(#1)Technology and Deaf Education Symposium
June 23-25, 2008
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Technology and Deaf Education:
Need and Opportunity for Technology Infusion

Introduction

I am pleased to be with you. In many ways it's like coming home because of my long term concern for the education and general welfare of Deaf and Hard of Hearing people here in the US, and elsewhere. My introduction to the "world of the deaf" occurred while an undergraduate student in a Missouri college located in the geographic center of rural America. This fortuitous circumstance took place when I agreed to assist in athletic programs at the nearby Mo. State School for the Deaf. At that time*, direct instruction public residential schools were in their ascendancy where approximately 80% of K-12 deaf students were in attendance.*

(#2)*This is a special time in education,* and especially so, because of technology available to dramatically influence the learning process. My purpose today is to share some perspectives on the ever-changing landscape of educating deaf and hard of hearing students, and in the process stimulate your thinking as to how existing and emerging technologies might accomplish *two challenges; first, to quicken the rate of learning and second, to enrich the depth of learning at each stage of education.* It is clear that today's coalescence of need, and opportunity for creative use of technology, has never been stronger. The electronic technology available today far exceeds that of the earliest days of NTID and the Nebraska symposia (on technology).

(#3) The abiding problem encountered by Deaf and Hard of Hearing (D&HH) persons is living in, and *adapting to, acoustically-biased societies*. The snowballing effects of early onset are well known. Inability to hear clearly inhibits spontaneous development of speech and language, which in turn impacts learning to read and to write. The one thing that has not changed is the *purpose of your work.*

A constant challenge to educators is *overcoming the historic persistent gap in educational progress*. And it is in this sphere that innovative auditory and visual sensory technologies hold great promise.

"For millions of years, we couldn't see atoms, we couldn't hear radio waves, and we couldn't smell TNT." But now, thanks to science and modern technology, previously unexplored universes have been opened to us; to such an extent that opportunities and ambitions are in large measure shaped by science and technology. An historic boost to the scope *of basic research and technology* came about in the years surrounding WWII. That experience catapulted a reluctant nation into a world leadership role in science and technology. In a mere half century since, *an earth-spanning connectedness has been established.*

It is clear from the content of your symposium that your profession has capitalized on this revolution in science and technology. During this time much has changed, and yet much remains the same.

The one thing that has not changed is the *purpose of your work.*

However, three significant changes have occurred and will be the focus of my comments. **(#4)**First, the *system for reaching students has changed, s*econd, t*he characteristics* of those who come to be served have changed; and third, t*he educational demands of the work force have changed*.

Reaching them, their characteristics, and the work place – these constitute the "big three" for any serious conversation about the future. In examining these, recognize that I have used a personal filtering approach, since human enterprises by their very nature, are complex. Being deaf or hard of hearing can be even more vexing… especially to the uninitiated public at large. One seemingly *never ending challenge is to convey, and to have accepted, the legitimate learning needs of a group of students at odds with the conventional acoustically biased approach to learning*. And in my experience this applies at all levels of education.

I also suggest a series of *unintended consequences that have shaped the current state of the art in your work.* These are revealed in the changing role of education in society, scientific discoveries, demographics, workforce dynamics, telecommunication systems, organization of educational programs, and advances in health that all have conspired to make your lives, if not different, at least all the more interesting as you face the day-to-day needs of a more diversified generation of youngsters.

(#5)The Purpose of Your Work Has Not Changed.
I think we could all agree that the *purpose* of your work as educators has not changed. You continue to strengthen the academic, personal, social and communication-skill preparation of students that will enable them to become self-generated learners, and thereby gain success in the economic mainstream, as well as in the social milieu of their choice. Additionally, the "coin of the realm" for those persons with whom you concern yourselves is, has been, and continues to be, literacy. Facility with the language that dominates education and economic participation is paramount.

