

NTID RESEARCH BULLETIN

Center for Research, Teaching and Learning · National Technical Institute for the Deaf · Rochester Institute of Technology

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Harry Lang discusses the science of a twister with deaf students at the Washington State School for the Deaf.

Keeping an Eye on the Big Picture

A couple of weeks ago, I received a telephone call from Sandy Harvey, Executive Director of the American Society for Deaf Children. Sandy wanted my help in urging researchers to devote more attention to educating deaf children who have multiple handicaps. Her point was a good one. We have both argued in other venues that parents and professionals involved with multiply-handicapped deaf children are often so preoccupied with medical and other urgent imperatives that they neglect the basic social and communication needs essential for any child, deaf or hearing, in such a situation.

Sandy Harvey was certainly correct in saying that we know very little about educating multiply-handicapped deaf children. But, in response to her request, I found myself suggesting that what we really need is some research on educating deaf children, period. That is, we know about the basics of language development, social development, and cognitive development as they relate to deaf children, but what have we done with that knowledge?

For some reason, we have not put it all together into a complete package. In part, the situation may reflect the practical difficulties inherent in bringing on-board local school districts and teachers who have more mundane, but no less significant issues to deal with. In part, we also are stymied by the fact that various innovative programs for deaf children around the country have not been evaluated in ways that allow objective, confident assessments of their success (and hence their possible emulation). And, of course, there is the not insignificant challenge of crossing geographical, philosophical, and political boundaries to do what we all know needs to be done. But, given the wealth of knowledge we have about deaf children's educational needs and the abilities they bring to the learning situation, there really is no excuse for our failure to implement valid and reliable research findings that have so much to offer.

What really seems to be lacking here is the will--not the way. If researchers, parents, and educators of deaf children could join hands and work together in the way that the Learning First Alliance recently announced, we would be able to put aside superficial differences and really make an impact on the lives of deaf children. If there are some not-so-superficial differences that are also in the way (we know there are), we would have a mandate to resolve them rather than arguing about them without data.

Given such broad-based support, the way would open itself up. We have all or most of the pieces of the puzzle. We need a committed group working together to assemble them, beginning with the most obvious pieces that can only fit one way, and then sorting and putting the more difficult ones in place. Ultimately, what we will get is that big picture with which we have been struggling for so long.

Sandy, you want to know the best way to educate multiply-handicapped deaf children? Let's put together what we know about the optimal educational methods for deaf children, and then figure out what accommodations are necessary to make that education fully accessible for children who face other challenges. I'm not saying that either of these tasks will be simple; but we have to start somewhere, and I can't think of a better place.



Marc Marschark, Director, CRTL

Networking! NTID's Access to English and Science Outreach Project

Over the past thirty years, the number of deaf and hard-of-hearing students entering postsecondary education programs in the United States has increased from several hundred to more than 20,000. Unfortunately, few young deaf men and women choose science as a career. One reason is that science teachers have not been well prepared to provide quality science instruction in K-12 programs. In one study of nearly five hundred science teachers in 326 school programs serving deaf students (both mainstream and residential), Lang and Propp (1982) found that more than eight out of ten science teachers had no degrees in science or science education. More recent data verifies that this problem continues. Such teachers would benefit from in-service training with regard to appropriate materials and instructional strategies for teaching science effectively to deaf students in K-12 programs.

As with hearing students, a major predictor of success for deaf students in science is competency in the English language. English, however, is a second language for many deaf students, and deaf college freshmen frequently have achievement scores in reading and writing which are several grade levels below those of their hearing peers. Limited English literacy skills is the primary barrier standing between deaf students and science careers.

"I definitely [sic] see this writing activity as beneficial because another student attempted to write the same story and it was full of misconceptions. It truly helps to weed out the misconceptions."

"I loved the way writing as a process was tied to science—writing across the curriculum is so important."

In mainstream programs, the majority of science teachers are not familiar with deafness as an educational condition, and often do not understand the language issues associated with teaching science to deaf students. This lack of training and experience has frequently led to a third factor that helps to explain the low number of deaf students in science--the perception or attitude that science cannot or should not be taught to deaf students.

The Lang and Propp study found that fewer than one in ten science teachers made any effort to have deaf students meet or read about deaf persons in science. This, too, has not changed over the years. In 1990, the National Science Foundation Task Force on Persons with Disabilities identified the lack of role models for people with disabilities as a major concern. In response to this problem, NTID's Harry Lang published *Silence of the Spheres: The Deaf Experience in the History of Science* (Lang, 1994) and *Deaf Persons in the Arts and Sciences: A Biographical Dictionary* (Lang & Meath-Lang, 1995) to highlight the contributions of deaf Nobel laureates, founders of fields of science and scientific societies, discoverers of chemical elements and scientific principles, and recipients of scientific honors and awards around the world.



