structurally and functionally very different from typical odorant receptors. These new receptors are expressed in a unique class of olfactory sensory neurons (OSNs) in the nose which are part of the 'olfactory necklace system' and send signals to a distinct region of the olfactory bulb of the brain. Unlike typical OSNs which only express a single receptor type, the necklace OSNs express more than one type of odorant receptor suggesting that they relay odor information to the brain differently. Interestingly, these receptors detect odors that seem to stimulate innate (unlearned) responses critical for survival, such as those to help avoid danger, rather than learned odors, such as "this is the smell of roses." These receptors are also found in humans. Scientists are now working to learn more about how these newly-identified receptors interact with odorants and trying to understand how the brain interprets messages from the olfactory necklace system.

- **Fundamental Science: New Technology Offers Insights into Primary Progressive Aphasia[7]:** Primary progressive aphasia (PPA) is a gradual and increasing impairment of language use and comprehension resulting from an underlying brain disease. PPA is caused by a buildup of toxic amyloid protein which is similar to individuals with Alzheimer's disease. In a study funded in part by NIDCD, scientists used a new imaging technology called amyloid-PET to study the buildup of amyloid protein in the brain. They discovered that accumulation was greater on the left side of the brain - the site of language processing - than on the right side in many individuals living with PPA. Previously, amyloid buildup in the brain could only be studied after an individual with the disease had died. This new technology can help scientists diagnose neurodegenerative diseases caused by amyloid protein accumulation during onset, with the goal of guiding treatment and identifying regions to target for future drug trials for individuals with PPA and Alzheimer's disease.

NIDCD Plans, Priorities, and Challenges for the Future: NIDCD continues its support of new and competing Research Project Grants from investigators who have innovative ideas and fresh perspectives. NIDCD is preparing a diverse and talented biomedical research workforce focused on communication disorders, especially the research training and career development of emerging clinician-investigators. NIDCD prioritizes its research investments to identify the most promising opportunities for human communication research, including:

- **Health Promotion and Disease Prevention: Accessible and Affordable Hearing Health Care for Adults**: In June 2016, the National Academies of Science, Engineering, and Medicine released its consensus study on improving accessibility and affordability of hearing health care for adults. The report includes 12 key recommendations to enhance consumers' ability to find and use the appropriate, affordable, and high-quality services, technologies, and support they need to manage hearing loss. The report also calls for more evidence-based information for the public and increased transparency of fee structures for devices and

[6] https://www.ncbi.nlm.nih.gov/pubmed/27238024
[7] https://www.ncbi.nlm.nih.gov/pubmed/26600088, https://www.ncbi.nlm.nih.gov/pubmed/27183206

services, compatible technologies, and patients' rights to their hearing health care records so they can make more informed decisions. In response to the report's many recommendations for further research, NIDCD supports adult hearing loss research that addresses multilevel, transdisciplinary population health interventions that target underlying social, economic, and environmental conditions in an effort to improve health outcomes. NIDCD hopes data from this research will improve the quality of hearing health care for adults and make it more accessible and affordable for everyone.

- **Enhancing Stewardship: Supporting Young and Early Career Investigators:** NIDCD places great emphasis on supporting training and career development of young and early stage investigators to ensure an innovative cadre of qualified communication scientists enter the biomedical research workforce. In addition to providing research training programs aimed at M.D. and Ph.D. scientists, NIDCD supports a Research Dissertation Fellowship and a Mentored Career Development Award for audiologists holding an Au.D. to integrate biomedical, behavioral, or clinical research sciences into their career path. To bolster clinician-scientists in the chemical senses research field, NIDCD supports administrative research supplements for medical students who have an interest in conducting basic, translational, or patient-oriented research. Further, the NIDCD Early Career Research Award is intended to support both basic and clinical research scientists who are beginning to establish an independent research career to obtain sufficient preliminary data for a subsequent R01 research project grant application.

Overall Budget Policy: The FY 2018 President's Budget request is $325.846 million, a decrease of $111.029 million compared with the FY 2017 Annualized CR level. These reductions are distributed across all programmatic areas and basic, epidemiology, or clinical research.