In the end, it is the general success and well-being of your graduates that matters.   Producing independent learners with the skills to move through successive educational levels is easier said than done. Especially, in a time when the system of education is undergoing what I perceive to be a restructuring, not merely modification. Hence, all the uncertainties of ill-defined transition are likely to be present. I have found that understanding the driving forces responsible for such conditions can be helpful.

Inside and Outside Influences.
Just as no "man is an island" no profession is an island. **(#6)**What a profession becomes is influenced by factors outside as well as factors from within. Recognize first, that external forces are *constantly in flux*; consequently, the issue becomes one of *how to adapt to such*

changes. For each profession the challenge is to determine how these forces actually play-out in one's day-to-day realities.

Second, it is also true, that the origin and character of macro trends remain *outside the control of any single profession*. Therefore, each profession must determine whether such forces can be *helpful, neutral or run contrary* to its goals.

Third, it is also necessary to realize that *no single academic discipline* can solve all of the problems of your students. This requires that the educational system promotes the constructive interaction of all employed in the enterprise.

(#7) The purpose of which is to *create the synergies that lead to quickened rates of learning and educational progress* more closely approximating OR EXCEEDING that of their hearing peer groups.

The Changing Role of Postsecondary Education in U.S.
A significant external force affecting all of us has been the changing role of postsecondary education in U.S. A little-known outcome of WWII was the unique challenge of assimilating some 11 million veterans back into America's economic mainstream. **(#8)**Thus was born the GI Bill of Rights – a device to help avoid massive unemployment. In the process however, this signaled a deeper sociologic change. This single act by Congress set into motion *the beginning of universal postsecondary education in this country*; one that produced graduates with significant knowledge and skills that in turn led the nation into its second industrial revolution. Talk about unintended consequences! You must understand that, prior to that generation and with few exceptions, a high school education satisfactorily met the demands of the work place.

Multi-layered postsecondary education created new research and training opportunities that resulted in a more broadly constituted work force of craftsmen, managers, scientists, and engineers. *A place, incidentally, where few deaf adults dwelt.* Advanced education spawned fundamental scientific discoveries that gave birth to a dazzling array of new technologies many of which have changed the substance and the means by which you carry out your work today**.**

(#9)*Stage 1 technologies* in the modern period that impacted education of deaf and hard of hearing students came from the fields of mathematics, physics and electrical engineering. This stage was marked by the invention of the *transistor and printed circuits* that enabled a quantum leap in reliability and miniaturization of electromechanical devices. From this flowed fixed and portable audiometers and precise measurement of residual hearing, group auditory training devices, wearable ear-level hearing aids, and tape recorders. The invention of the Scanning Electron Microscope (magnified images by using electrons instead of light waves) made visible the anatomy and structure of the inner ear; the operating microscope, (a binocular microscope uses light waves) revolutionized medical practice by advancing middle ear surgery and future cochlear implants. In addition, overhead projectors, Xerographic copiers, TV and video recorders, TDD's, captioned media – and circumscribed voice recognition systems, all examples of Stage 1innovations.

In Stage 2, physics, photographic science and electrical engineering produced *the semiconductor microchip.* This invention eclipsed electro-mechanical switches and opened the whole *new era of electronics.* Enter digital processing that led to batch, mini and personal computers, hand held calculators, fiber optic cable, Internet, cell phones , portable wireless telecommunication devices, on-line learning, flat screen projection, smart classrooms, hand-held multiple-purpose computer and telecommunication devices, binaural cochlear implants, C-Print and the list goes on.

(#10)Technological advances impact how professions and organizations conduct their business.

The computer is a good example of how an external development can penetrate and eventually affect the very essence of a profession or business organization. In this regard, what should not escape us as educators of D&HH persons is the momentous change wrought in human-machine interface--*the alphanumeric keyboard.* The auditory-based telephone, which for decades placed deaf persons at a serious disadvantage, was now co-opted by alphanumeric visual input and output for E-mail and Internet communication. *The treasured establishment of a level play field in communication!* How many of you have such a device with you today?