A science teacher at the Rochester, New York workshop presents her writing and hands-On science strategies to other participants

While information about deaf role models in science has been completely lacking in science education for deaf students until this year, an additional concern is that only about one in ten science teachers of deaf students is deaf. Hence, not only do deaf students have little exposure to information about deaf people in science, they also have little exposure to science teachers who are deaf.

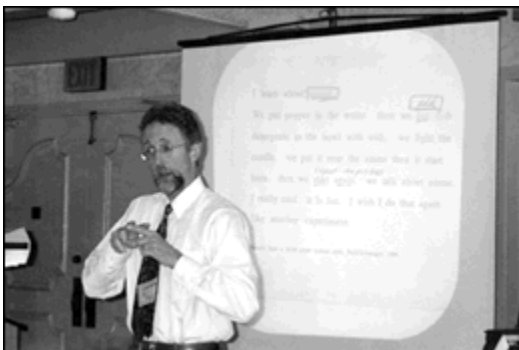
Since these factors--teacher preparation, English literacy, and professional attitude--are interrelated, a multifaceted and coherent training approach for science teachers was developed by NTID educational researchers Lang and John Albertini. NTID's Access to English and Science Outreach Project (AESOP) is a model science outreach project sponsored by a National Science Foundation grant that addresses these factors by providing teachers with appropriate materials and instructional strategies to improve deaf students' access to the content of science, accurate information about deaf students as language learners and strategies to improve deaf students' access to the language of science, and information about the significant contributions that deaf men and women have made to many fields of scientific research.

"I do think if the writing activity were used more, the students would get used to refining the information on their own without as much prodding. This in fact would foster better critical thinking skills."

Lang is a professor and research associate with 27 years' experience in teaching physics and mathematics to deaf and hard-of-hearing students. He has published over 35 research and theoretical papers on teaching science to deaf students. For six years he also served as the coordinator of the NTID Office of Faculty Development, which was responsible for teacher training. He has taught methods courses in science and mathematics education for deaf students as a visiting professor at the University of Rochester and in the RIT Master of Science in Secondary Education (MSSE) graduate program.

Albertini is also a professor and research associate in the Center for Research, Teaching and Learning. Since 1976, he has been investigating the acquisition, teaching and assessment of English by adult deaf students. Recently he has focused on the development of literacy skills, in particular writing, and has published on the assessment and teaching of writing to deaf students. In 1987, he received a Fulbright Senior Scholar Award to conduct research on the teaching of writing to deaf students in Germany. In addition to teaching English language and writing courses to undergraduates, Albertini has taught introduction to language and language acquisition courses to graduate students preparing to become teachers secondary of deaf students.

Lang and Albertini have co-directed AESOP for two years, combining their expertise in English and science literacy as they established a network of more than 500 science teachers and other professionals interested in collaborating with science teachers to enhance secondary education for deaf students. To date, eight workshops with 240 teachers have been conducted in different regions of the country. The AESOP workshops have included NTID faculty presenters from the Center for Arts and Sciences (Vicki Robinson and Keith Mousley) and the Center for Technical Studies (David Templeton and Dale Rockwell). Teachers from the network have sometimes joined the staff. Amy Chizk, a biology teacher at the Texas School for the Deaf, demonstrated hands-on activities at the Texas and Louisiana AESOP workshops.



John Albertini presents writing strategies to AESOP participants in the San Diego workshop

Additional expertise is provided by the members of NTID's AESOP's national advisory board: Peter Paul, a deaf professor of language and literacy at Ohio State University; Dorothy "Del" Wynne, a science teacher at Gallaudet University's Model Secondary School for the Deaf and an NTID graduate; Dean Sheridan, a deaf scientist in Seattle, Washington; and James LaVilla-Havelin, a leader in hands-on activities and museum education in San Antonio, Texas. Thanks to NTID's Educational Outreach program, the board makes annual visits to NTID to review the accomplishments of the project and make recommendations for enhancing its effectiveness. Last, but not least, NTID's Mary Ann Erickson handles the formidable logistics of the regional workshops, work which is critical to the success of this project.

Supported by this pool of expertise, Lang and Albertini have been able to spark interest in networking and action research around the country. As Fred Koch, Assistant Superintendent at Rochester School for the Deaf, said following the AESOP regional workshop held at RSD, "The workshop will be significant

in its impact on teaching practices for all teachers who work with deaf students." In *Project Needs News*, one teacher in San Diego County reported: "I liked the information about the quantity and quality of Deaf scientists throughout history and the encouragement this inspires to incorporate Deaf role models as much as possible." Another said, "The enthusiasm of the speakers was contagious!"