Program Descriptions and Accomplishments

Hearing and Balance Program: Loss of hearing or balance imposes a significant social and economic burden upon individuals, their families, and the communities in which they live. Millions of Americans experience a hearing or balance disorder at some point in their life, especially as young children or older adults. Common examples include middle-ear infections (otitis media), noise-induced hearing loss, tinnitus, age-related hearing loss, dizziness, and vertigo. Hearing and balance disorders also decrease quality of life, and cross all ethnic and socioeconomic lines. Approximately 36 million American adults report some degree of hearing loss[8] and almost eight million adults report a chronic problem with balance.[9] In addition, about two to three out of every 1,000 children in the U.S. are born with a detectable level of hearing loss in one or both ears that can affect their speech, language, social, and cognitive development.[10] Accordingly, research projects within the NIDCD Hearing and Balance Program encompass over half of NIDCD's portfolio. To study normal and disordered functions of the auditory and vestibular systems, NIDCD employs a wide range of research approaches such as molecular genetics, cellular biology, biomedical imaging, nanotechnology, psychoacoustics, and structural and functional biology. NIDCD supports research that will lead to improved

[8] Based on NCHS/NHIS data for 2007.
[9] Based on prevalences from the 1994–95 Disability Supplement to the NHIS and current US population estimates.
[10] http://www.ncbi.nlm.nih.gov/pubmed/20203554, http://www.ncbi.nlm.nih.gov/pubmed/12784222

treatments for, and prevention of, hearing and balance disorders. For example, NIDCD is continuing its long-standing commitment to improving access to human ear tissues through the support of the National Temporal Bone Registry, which contains information on thousands of donated human temporal bones and coordinates new temporal bone donations for scientific research. In addition, NIDCD will support a new National Human Ear Tissue Laboratory Resource for Hearing and Balance Research which will serve as a national technological resource for auditory and vestibular researchers who use human inner and middle ear tissues for a variety of basic and clinical studies.

In addition, NIDCD is supporting scientists who are using an artificial microRNA molecule to slow progressive hearing loss in an animal model that will become deaf in the first few years of life due to a genetic mutation. Given that many causes of humans hearing loss are the result of a gene mutation, microRNA-based therapy may be a possible future treatment for preventing this type of deafness. Another NIDCD-supported scientist has discovered that using a cocktail of monoclonal antibodies with a traditional antibiotic is effective in killing bacteria that cause otitis media (middle ear infection). This treatment disrupted the protective biofilm formed by the bacteria in an animal model with otitis media. In another study, NIDCD-supported scientists have determined that individuals with severe bacterial infection are at greater risk of hearing loss when treated with aminoglycoside antibiotics. It is well known that aminoglycoside antibiotics are effective in treating bacterial infections, however, these life-saving antibiotics are also toxic to the delicate hair cells in the inner ear. These animal studies demonstrated that inflammation produced in severe bacterial infections made the sensitive hair-cells in the inner ear more susceptible to damage from the antibiotics.

Auditory perception of discriminable categories of sounds is an essential feature for understanding human speech. A NIDCD-supported scientist has used behavioral studies and computational modeling to show how English-speaking adults learn to categorize non-native speech sounds (Mandarin Chinese tones). A particular gene known as FOXP2 is associated with dysfunction of speech acquisition, and here individuals with particular genetic variants of FOXP2 showed some advantages compared to other variants in learning these non-native tonal categories. These results show important human parallels to effects of FOXP2 on animal learning, and could lead to better understanding of the genetic basis of how learning is involved in central auditory processing.

PROGRAM PORTRAIT: Fundamental Science: Synaptopathy and Noise-Induced Hearing Loss

FY 2017 Level: $1,316,000
FY 2018 Level: $1,158,000
Change: -$158,000

Loud noises can result in permanent damage to the sensitive structures of the auditory system resulting in a sensorineural hearing loss. This noise-induced hearing loss (NIHL) can be detected during a hearing test as a change in the softest sound that a person can detect at a given sound frequency. Sometimes after noise exposure, however, an individual initially has difficulty detecting soft sounds, but over a relatively short period of time, their detection ability returns back to normal. This is called a temporary threshold shift. Auditory scientists assumed that the restoration of "normal" hearing following a temporary threshold shift indicated that the loud noise had not permanently damaged the auditory system.

