Rob Labadie, Ph.D., M.D., is trying to bridge a surgical technology gap. “Surgeons have been using image guided systems for years,” says researcher and surgeon Labadie. “CT or X-ray information can be superimposed on the patient as a locator for endoscopic sinus or orthopedic surgery. However, the commercially available systems aren’t accurate enough for ear surgery.”

Surgery on the ear is complicated and delicate. Because of the close proximity of vital systems — auditory and facial nerves, vascular structures — accuracy in ear surgery needs to be within a millimeter, a level that standard image guided techniques can’t achieve.

“The key,” says Labadie, “is linking the patient to the X-ray with immobile markers. Stick-on markers don’t work because skin moves too much for the accuracy level we need.” Instead, Labadie and colleagues have developed a marker system that attaches to patients via a dental bite-block — similar to an athletic mouthguard. “Mounting the marker system on the dental guard allows placement of the markers surrounding the ears — allowing accuracy to be within a millimeter.” Their publications in Otolaryngology-Head and Neck Surgery and Computer Aided Surgery attest to the accuracy of the system.

Trained in both engineering and medicine, Labadie has always had an interest in using his engineering skills to improve the quality of life for individuals with medical problems. Currently, he is using a select group of patients to further validate the accuracy of the image guided method. Eventually, however, he hopes to implement the technique into standard operating rooms for use as a safeguard for surgeons performing ear surgery.

He is also exploring the idea of using computer-guided robotics to assist in otologic procedures. For this, he is working with Michael Goldfarb, Ph.D., and Kevin Fite, Ph.D., from the Department of Mechanical Engineering.

“There’s a huge variation in the way that different surgeons perform the same surgery,” says Labadie. “Everybody’s trained in slightly different ways to achieve the same end. So it’s not easy to state objectively what the most efficient method is.” Labadie and his research colleagues have videotaped and analyzed the surgical path that different surgeons take when performing a mastoidectomy.

"Despite the variation in personal techniques, their motions can be decomposed into the same four major steps. Along with the image guided surgery, a robot can be programmed to do the same thing, and to do it in a more efficient, standardized way.”

As a corollary to this, Labadie and his colleague in Computer Science and Engineering Department, J. Michael Fitzpatrick, Ph.D., have developed and patented a technique that allows surgical tools, like scalpels and drills, to only be active where needed. “It’s kind of a paint-by-numbers system that constrains the scalpel or drill until the image-guided system tells it that you’ve reached the tissue that you want to cut. There’s also the ability to override that system if you choose, and use the system as a kind of radar detector to tell you (continued on page 4)
BRAIN MAPPING
CHARTING THE NEUROLOGY OF COMMUNICATION DISORDERS

Aside from occasionally scratching his head, the four-year-old research subject seems blissfully unbothered by the electrode hat he wears while playing a computer game with doctoral student Hayley Arnold. The hat is sending thousands of bits of information about his brain activity back to the control room where fellow doctoral student Kia Hartfield watches the data intently. “We’re watching to see how quickly he names the object based on cues he hears before he sees the pictures,” explains Hartfield. “We are also looking at what his brain waves do as he prepares to name an object on the screen.”

Hartfield and Arnold, members of the Stuttering research team led by Dr. Edward Conture, are conducting part of their research in the Brain Mapping lab under the direction of Sasha Key, Ph.D. Key is Research Assistant Professor for the Department of Hearing and Speech Sciences and Director of Psychophysiology Core Services at the Vanderbilt Kennedy Center for Research on Human Development. The three are comparing the brain wave differences between children with a stuttering disorder and children with normal communication development when responding to performing naming tasks.

“Typically, children with normal communication development have a faster response time when they hear the first sound of the word before seeing the picture,” explains Arnold. “Children with a stuttering disorder don’t respond as quickly to that task, but they respond more quickly than non-disordered children when they hear most of the word first — “ish” before seeing the picture of a fish. It shows us that children with a stuttering disorder are processing language and phonology in a different way.”