"To be quite honest, when I started back to work last year, I used journals, but there was no rhyme or reason to my methodology. It was only after your conference that I felt that I implemented the journals consistently and correctly!"

For teachers who are unable to attend the regional workshops, much of the information is presented in the AESOP web site (<http://www.rit.edu/~aesopwww>). AESOP's web site includes information about this NSF-sponsored project; a summary of what research says to science teachers about the use of hands-on activities, writing to learn science; self esteem/motivation; effective teaching strategies with examples; a list of deaf men and women in science careers, in history and in the present; a deaf scientist "hotline," which allows teachers to email the AESOP staff with questions; information on available resource materials, including the book *Signs for Science and Mathematics: A Resource Book for Teachers and Students* (Caccamise & Lang, 1996); and a bank of instructional units developed by teachers in the AESOP network. About 25 percent of the 60 queries received last year were a direct result of the web page.

"I have thoroughly enjoyed our dialogues and will certainly put those ideas to work next year."

AESOP pools the knowledge and expertise of high school science and language teachers, special education professionals, educational researchers and instructors in higher education. Instructional strategies based on best practices and recent knowledge are being used to raise deaf students' interest and achievement in science. Action research is a critical part of this endeavor. Action research emphasizes the belief that the teacher can be systematic and insightful in arriving at best practices. In *Curriculum Action Research*, McKernan (1991) writes that "advances in knowledge do not come about through the efforts of any one individual's charisma or skills but are the aggregate result of the community of discourse and researchers in that field" (p. 40). As in the past, the reflective teacher of today, one who has a hunch and wishes to systematically investigate it, is the heart of this "community of discourse" in our field of teaching deaf students. Lang and Albertini's "community," the AESOP network, sets the school as the center of inquiry.

Lang and Albertini are gathering data on successful classroom strategies following each regional workshop by asking teachers to try up to five hands-on activities and associated writing strategies in their classes. Teachers correspond with the AESOP researchers regarding the usefulness of the hands-on activity to teach the intended science principle, and the writing strategy to assist the teacher in assessing how well the science was learned. Many writing samples have been collected so far, with one more year of research ahead. Teachers who have completed the research phase of AESOP have commented on the value of the dialogue with the NTID faculty.

"I feel I have learned more in this workshop than in some of my [graduate] classes that last a semester long, as sad as that may seem, it is true! Thank you for a great learning experience!"

With regard to self-esteem and motivation, Lang and Albertini are sharing information about the success of deaf women and men in science, engineering, mathematics, and medical careers based on the results of Lang's historical research. Teachers are being trained to infuse this information into their science classrooms, and deaf scientists, including Lang, are invited to visit schools and give presentations. The students write about deaf scientists and their own career aspirations. This writing is being analyzed for impact on the self esteem and motivation of deaf students and their interest in pursuing careers in science or mathematics. The dialogues conducted by Lang and Albertini with the teachers around the country is an exciting form of distance learning which they would like to pursue further when the grant is finished.

Another objective of the project is to determine what factors promote sustained implementation of innovation. In the past, research has shown that teachers have discontinued the use of new strategies for a variety of reasons, including a lack of appropriate in-service training. The AESOP researchers are investigating factors leading to implementation of new strategies in teaching science to deaf students and the role the network plays in initiating and sustaining the use of these strategies over time.

"As someone very new to this field and without much sign language skills, I felt extremely comfortable and learned so much in the educational setting of the workshop. There were so many hands-on activities shown that I can apply in the classroom."

The project is having a favorable impact in other ways. Following one workshop, a science teacher enthusiastically reported that she intended to bring five of her students to NTID's "Explore Your Future" summer project. Other teachers have expressed similar interest. AESOP also assisted the Boystown (Nebraska) project for gifted deaf youth, encouraging students to consider science, engineering, and math as possible careers. In addition, students are contacting AESOP independently with class projects involving interviewing deaf persons in science careers. Lang and Albertini were invited in June, 1996 to present a special workshop in North Dakota to teachers of Native American students with disabilities.



Vicki Robinson, physics teacher in the NTID Center for Arts and Sciences, demonstrates a hands-on activity for teaching about heat in a workshop in San Diego.