However, recent NIDCD-funded studies in animal models have demonstrated that there is in fact permanent damage to the auditory system after a temporary auditory threshold shift. This damage is located within the cochlea at the connection site, called a synapse, between sensory hair cells and the auditory nerve. This hair-cell synapse is critical for conveying information from the hair cell to the brain. Noise damage to this synapse, called cochlear synaptopathy, eventually leads to the loss of a subset of auditory nerves that play a role in detecting sounds in a noisy environment. This type of noise-induced synaptic damage may underlie a frequent patient complaint of difficulty hearing speech in noise, despite a normal hearing test.

In 2015, NIDCD invited a panel of expert auditory scientists to a workshop on cochlear synaptopathy and NIHL. The focus of the workshop was to identify barriers to, and opportunities in, this research area and to articulate unmet research needs as the field works to translate the cochlear synaptopathy animal studies to the human auditory system and the clinic. The workshop panelists were asked to identify long-term and short-term research recommendations in the areas of mechanisms, potential therapies and diagnostics.

The workshop experts compiled an extensive list of research recommendations including additional studies to understand the normal mechanism of hair-cell synaptic transmission and how that synapse is damaged by noise exposure. They also recommended more research exploring the possible repair of noise-damaged cochlear synapses well as research on ways to detect cochlear synaptopathy in humans. In response to these recommendations, NIDCD published two funding opportunity announcements[11,12] focused on noised-induced cochlear synaptopathy. Research funded in response to these announcements is expanding the NIDCD portfolio in this area, with an emphasis on determining ways to identify and measure cochlear synaptopathy in humans.

NIDCD continues to place a high priority on NIHL and additional cochlear synaptopathy studies will complement our ongoing efforts to support other studies on NIHL including the identification of gene mutations that make individuals more susceptible to NIHL; the cellular mechanisms that lead to other types of noise-induced auditory damage; ways that the ear protects itself from noise damage; and molecules/drugs that can prevent or treat noise-induced auditory damage.

The decrease in funding in FY 2018 for this program will bring commitments in line with available resources.

Taste and Smell Program: Each year, more than 200,000 people visit a physician for chemosensory problems such as taste and smell disorders.[13] Many more taste and smell disorders go unreported. NIDCD supports studies of the chemical senses known as taste, smell, and chemethesis (chemically provoked irritation) to enhance our understanding of how

[11] http://grants.nih.gov/grants/guide/rfa-files/RFA-DC-17-002.html,
[12] https://grants.nih.gov/grants/guide/pa-files/PAR-16-170.html
[13] https://www.nidcd.nih.gov/health/statistics/quick-statistics-taste-smell

individuals communicate with their environment and how human chemosensory disorders can be diagnosed and treated. The regenerative capability of the olfactory system declines with age, which negatively impacts olfactory function. Although the estimates of the prevalence of olfactory impairment vary, it is likely that more than one third of adults over the age of 70 have olfactory deficits. Since both taste and smell contribute to flavor, such olfactory deficits affect the flavor of foods and consequently food intake, diet and overall nutrition, and health status. NIDCD encourages further studies of this age-related decline in olfactory sensitivity including the development of better diagnostic tests to assess chemosensory loss as well as animal models for use in studying why this decline occurs and how to prevent it.

Taste and smell play important roles in preferences and aversions for aromas, specific foods, and flavors. By helping us understand why people prefer certain foods over others, research on taste and smell may help develop prevention and treatment strategies for obesity and diabetes. Taste preferences can also influence whether someone is willing to take a needed medication. Because of the importance of taste and smell in overall health, NIDCD is supporting research directed at understanding both the original development of the taste and smell sensory systems and also how they regenerate in adults. A better understanding of these processes may help us develop ways to encourage regeneration to restore the chemical senses when they are damaged by chemotherapy, disease, or as their function declines with age.