The Brain Mapping Lab is another new dimension for the Vanderbilt Bill Wilkerson Center. It enables scientists working in the area of communication development and disorders to generate research that looks at the underlying psychophysiology of the language behaviors they study. “Auditory and speech processing differences seem to underlie a lot of communication disorders,” says Key. “The brain’s ability to process basic auditory input quickly and efficiently appears to be important for a variety of more complex behaviors. We can present tasks with sounds alone or paired with pictures and watch exactly what the brain is doing with the information even if a participant does not provide a behavioral response. And we can gather the information relatively quickly compared with other forms of testing.”

Key says that brain mapping can measure the sensitivity and speed with which children and adults are discriminating sounds, processing speech, or relating what they hear to what they see. It can also help predict how different people will respond to different treatments, and may someday help predict whether a child is at risk for developing dyslexia, autism or other communication disorders before any behavioral indicators of a problem are present.

Key was drawn to psychophysiology for its objective nature. “Behavioral testing can run into a lot of variables that can affect the score and many traditional assessments are not well suited for use with very young children,” she says, “but the brain activity is always present, can be recorded without interrupting ongoing behaviors, and provides a lot of data about perceptual, emotional, and cognitive processes. It’s also one of the most child-friendly (continued on page 4)
assessment tools because it can be done as a passive test where a child does not have to respond at all or it could be an active game. And our procedures are much more tolerable than other imaging techniques, for example, an MRI.”

Studies with children who stutter are not the only research projects planned for the Bill Wilkerson Brain Mapping Lab; Key has several other projects in the works. In collaboration with Stephen Camarata, Ph.D., she will use brain waves to explore the efficacy of speech intervention on children with autism. She’s also working with Au.D. student, Heather Porter, on relating brain wave measures of speech and language processing in children with cochlear implants to their performance on standardized behavioral assessments.

“One of the most interesting things about brain mapping is that the brain often changes before the corresponding behavior does,” concludes Key. “By looking at the brain’s activity, we can examine how it adapts to processing new information provided by a cochlear implant, even in children who are not yet able to speak, and hopefully gain new insights about the factors contributing to better outcomes in their hearing and speech abilities.”

LASIK of ear surgery. We predict that we can decrease operative time from 2-3 hours to 15 minutes, and, if we can perform the surgery under local anesthesia, we can test the cochlear implant before we close the incision. That gives us the option of adjusting where the implant lies within the cochlea in order to get better overall sound perception from the implant. This is analogous to what the optometrist does in his or her office: “Do you like position A or position B for the cochlear implant?” While this concept may seem far-fetched, Labadie’s team has demonstrated the concept on cadavers and has IRB-approval for clinical validation trials for which NIH funding is being sought with positive feedback from the initial submission.

Although his research began long before the move to the new building, Labadie says he can’t believe how quickly his research has been developing in the new environment. “The larger, better equipped lab has been an enormous boon. Add to that the Anspach-Zeiss Temporal Bone Lab right across the hall and clinical and surgical facilities in the same building, just the proximity to everything we need is making the research more efficient. The new building has been a huge asset to everyone’s research capabilities.”
One of the most innovative programs that the new space has enabled is the National Center for Childhood Deafness and Family Communication. The NCCDFC is a center within a center with the three-fold goal of providing direct speech, language, audiological and educational services to children with hearing loss; training new pediatric specialists in hearing and speech sciences; and conducting groundbreaking research in diagnoses, prevention, genetics, and treatment for children with hearing loss.

The Mama Lere Hearing School at Vanderbilt is an important and busy component of the NCCDFC. Twenty-eight preschool children with hearing loss are enrolled in the school. About half of the children have cochlear implants and about half have hearing aids, but they all have one thing in common: they are all learning to talk and listen without using sign language. The school strives to develop spoken language in children with hearing loss and to maximize the child’s hearing potential so that he or she can communicate independently and effectively. The Vanderbilt Hearing School is the only mid-state option for preschool children with hearing loss to receive intensive training in spoken language.

The school received special treatment during construction of the new building. Knowing in advance which rooms were going to house the Hearing School enabled the architects to use special construction techniques and materials in that area of the building. The walls and ceiling are acoustically treated, the stud walls are offset, and the doors create a slight seal when closed so that background noise, inside and outside, is lessened. Even the children’s playground was considered; the slides are coated metal instead of plastic so that children with cochlear implants don’t risk creating a static charge that could damage the implant.