What we might take for granted today has not always been the case. It has not been long since the question posed regarding auditory training was "For whom and for how long?" There was considerable skepticism regarding the use of residual hearing in D&HH children. Quite remarkable that this question currently is being played-out in the form of cochlear implants.

Another mid-century development – Aural rehabilitation programs originally designed for WWII veterans were developed and served by teachers of the deaf, speech scientists, and hearing scientists. **(#11)**Experience gained from those rehab programs led to a *new field called Audiology and Speech Pathology.* Because of their knowledge base, Educators of the Deaf played a major role in shaping the intersection of these related professions. Since then Audiologists helped shape diagnostics, established neonatal hearing screening, promoted wider use of residual hearing, and promoted earlier and more relevant educational planning.

Another tangential development – mid-way in the past century virtually all established urban areas had what were called Hearing Societies. Chicago Hearing Society, San Francisco Hearing Society, Washington DC Hearing Society, and New York League for the Hard of Hearing. These organizations served hard of hearing adults, a large proportion of whom had hearing loss due to otosclerosis. A bony growth in the middle ear created a mechanical deterrent to sound reaching the inner ear, resulting in a conductive hearing loss. When the binocular operating microscope was invented it not only transformed the practice of otology but also caused *the demise of the historically popular "hearing society".* A notable exception is the New York League that modified its mission and goals in order to survive. Yet another example of how forces external to one's profession can exert pressure for change neither initiated nor planned for from within.

The system for reaching students has changed.

(#12) In this regard, not long ago, the *residential school for the deaf was the center of the educational delivery system* for deaf and hard of hearing students. There were a few day schools or classes located in long-established large cities but the vast majority of students

were enrolled in residential schools. All involved direct instruction. Nearly all teachers, principals, and superintendents were trained at one of four places -- Gallaudet, Lexington, Clarke or Central Institute. Less than 1% of secondary school leavers entered colleges and universities. And ninety-nine percent were enrolled at Gallaudet. Relatively few K-12 deaf children fell between the cracks – however, the same could *not* be said for hard of hearing children --primarily because they were not diagnosed early and properly. After falling seriously behind academically they were often referred to residential schools – historically a subtle positive service performed by many residential schools. Teachers and administrators among schools and programs nationwide compared notes routinely through formal conferences and informal channels. So much so that the education of deaf children until recently could accurately be described as a "national educational system".

Nationwide Intimacy of that day has given way gradually to *a dispersed local system* – largely due to a number of forces outside education. For example -- The rationale for a national highway system begun in the 50's was part of a military strategy that would enable rapid movement of personnel and materiel. Unintentially, these new highways also contributed to a population shift from rural to urban. That's where the jobs were. Simultaneously, universal higher education through the GI Bill created new generations of college graduates who fueled the manufacturing and service sectors of our economy to unprecedented levels. With that degree in hand, rural hometowns rarely held out appropriate prospects for work. It became evident that a college degree and mobility were highly correlated. The term "extended family" was re-introduced to the daily lexicon and through the years has become a commonplace circumstance. Hence, urbanization and increased educational levels of parents began to impact the public policy arena. One unintended consequence -- we now have a more localized special educational approach, which in many ways presents you, as a profession, essentially a non-system marked by considerable fragmentation. **(#13)***A structural shift from direct instruction to one of access and support services in mainstream settings.*

Federal investment in special education and federal civil rights legislation during the past half century has contributed substantially to the breakup of the residential school as the center of the delivery system. Quite interesting, the analog in healthcare is the move away from the acute-care hospital as the center of health care delivery. The point is that *any time an organization or industry is forced to restructure, the fallout is far reaching* and that is how I would characterize the *present state of our profession – one of restructuring the delivery of service. A condition that offers new opportunities for innovative technology application in the learning process.*

(#14)**The characteristics of the children and youth who come to be served have changed.**
Population growth, urbanization, and immigration have combined to produce *a diverse set of backgrounds in children* who need your services. Socio-economic status of families, in the main, determines the potential effectiveness of your efforts. Add inner city living conditions and you have raised exponentially the level of creativeness required to win more than you lose; especially, when parents are not active participants in the education of their offsprings.