Voice, Speech, and Language Program: Disorders involving voice, speech, or language can have an overwhelming effect on an individual's health and quality of life. These disorders affect people of all ages with or without hearing impairment, including children with autism, those who stutter, and adults with aphasia or other speech disorders. Voice, speech, and language disorders also come at a significant cost. The societal burden of laryngeal disorders is estimated at $11 billion dollars annually due to work-related disability, lost productivity, and direct health care cost.[14] Further, nearly 8 percent of children ages 3-17 years have had a communication disorder during the past 12 months, according to data from the National Health Interview Survey, 2012.[15] By the first grade, roughly 5 percent of children have noticeable speech disorders.[16] In children, delayed speech and language acquisition or impairment are very often significant predictors of future academic, social, vocational, and adaptive outcomes.[17]

Children using hearing aids or cochlear implants because of hearing loss often have difficulties in acquiring spoken and written language skills, and in mastering English literacy. American Sign Language, used by many North Americans who are deaf or hard-of-hearing, is a language completely separate and distinct from English, and thus, reading English may present challenges to some users of ASL.

Many normal hearing children will learn English upon entry into school while speaking another language at home. These individuals are known as dual language learners (DLLs), and they represent a population with unique challenges and requirements for language development and

[14] https://www.ncbi.nlm.nih.gov/pubmed/22549455, https://www.ncbi.nlm.nih.gov/pubmed/22544473
[15] http://www.cdc.gov/nchs/data/databriefs/db205.htm
[16] http://www.ahrq.gov/downloads/pub/prevent/pdfser/speechsyn.pdf
[17] https://www.ncbi.nlm.nih.gov/pubmed/18695010, https://www.ncbi.nlm.nih.gov/pubmed/17883441, https://www.ncbi.nlm.nih.gov/pubmed/15679523

learning in schools. Research is needed regarding how best to distinguish language variation from impairment as well as methods to promote literacy and learning in DLLs.

In August 2016, NIDCD along with the *Eunice Kennedy Shriver* National Institute of Child Health and Human Development and the NIH Office of Behavioral and Social Sciences Research held a workshop on "Language and Literacy Development in Early Dual Language Learners." The purpose of the workshop was to gather clinical and research experts involved with DLLs to develop a contemporary research agenda that would provide evidence-based guidance on best practices for this population. A better understanding of typical and atypical language and literacy development in DLLs is critical for improving reading skills and academic success in these children.

Intramural Research Program (IRP): The NIDCD Intramural Research Program conducts basic and clinical research in human communication, with a primary focus on hearing. Research projects address the genetics of hearing and balance disorders in humans and mouse models; identifying molecules and genes important for inner ear development; observing hearing in action by neuroimaging and computer modeling of brain function; and describing how auditory nerve cells communicate. This intense concentration on hearing research and its genetic causes has enabled NIDCD intramural scientists to make significant research progress on this priority for NIDCD.

NIDCD intramural scientists continue to perform exemplary research and are recognized for their contributions with high honors. Matthew W. Kelley, Ph.D., chief of the NIDCD Laboratory of Cochlear Development, was named president of the Association for Research in Otolaryngology (ARO), the professional organization that promotes research in the field. At NIDCD, the goal of his lab is to understand the molecular and cellular factors of different structures in the cochlea that are essential for sound to travel from the inner ear to the brain. Katie Kindt, Ph.D., acting chief of the NIDCD Section on Sensory Cell Development and Function, received a Presidential Early Career Award for Scientists and Engineers in May 2016. This award is the highest honor bestowed by the federal government on scientists and engineers who are in the early stages of their careers. Her laboratory focuses on the study of hair cells - the sensory cells of the auditory and vestibular systems that are required for proper hearing and balance.