The Mama Lere Hearing School is a direct descendant of the Mama Lere Parent Teaching Home that was established by the Bill Wilkerson Center in 1972 to house the parent-infant training program. The original program taught parents of children with hearing loss to provide language intervention for their children in the home environment. The home was named for Mrs. Valere Potter — called Mama Lere by her children and grandchildren — whose foundation funded the construction of the building. The Mama Lere Home quickly gained a national reputation for excellence in oral education of children with hearing loss. When the new Center was finished last year, the historic Mama Lere name was transferred to the new hearing school.

The new Mama Lere School is also family oriented. “Our philosophy is that parents are their child’s best teacher,” said Tami Bradham, Ph.D., (continued on page 6)
Dr. Russell J. Love, beloved Professor Emeritus, Department of Hearing and Speech Sciences, Vanderbilt University, passed away March 8, 2006 following an extended illness. Dr. Love attended Tulane University as an undergraduate and received his Master’s degree and later his Ph.D. from Northwestern University. His career included clinical work at the Moody State School for Cerebral Palsied Children in Galveston, TX, the Northwestern University Cerebral Palsy Speech Clinic, the Veterans Administration Hospital in Coral Gables, and Michael Reese Hospital. He was an associate professor at DePaul University. In 1967 he began as Chief Speech Pathologist at the Bill Wilkerson Hearing and Speech Center in Nashville, TN with a dual appointment as Assistant Professor of Hearing and Speech Sciences at Vanderbilt University. He retired as Professor Emeritus in 1995.

During his distinguished career, Dr. Love was recognized for his research and teaching in the area of motor speech disorders and neurologically-based language disorders in children and adults. He was the author of many papers, chapters, and two textbooks. Dr. Love was an activist and advocate for persons with communication and physical handicaps and often spoke and wrote on the subject of the rights of persons with communication disorders. Awards honoring his achievements included the Honors of the Tennessee Association of Audiologists and Speech-Language Pathologists (TAASLP) and Fellow of ASHA. He is survived by his wife, Barbara, two sons, and six grandchildren. He will long be remembered affectionately by the hundreds of students he taught at Vanderbilt and in whom he infused a love for the study and practice of the profession of Speech-Language Pathology.
Located on the seventh floor of the new building, along with the John S. Odess Otolaryngology and Head & Neck Surgery Clinic, the Voice Center sees scores of patients every week who are trying to regain or retain the use of their voices. Many are vocal professionals, but most are average people whose inability to communicate easily is impacting their daily lives.

The Voice Center has been creating patient successes for 15 years, and the move to the new building has opened a new world of clinical care.

“Consultations with the swallowing teams or the otolaryngology clinic are far faster and more efficient for the patient,” said Barb Jacobson, Ph.D., director of speech-language pathology for the Voice Center. “Having experts in other areas nearby means that a consultation can often take place immediately.”

Technology, too, has taken a giant leap forward. “Olympus has developed a special flexible laryngeal scope just for our clinic,” said Tom Cleveland, Ph.D., singing specialist and director of Vocology. “It’s far smaller than any scope we’ve used before. It does not use fiber-optics but has a tiny camera in the distal end. The image is much clearer and because the scope is smaller it’s more comfortable for the patients and often doesn’t require numbing of the nose or throat.”

Storage of the images taken of a patient’s larynx has been upgraded as well. Instead of using videotape, the endoscopic images are recorded directly to the server where they can be pulled up on a computer for viewing, editing or use in a presentation. “Our system is a prototype,” explained Dr. Cleveland. “The engineers who developed it spent a week with us watching what we do and created the system specifically for our needs.”

Another technology development in use at the clinic is the Life Shirt, created by the Vivometrics Company in California. The Life Shirt is a close fitting shirt that contains electronic sensors to record a singer’s breathing dynamics during practice or performance. “Measuring in a real-life situation gives us a much better idea of natural breathing patterns,” continued Dr. Cleveland.

All of these new technologies have made diagnosis and treatment much easier for the clinicians at the Voice Center. But the real beneficiaries are the patients. “We want to do everything we can to assist every patient who comes to our clinic,” Cleveland said. It’s great to be a part of this new world.
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