While the majority of participants are teaching science at the time they attend a regional workshop, AESOP has also assisted with pre-service teacher preparation, training more than 50 graduate students who plan to teach science upon completion of their degrees. Several graduate school professors in Texas, Colorado, Washington, and New Jersey have consulted with AESOP for assistance in course content and preparation. AESOP has also collaborated with several scientists in industry and university environments. Karen Sadler, a deaf neurobiologist, has offered to be a consultant to advise teachers on teaching AIDS awareness. Ken Barr, a hearing chemist at Abbotts Laboratories in Chicago, has

developed an instructional unit on the olfactory sense for AESOP's web page, and has visited NTID in an effort to recruit deaf chemists.

As the Access to English and Science Outreach Project completes its third and final year under the support of the National Science Foundation, Lang and Albertini have every reason to be satisfied. What began as a shared interest in English and science literacy between two friends in the Center for Research, Teaching and Learning has blossomed into a very successful project, bringing together professionals from many secondary and postsecondary schools with a common purpose of improving science education for students who are deaf.

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Special Applications of Automatic Speech Recognition (ASR) with Deaf and Hard-of-Hearing People

by Ross Stuckless



A member of the senior research faculty in the Department of Educational and Career Research at NTID, Ross Stuckless began his career more than 40 years ago as an English teacher at the American School for the Deaf in Hartford, Connecticut, where his brother David was among his students. Ross is optimistic that future applications of automatic speech recognition will contribute substantially to the quality of life among deaf children and adults, and others who share their lives. For more information on ASR, contact Stuckless at ERSNVD@RIT.EDU

What is ASR?

Automatic speech recognition can be defined as the independent, computer-driven transcription of spoken language into readable text in real time (Stuckless, 1994). Interest in the application of a device of some kind to enable deaf people to read in text form what is being spoken while it is being spoken, is

not new. In 1883, the editor of the *American Annals of the Deaf* reported that while the mechanical device used to automatically transcribe human speech was unsuitable, "it is not unreasonable to hope that some instrument will yet be contrived that will record ordinary human utterance without annoyance or discomfort to the speaker" (Fay, 1883).

NTID's interest in operator-assisted systems

In the absence of practical automatic speech recognition systems, NTID has been active in the development and application of operator-assisted speech recognition since 1981 when it acquired the first model of a stenographer-assisted speech-to-text system. ASR was introduced in selected NTID/RIT classes in February, 1982, and with large audiences of deaf adults at a convention of the A.G. Bell Association for the Deaf in Portland, Oregon, in June, 1984.

Research with several hundred deaf students who used the first two generations of this system provided information pertaining to accuracy and error types, error detection by deaf students and their hearing classmates, instructors' speaking rates and styles, and text display considerations (Stuckless, 1983). Stinson et al. (1988) reported on the perceptions of deaf students, differentiated by several demographic and communication characteristics, toward the real-time system relative to other support services such as interpreting. The information derived from all this work provides excellent benchmark criteria against which to assess potential applications of ASR. In the meantime, more technically-advanced stenographic-assisted systems continue to be used with considerable numbers of deaf and severely hard-of-hearing students mainstreamed in regular classes across the country, particularly at the college level.

Unfortunately, the cost and shortage of well-qualified stenographers are deterrents to the widespread use of stenographic-assisted systems. This is especially problematic in a setting such as NTID/RIT where deaf students are mainstreamed with hearing students in 400 or more different undergraduate and graduate courses each quarter.

With the intent of maintaining the benefits of operator-assisted systems at lower cost and with a larger potential pool of operators, Michael Stinson and several of his colleagues in NTID's Department of Educational and Career Research have taken a slightly different approach. Instead of using stenographers and their steno machines to input speech symbols, people with typing skills input standardized abbreviations of words using a regular laptop keyboard and special software designed and adapted at NTID. These abbreviations appear as full words on the screen.

While C-Print does not reach the transcription speeds required for the verbatim transcription of rapid speech, a trained typist can reach speeds of up to 100 words per minute. Many deaf students prefer to read the condensed text of an instructor, particularly when it reduces the transcription of false starts and other idiosyncrasies inherent in the unrehearsed speech of most speakers (Stinson & Stuckless, in press).

*A description of the C-Print project mentioned in this article appeared in the Fall 1996 issue of the NTID Research Bulletin. See **C-Print: Where Have We Been? What Did We Learn? Where Are We Going?** by Barbara McKee, Michael Stinson and Pam Giles. For more information about C-Print workshops designed to train typists in its application, contact Gina Coyne, C-Print Project, NTID Department of Educational and Career Research, e-mail 473DEPT1@RIT.EDU.*

What's been happening in ASR?