NIDCD continued its new speaker series, *Beyond the Lab, Understanding Communication Disorders*. Designed for administrative and support staff as well as scientists, the series gives NIH staff and the public the opportunity to learn about NIDCD's research and about scientific advances in communication disorders. The goal of the series is to present the science of the NIDCD mission areas in ways that everyone can understand. In April 2016, scientists from the NIDCD Audiology Unit presented a talk titled "From Natural History to Clinical Trial: The Role of Audiology in Understanding and Treating Niemann-Pick Disease Type C." Their presentation focused on how the NIDCD Audiology Unit's contribution to research and the NIH mission, and its involvement in the development of a new therapy for Niemann-Pick disease type C (NPC). NPC is a rare cholesterol storage disorder that primarily affects children and is often fatal by early adulthood. The disease damages a variety of organs in the body, including the ear, but primarily affects the brain. NIDCD intramural scientists were the first to detail the effects of

NPC on hearing, and are now members of a team, led by NICHD, working on a clinical trial to test a promising new therapy for the disease.

NIDCD intramural investigators worked with NIDCD extramural scientists to create a mouse model that carries a human stuttering mutation.[18] Mice with the mutation made vocalizations with longer pauses than those of their littermates without the mutation, and they also seem to repeat vocalizations. This abnormal mouse "speech pattern" is similar to the speech of humans who stutter and carry the same mutation. Now, the scientists are eager to study these mice to help them understand what makes people with the mutation stutter, and how they might help them stop stuttering.

Stereocilia are bundles of super-sensitive fibers perched atop the sensory hair cells that line the inner ear. Stereocilia are responsible for converting vibrations entering the ear into electrical signals that travel to the brain and are interpreted as sound. These bundles have precisely graded heights, and normal hearing depends on the proper development of this staircase organization. Yet, the mechanisms of how this structural organization develops is largely unknown. NIDCD intramural scientists used cultured cells and genetically engineered animal models to determine how different combinations of motor proteins - proteins that transport other proteins within a cell - and their cargo proteins influence stereocilia length.[19] They determined that different motor-cargo protein combinations differentially affect the number and the length of the stereocilia. Understanding the normal hair cell development process provides insight to what happens when that process becomes disordered. This can help scientists identify future therapies to preserve or restore hearing.

Another NIDCD laboratory is working to understand how the cells in the early chicken embryo develop into the complicated structure of the inner ear.[20] The scientists used a combination of two techniques to help them understand early ear development: lineage tracing and surgical manipulation. Scientists use lineage tracing to follow cells as they divide and move. In this study, they labelled early cells by injecting them with a dye, and then examined the animal's tissue later in development to determine the labelled cells' final destination and fates in the inner ear. The scientists then combined lineage tracing with surgical manipulation to determine when cells became committed to their fates (e.g., types of neurons and sensory organs). The team labelled and then cut and rotated the developing ear to determine if the cells could adopt a new fate, meaning that they were not yet committed to a fate at the time of the surgery, or whether they behaved as if they were still in their previous location, meaning that they were already committed to a fate at the time of the surgery. Their results provide evidence that although neurons seem to develop much earlier than sensory organs during inner ear development, specification of their fates is coupled. This discovery raises the possibility that neural stem cells could be used as a source for replacing lost sensory hair cells.

[18] https://www.ncbi.nlm.nih.gov/pubmed/27151663
[19] https://www.ncbi.nlm.nih.gov/pubmed/26926603
[20] https://www.ncbi.nlm.nih.gov/pubmed/27083418

PROGRAM PORTRAIT: Fundamental Science: Inner Ear Blueprint May Lead to Treatment for Hearing Loss and Balance Disorders

FY 2017 Level: $2.000 million
FY 2018 Level: $1.600 million
Change: -$0.400 million

Approximately 50 percent of Americans ages 75 and older have a disabling hearing loss. In addition, more than 1 in 20 children in the U.S. between the ages of 3 and 17 have a dizziness or balance problem. To determine the cause of hearing loss and balance disorders, it is important to understand what is happening to the cells in the inner ear. To gain a better understanding of inner ear cell development, NIDCD intramural scientists used a new technology that can extract comprehensive gene expression data from just one cell. Identifying the gene expression maps for the development of inner ear cells is essential to understanding how they form, and may help us create ways to regenerate these cells and restore hearing and balance.