I can remember attending the White House Conference on Education convened in the early 60's shortly after the surprise appearance of Sputnik, which in large measure was the justification for more Federal involvement in education. The major concern of that early 60's

meeting was the apparent shallowness of the high school curriculum. The worry related primarily to science and mathematics offerings judged to be inadequate. That is, inadequate to compete in the forthcoming global economy and the then necessary containment of the Soviet Union. In essence, bringing the college liberal arts curriculum of that period to the high school appeared to me one of the messages. We see this today in the form of "advanced placement" courses offered at the high school level. *Emphasis on STEM education for D&HH today is a corollary to these earlier priorities.*

(#15) Another take home message for me was that a subtle attitudinal shift was taking root across the country– *a sociological shift from one of a "melting pot" mentality to one of a "salad bowl".* Therefore, diversity in backgrounds that may challenge your daily work today ought not to be a surprise. Moreover, in my view, social policies adopted soon thereafter subtly *changed the American psyche from one of opportunity to one of entitlement.* For whatever reasons, parents who have adopted this attitude only contribute to the indifference often reflected in your student population's motivation for learning and earning.

In my early professional years, deaf adults had not had the benefits of today's new health related vaccines and technology. Meningitis and other childhood diseases were principal causes of deafness at that time. Thirty-forty percent of students in residential schools or elsewhere were due to meningitis and other high fever illnesses. Two consequences were -- profound deafness -- and later age at onset that allowed spontaneous development of speech and language. In contrast, the maternal Rubella epidemic of the 60's resulted in a wave of students whose onset was at birth and who by comparison to genetically-based deafness presented multiple developmental conditions. *Antibiotics, vaccines, and prenatal care helped moderate some of the historic causes.* However, more recent socio-cultural and demographic changes have resulted in *life-styles* that have presented you a mix of consequences, some of which you will recognize at this conference. In sum, those with whom you deal today are primarily deaf from birth and many of whom may have suffered undiagnosed prenatal insults – often resulting in *a variety of behavior and learning problems.*

However, it is good to remember that what we have known intuitively a long time about brain development has been confirmed empirically. *The brain is not hard wired as once thought.* Therefore, use of technology in providing novel sensory inputs, can lead to exponential increases in neuronal connections in the brain, and as a result, *a more sophisticated capacity to perform.*

(#16)Demands of the work force continue to change.
The character of the nation's work place is reflected in its principal economic sectors. Early on, agriculture dominated the work place. At the turn of the last century, manufacturing took over as the preeminent job-producing sector of our economy. At mid-century shift that next took occurred when more jobs were generated in the service industries. Incidentally, the service industries dominate to this day as the so-called information era, aided by the relegation of manufacturing offshore.

Education and communication demands of the agricultural workplace were quite limited. To participate fully in the manufacturing era required more technical training and facility with the English language. It was the emerging technologies of the 50's and 60's that provided the wake-up call for those concerned with the general welfare of deaf citizens. *Deaf adults were*

slipping dramatically behind their peers in educational opportunities and job accessibility. For example, at the time of the 1965 enabling legislation for NTID, 85% of all deaf adults were in unskilled or semi-skilled occupations. The other 15% were largely Gallaudet graduates who were employed as linotypists in the Government Printing Office in Washington, or in residential schools for the deaf where they functioned as teachers, athletic coaches and resident advisors.