Aside from the scientists and technicians who are actually engaged in ASR research and development, most people who think about ASR at all underestimate its complexity. More than speech synthesis, i.e., automatic text-to-speech, ASR requires fast computers with lots of data capacity and memory--a necessary condition for complex recognition tasks, and the involvement of speech scientists, linguists, computer scientists, mathematicians, and engineers. These in turn require the necessary support from the private and public sectors.

The search is on for ASR systems that incorporate three features: large vocabularies, continuous speech capabilities, and speaker independence. Today, there are numerous systems which incorporate two of these combinations, but not all three, as illustrated by products developed and marketed by Dragon Systems and IBM.

In 1994, Dragon Systems introduced a large vocabulary ASR system called DragonDictate for use on a Windows platform. IBM followed shortly after with a comparable product called VoiceType. Both products feature large vocabularies in excess of 20,000 words, with the provision for the user to customize his or her system by adding more. Both systems, however, require the user to pause briefly between each word he or she utters, i.e., discrete speech recognition in contrast to continuous speech recognition capabilities.

Also, both systems were designed as single speaker systems rather than speaker-independent systems, meaning that acceptable accuracy can be obtained only by training the system to recognize each user's particular speech characteristics.

With an hour of training, and reading selected materials, speakers reached speeds of 50 words per minute and word accuracy as high as 97 percent (Stuckless, 1996). In examining both systems at NTID for speech and accuracy (in collaboration with Harry Levitt of the City University of New York), we found that the absence of both continuous speech and speaker-independent capabilities presented major limitations for people who are deaf, precluding applications such as its use to capture spontaneous speech (as in conversation) or more formal speech (as in a college lecture situation).

In Spring 1997, Dragon Systems announced the availability of the first edition of NaturallySpeaking, a system featuring continuous speech recognition. Informal use of this system has produced speeds of around 130 words per minute and word accuracy rates of approximately 95 percent. In Fall 1997, IBM announced its own continuous speech recognition system, called ViaVoice, which has not yet been examined. Both of these systems remain speaker dependent.

What's ahead?

Encouraged by some innovative models and fresh sources of information, developments in ASR appear to be accelerating. There now arises the question of whether these developments will support communication as needed by people who are deaf or hard of hearing, or will induce the kinds of isolating effects that the telephone had on deaf and hard-of-hearing people for so many years.

Prompted by the interest of a Rochester couple, Mr. and Mrs. F. W. Lovejoy, in exploring an adaptation of existing ASR software to permit the wife to communicate more readily with her late-deafened husband, a committee from the Rochester community came together in 1996 to plan a national meeting, the F.W. Lovejoy Symposium on Applications of ASR Systems with Deaf and Hard of Hearing People. This meeting was co-sponsored by RIT and the University of Rochester, and took place in April 1997.

A report on the symposium will appear in the Winter issue of the *NTID Research Bulletin*.

The Proceedings of the F.W. Lovejoy Symposium on Applications of ASR Systems with Deaf and Hard of Hearing People are scheduled for distribution in late Fall, 1997. For a copy of the Proceedings, contact Ross Stuckless, NTID Department of Educational and Career Research, or by e-mail at ERSNVD@RIT.EDU.

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NOTES OF NOTE

Susan Fischer, Department of Applied Language and Cognition Research, recently returned from a year in Japan, where she worked on a study comparing the sign language of Japan (Nihonsyuwa, or NS) with American Sign Language (ASL). Based in Sendai, she worked with a number of native NS signers in Sendai and also at Tsukuba Institute of Technology, NTID's sister institution in Tokyo. While her data is not fully analyzed yet, preliminary results suggest many similarities in the grammatical use of facial expression, but the radically different word order results in different ways of using facial expression in the two languages. While in Japan, Fischer was invited to address a number of deaf and hearing groups, including providing the keynote lectures for the Linguistic Society of Japan and for a regional deaf women's association. For more information, she can be contacted at e-mail SDFNCR@RIT.EDU.

This summer, Oxford University Press published a new book by **Marc Marschark**, Patricia Siple, Diane Lillo-Martin, Ruth Campbell, and Victoria Everhart. Entitled *Relations of Language and Thought: The View from Sign Language and Deaf Children*, the book provides a critical examination of the link between language development and cognitive development in deaf children. The authors' exploration of how sign language might affect language development and other domains of early growth provides valuable insights into the development of deaf children and implications for their education.

Susan Fischer, Department of Applied Language and Cognition Research, recently reviewed Douglas Baynton's book **Forbidden Signs: American Culture and the Campaign Against Sign Language** (University of Chicago Press, 1996), for the October 24th issue of the [London] **Times Higher Education Supplement**

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