Specialized sensory epithelial cells in the inner ear are responsible for hearing and balance. These cells, which include hair cells and supporting cells, are located in the cochlea, the snail-shaped structure in the inner ear, and work together to detect sound. Similar types of hair cells and supporting cells are also found in the utricle, a fluid-filled pouch located near the cochlea, that plays a critical role in helping us maintain our balance. These cells detect how we move our heads, how our heads are positioned and whether we are moving or stationary; this information tells our brain, for example, whether we are standing or lying down. The utricle is one of several structures and organs in the body that provide our sense of balance; together, they comprise the vestibular system.

Hair cells and supporting cells can be damaged by medications, infections or disease, injury, or aging, leading to hearing loss and balance problems. In humans, these cells cannot naturally repair themselves, so effective treatments are limited. In addition, there are only a few thousand of these sensory cells and they are located in a bony channel embedded in the skull, making them difficult to study.

Using a sensitive new technology called single-cell RNA-seq, NIDCD intramural scientists have created the first high-resolution gene expression map of cells within the newborn mouse inner ear.[21] By analyzing the cells' gene activity profiles, the scientists were able to identify genes that are active at different stages of development. The findings provide new insights into how epithelial cells in the inner ear develop and differentiate into the specialized cells that serve critical functions for hearing and maintaining balance. Understanding how these important cells form may provide a foundation for the potential development of cell-based therapies for treating hearing loss and balance disorders.

Research Management and Support (RMS) Program: NIDCD RMS activities provide administrative, budgetary, logistical, and scientific support in the review, award, and monitoring of research grants, training awards, and research and development contracts. RMS functions also include strategic planning, coordination, and evaluation of the Institute's programs, regulatory compliance, international coordination, and liaison with other Federal agencies, Congress, and the public. The Institute currently supports approximately 1,300 research grants, training awards, and R&D contracts.

NIDCD continues to expand its education and outreach of science to the public through it's *Noisy Planet. Protect Their Hearing.* campaign. For example, the NIDCD Noisy Planet team continues to raise awareness about healthy hearing habits through classroom presentations, community events, and conferences across the Washington, D.C., metropolitan area and beyond. To reach the Noisy Planet campaign's target audiences – preteens – the Noisy Planet team

[21] https://www.ncbi.nlm.nih.gov/pubmed/26469390

spends, on average, two days each month spreading awareness at local schools about the causes and prevention of noise-induced hearing loss using an interactive, 45-minute presentation. By the end of the 2015-2016 school year, Noisy Planet reached nearly 3,000 students through community events and classroom presentations. That brings the total of youth reached by the Noisy Planet campaign's in-person presentations to more than 16,000 since June 2010. In July 2016, NIDCD updated the Noisy Planet's website to makes it easier for users to locate and share information about noise-induced hearing loss. Content is divided into three core audience sections: parents, kids and preteens, and educators and health care professionals.

NIDCD has implemented several enhancements to the NIDCD website. The changes are designed to enhance users' experience and strengthen the Institute's alignment with Federal mandates for information technology. Key features of the revised website include: 1) responsive design, enabling the content to automatically adjust to fit a user's screen size; 2) redesigning research and funding sections, and a new, prominent section highlighting NIDCD-supported research training and career development funding opportunities; 3) integration of relevant NIDCD-supported research results with consumer health information on hearing, balance, taste, smell, voice, speech, and language disorders; and 4) a new portal to Spanish-language consumer information published by NIDCD. We will continue to update and enhance NIDCD digital communications for health consumers, researchers and trainees, health professionals, and others.

Improving hearing health care for adults is an urgent public health problem, and contributing to solutions is a priority for NIDCD. On June 2016, Dr. Amy Donahue, deputy director of the NIDCD Division of Scientific Programs, received the James B. Snow, Jr., M.D., Award at the Hearing Loss Association of America (HLAA)'s annual convention in Washington, D.C. In 2009, NIDCD sponsored a Working Group on Accessible Affordable Hearing Health Care for Adults with Mild to Moderate Hearing Loss. Based in large part on the outcomes of that workshop, the National Academies of Sciences, Engineering, and Medicine took on the issue of hearing health care. On June 2, 2016, an expert committee released a consensus study report, Hearing Health Care for Adults: Priorities for Improving Access and Affordability, which describes 12 goals to advance hearing health care in the U.S. NIDCD continues to fund several initiatives supporting a research portfolio informing this public health area.