(#17) Rarely did deaf adults occupy technical and managerial positions in the private sector. Recognition that technical skills and English language proficiency were hallmarks of the modern workforce induced the Congress to support *the establishment of NTID.* It became evident that, (a) more appropriate *educational postsecondary opportunities were necessary*, (b) that technical skills that added value in the open market place were key, (c) that business and industry needed to be educated regarding the capabilities of deaf employees, and (d) that the greater public needed to learn that when given a chance to an appropriate education, deaf people could succeed at levels comparable to their hearing peers.

Considerable progress has been made over the past 40 years. Today there are more deaf adults holding postsecondary degrees than in their entire history. And they are engaged in technical and managerial positions in a broader array of jobs than any previous time. But the challenges for the future mount. Job environment characteristics that bear directly on your work will continue.

For example, there is little doubt that literacy continues to be a fundamental issue. Especially since the computer-based Internet is firmly established and the odds are very high that the standard international language will be English. How your students think, is critical. Thinking in an analytic way, how to solve a problem, multi-tasking and working in teams. **(#18)**Successful thought processing, in this information-based social and economic world, assumes *the capacity to integrate and prioritize multiple sets of information quickly.*

(#19)As you look to the future opportunities for technology abound. For example, *comprehensive K-12 programs need Technologies for Organization* –specifically (a) how to effect an integrated tracking and operational database system within local school districts that makes it possible to move D&HH children in a timely manner according to their changing needs as they advance from K through 12, (b) How best to organize regular teachers, support instruction personnel and classroom arrangements to counteract the fragmentation of effort that has occurred, (c) How to introduce telecommunication technology to engage more parents in the process, (d) How to foster infusion of access technologies into high school curricula that lead to achievement levels required for entry into postsecondary schools, and (e) How virtual networking systems might be employed in bringing together faculty and administrators at the local level thus capturing the benefits of an integrated system of education for D&HH.

(#20) It is clear that *a shift from direct instruction to supported instruction continues.* Regardless of the domain, innovative use of communication and instructional technologies hold significant promise for improved educational outcomes. Greater interaction among teachers, information technologists, and students has been made possible by new digital production and retrieval technology. Access technology that encourages active as opposed to passive learning and simultaneously accommodates to different rates of end-users' learning, are keys to building improved educational programs. At the heart of such programs is the ability to expand the

learning period beyond structured time slots and to enable multiple as well as individual uses of the subject- matter content. Infusion rates for new technologies will depend upon educational systems that allow for experimentation and integration of efforts.

Greater control for managing the process exists in the direct instruction model than in the supported-instruction system. Guiding the selection and evaluation of instructional technologies by teachers involved in *direct instruction* can be a contribution fostered by information technology experts. The model of supported instruction exemplified in mainstream settings requires application of technologies germane to the *conventional classroom methods for hearing students*. Beyond enabling teachers to adapt to promising applications, there exists the opportunity to assist support personnel in mainstream programs to experiment, and they in turn enable end-users to adapt technologies to their personal needs and personal rates of learning.

The NTID experience can be helpful given its well-developed career-focused or 2 + 2 Associate Degree programs where *students receive direct instruction and communication* from signing professors. NTID classes are generally small, allowing for important personal attention and interaction among students and professors. The classrooms and labs are state-of-the-art, and there are over 200 faculty members with knowledge and experience of the unique educational and communication needs of Deaf and hard-of-hearing students.

(#21) From its inception NTID has opened new avenues of learning for those attending integrated classes with their hearing peers. From a world-wide perspective its admittedly idealized program offers *access and support services* for deaf and hard of hearing students enrolled in RIT's mainstreamed baccalaureate degree classes. These students receive access services such as interpreting, real-time captioning and notetaking, as well as faculty and peer tutoring, academic advising and counseling services. NTID's deep commitment to educational innovation is obvious in its 122+ interpreters, 55+ C-Print captionists, and some 45,000 hours of notetaking services offered each academic year. In addition, technologies such as FM listening devices, captioned media, and the use of Interpretype in offices on campus are routine.

