NATIONAL SCIENCE FOUNDATION
1800 G STREET, WASHINGTON, D.C. 20550
SCIENCE AND TECHNOLOGY TO AID THE HANDICAPPED

Donald R. McNeal, Ph. D., Program Manager

Tactile Perception of Speech
New / Continuing Grant PFR 80-17178
Indiana University
Bloomington, Indiana

James C. Craig, Principal Investigator

Targeted Disability: deaf and hearing impaired. Duration: 36 months.

The major objective of this project is to examine the feasibility of using the tactile sense as an alternate modality for the perception of speech and the understanding of spoken language.

Two major questions that are fundamental to this problem are therefore addressed: First, how should the distinctive elements of the acoustic speech signal be transformed to provide recognizable tactile patterns; and second, what is the most effective training procedure for both perceptual learning of tactile speech displays and evaluating various tactile representations of speech?

Natural and synthetic speech tokens are presented to the skin of the finger(s) using a computer-controlled spectral display and Optacon transducers. Training procedures for the acquisition of tactually presented speech are also being developed and evaluated. A novel training paradigm is being examined that takes advantage of the close association between speech production and speech perception by allowing the learner of tactile speech to produce, hear, and feel his or her own speech patterns in real-time.

The results of these experiments have broad implications for the development and improvement of speech aids for the deaf and aids for both perception and production of speech.

Production and Visual Articulatory Shaping of Speech in Deaf Children
New / Continuing Grant PFR80-16736
University of Alabama, Birmingham
Birmingham, Alabama

Samuel G. Fletcher, Principal Investigator

Targeted Disability: deaf and hearing impaired. Duration: 36 months.

The goal of this research is to bring new scientific and engineering developments to bear on understanding and improving speech production of deaf children. Four lines of investigation are underway.

First, using a new computer-based instrumentation system, a complete physiologic, acoustic, and phonetic description of speech production by 6-to-14-year-old deaf and hearing children is being developed. These data are being used to identify contrasting patterns and strategies of speech production, and to investigate relationships between articulatory visibility and proficiency.

Second, visual displays and monitoring devices are used to study lip, jaw, and tongue control in articulator positioning and in manipulating forms within the mouth. These data are being interpreted from a sensory deprivation viewpoint.

Third, static and dynamic visual articulatory displays are used to study recognition of English sounds through vision.

Fourth, The efficiency and effectiveness of visual articulatory displays for monitoring the speech of others and changing their own articulatory patterns is being explored.

In all of this work the ultimate goal is to develop a system which will provide a real-time, visual schematic display of tongue position and tongue-palate contact. This will be supplemented with a display of loudness and pitch information. The deaf child will thus be able to directly compare his own mouth and tongue movements with a corresponding display of normal speech dynamics.

The Development of a Nonvocal Communication System for Pre-Reading Children
New / Standard, PFR80-17163
Tufts-New England Medical Center
Boston, Massachusetts

Cheryl Goodenough-Trepagnier, Principal Investigator

Targeted Disability: nonvocal. Duration: 24 months

The eventual goal of this research is the development of an unrestricted, rapid communication system for severely motorically involved children who have been diagnosed as unlikely to develop functional speech. The system will use visual representation of frequent words, word-parts and sounds on an elastomeric keyboard, coupled with synthesized speech output, to make available to the pre-reading nonvocal child the means for productive language at a level equivalent to the child's perceptual language. The design of this system makes use of algorithms which select items based on the relative frequencies of occurrence of phoneme-sequences in spoken English.

Nonvocal children are typically able to communicate only in extremely restricted fashion, by means of sets of pictures, until they have mastered the complexities of English orthography. Picture indication offers little scope for the development of language skills and is conducive to a passive communication strategy which becomes difficult for the nonvocal child to forsake later on.

The proposed system will offer a means of providing nonvocal, pre-reading children full productive access to their linguistic knowledge during the most critical period for the acquisition of language and the development of communicative competence.

Urinary Sphincter Control by Collision Block Techniques
New / Standard Grant, PFR80-17190
Case Western Reserve University
Cleveland, Ohio

J. Thomas Mortimer, Principal Investigator

Targeted Disability: neurologically impaired. Duration: 24 months.

The purpose of this research is to develop a method to block spastic motor activity to the external urinary sphincter. Sphincter spasticity results in incomplete bladder evacuation and is a major complication of spinal cord injury. Efforts to induce bladder evacuation by electrical stimulation of the detrusor muscle have also been complicated by a reflex contraction of the sphincter.

This study is continuing its investigations of the technique of collision block, a method which uses tiny electrical currents to block a peripheral nerve. The properties of a monopolar electrode system are being studied in relation to the generation of unidirectionally propagated action potentials, the key to achieving success in the collision block technique.

Results of this study are being compared with data previously obtained using a tripolar electrode. Electrodes are being constructed for implantation in animals, and tests are being run to determine the effect of tissue ingrowth on the blocking properties of the electrode.

Low Bandwidth Visual Communication for the Deaf
New / Continuing Grant, PFR80-17189
New York University
New York, New York

George Sperling, Principal Investigator

Targeted Disability: deaf and hearing impaired. Duration: 24 months.

The only telephone substitute available to the deaf is the teletypewriter, which is slow and cumbersome. The goal of this research is to develop a television-like system to transmit a dynamic picture between sender and receiver. Such a system would enable the participants to communicate by means of manual systems such as American Sign Language (ASL), finger spelling, and speech reading at rates comparable to spoken English. While television or previously-developed video telephones would serve admirably, they are impractical because they require a bandwidth on the order of 1,000,000 Hz. To maximize its availability, the video communication system must be able to use ordinary telephone lines which have a bandwidth of 3,000 Hz.

Preliminary experiments show that 20,000 Hz is adequate for visual communication of ASL. The purpose of this proposal is to enable continuation of this research. It involves basic research to determine certain essential parameters of such a system, developmental research to discover an image coding scheme to achieve the bandwidth reduction to 3,000 Hz, and applied research to produce specifications for a prototype. Ultimately, the widespread availability of such a video communication system would have a profoundly favorable social and economic impact on the deaf population.