Throughout 2016, NIDCD staff in consultation with a working group of scientific experts from the National Deafness and Other Communication Disorders Advisory Council updated the 2017-2021 NIDCD Strategic Plan (Plan). The draft Plan presents a series of goals and objectives that represent the most promising research needs within the NIDCD mission areas. The Plan is a guide for scientists to better understand the directions that NIDCD research priorities may take in the future; assist NIDCD in developing Funding Opportunity Announcements and to identify research proposals that are high program priority; and help public stakeholders understand the state of communication sciences and to discover the scientific breakthroughs that are possible with sustained investments in biomedical research. The final Plan was published on the NIDCD website in January 2017.

NATIONAL INSTITUTES OF HEALTH
National Institute on Deafness and Other Communication Disorders

Detail of Full-Time Equivalent Employment (FTE)

OFFICE/DIVISION	FY 2016 Actual			FY 2017 Annualized CR			FY 2018 President's Budget		
	Civilian	Military	Total	Civilian	Military	Total	Civilian	Military	Total
Division of Extramural Activities									
Direct:	19	-	19	19	-	19	19	-	19
Reimbursable:	-	-	-	-	-	-	-	-	-
Total:	19	-	19	19	-	19	19	-	19
Division of Intramural Research Program									
Direct:	59	1	60	62	1	63	62	1	63
Reimbursable:	4	-	4	4	-	4	4	-	4
Total:	63	1	64	66	1	67	66	1	67
Division of Scientific Programs									
Direct:	15	-	15	15	-	15	15	-	15
Reimbursable:	-	-	-	-	-	-	-	-	-
Total:	15	-	15	15	-	15	15	-	15
Office of Administration									
Direct:	36	-	36	36	-	36	36	-	36
Reimbursable:	-	-	-	-	-	-	-	-	-
Total:	36	-	36	36	-	36	36	-	36
Office of the Director									
Direct:	3	-	3	3	-	3	3	-	3
Reimbursable:	-	-	-	-	-	-	-	-	-
Total:	3	-	3	3	-	3	3	-	3
Total	136	1	137	139	1	140	139	1	140
Includes FTEs whose payroll obligations are supported by the NIH Common Fund.									
FTEs supported by funds from Cooperative Research and Development Agreements.	0	0	0	0	0	0	0	0	0

FISCAL YEAR	Average GS Grade
2014	12.4
2015	12.4
2016	12.1
2017	12.1
2018	12.1

NATIONAL INSTITUTES OF HEALTH
National Institute on Deafness and Other Communication Disorders

Detail of Positions[1]

GRADE	FY 2016 Final	FY 2017 Annualized CR	FY 2018 President's Budget
Total, ES Positions	1	1	1
Total, ES Salary	185,100	187,000	190,647
GM/GS-15	21	21	21
GM/GS-14	19	19	19
GM/GS-13	25	25	25
GS-12	16	17	17
GS-11	10	10	10
GS-10	0	0	0
GS-9	8	8	8
GS-8	5	5	5
GS-7	3	3	3
GS-6	1	1	1
GS-5	0	0	0
GS-4	1	1	1
GS-3	0	0	0
GS-2	2	2	2
GS-1	1	1	1
Subtotal	112	113	113
Grades established by Act of July 1, 1944 (42 U.S.C. 207)	0	0	0
Assistant Surgeon General	0	0	0
Director Grade	0	0	0
Senior Grade	1	1	1
Full Grade	0	0	0
Senior Assistant Grade	0	0	0
Assistant Grade	0	0	0
Subtotal	1	1	1
Ungraded	44	46	46
Total permanent positions	108	111	111
Total positions, end of year	158	161	161
Total full-time equivalent (FTE) employment, end of year	137	140	140
Average ES salary	185,100	187,000	190,647
Average GM/GS grade	12.1	12.1	12.1
Average GM/GS salary	106,147	109,204	111,333

[1] Includes FTEs whose payroll obligations are supported by the NIH Common Fund.