(#22)A cautionary note on potential outside influences --Your future work might be complicated to some extent by the *apparent disconnect between social policy and educational goals of deaf children and youth* -- especially for those ill- prepared or not interested in pursuing postsecondary areas of study. Supplemental Security Income (SSI) for "disabled" and SSDI, the federal social insurance program for disabled workers may very well lure many into a dependency from which they will never recover. Public financial assistance may be an incentive very appealing for those who do not wish to join the ranks of the employed.

Trends in Postsecondary Education
An emerging trend in postsecondary education is the *push for the baccalaureate degree, particularly by community colleges.* Obviously this relates to what tomorrow's employers will be looking for: a) the value that one can add to the organization and b) certification of skills inherent to a career–ladder entry-level position that grows to a lifetime income accumulator. In educational parlance, an independent learner with life-long learning interests.

During the past half century, the relative value of a high school diploma has been replaced with the Associate Degree. Tomorrow's work place will see the applied baccalaureate replacing the associate degree. Simply because required knowledge and technique will take longer to acquire. The take home message from all of these realities: *Success in increasingly dynamic work environments will require high degrees of literacy and personal/social capabilities.*

(#23)Major External Developments of the 21st Century

As I bring my comments to a close, I would acknowledge that the production of goods and services during the past century was based principally on research and development in mathematics, physics, and engineering – radio, TV, computer, satellite telecommunication systems, space travel, and the sequencing of the human genome. The next century will see a *continuation from microelectronics to nano-technology*—resulting in a continuation of miniaturization, power, and portability and processing speed. All basic to further development of hearing enhancement and visual technologies for Deaf and Hard of Hearing persons.

(#24)We can expect technologies geared to improving the *matching of technology to the person.* Considerable room for improvement exists in the sphere of wearable hearing aids where digital signal processing (DSP) capabilities will be expanded; For example, already underway are efforts to utilize artificial intelligence algorithms that will permit data logging and auditory scene analysis. Speech and noise filtering in hearing aids that better capture the brainstem advantages of binaural hearing will be accomplished as will DSP strategies that allow the user to train the hearing aid for his/her unique hearing profile, and Bluetooth type technology that connects right and left hearing aids and for wireless connectivity to cell phones, music devices and computers.

(#25)Parallel breakthroughs in this century are likely to come from biology, spurred on by the recent *sequencing of the human genome.* Look for innovations stemming from *cell biology, biochemistry, genetics, and biomedical engineering.* Early on in education, you are likely to see the results in new tools for teaching and *virtual learning environments.* In medicine, breakthroughs are most likely to come through *pharmacology* applied to noise induced hearing loss and chemical changes in the brainstem. Later on we can expect the application of *stem cell and gene therapy* to various inner ear components, including for example, interruptions in potassium recycling in the inner ear, and neurotransmitter changes in the feedback system from brainstem to ear. It is safe to say that genetically-determined physical conditions of all types will be viewed as 21st century targets. Treating cancer and degenerative diseases such Alzheimer's and Parkinson's are obvious early targets. Treatment of spinal cord injuries should be enhanced through stem cell and cell regeneration research efforts. And then as more is learned about what makes cells live or die *advances in regenerating nerves of all types will follow.* So we will see a coupling of electronically and biologically based interventions. What might sound impossible today are future realities that will give people personal life choices that heretofore have been out of reach.

(#26)The enduring *hope for improved educational outcomes* rests with the creativity of you and your professional colleagues in *taking advantage of those technologies that enthuse and guide students to improved capacity for life-long learning.*

In spite of the uncertainties that confront us, I am hopeful. So in that spirit let me close with a thought from Charles Darwin —"it is not he strongest of the species that survives, nor the most

intelligent*; it is the one that is most adaptable to change".* And in order to assure organizational usefulness in tomorrow's world, change from inside your profession must anticipate influences of macro forces emanating from outside*. Leadership, innovative technologies and collaboration* may well be the order of the new day!

(#27)Thank you and best wishes for a productive and joyful symposium.