NTID Research Bulletin

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Vincent Samar is an associate professor in the Department of Research at NTID.

Identifying Learning Disabilities in the Deaf Population: The Leap From Gibraltar

By Vincent J. Samar

For three centuries, the tiny British colony of Gibraltar at the southern tip of Spain has languished in geopolitical isolation. Lying in the hollow of an impenetrable fortress through two world wars, and subject to Spanish roadblock in the latter half of the 20th century, there has been no more stalwart outpost of Victorian world-view than Gibraltar.

The study of learning disabilities (LD) in the deaf population is the Gibraltar of the modern world of LD research. Despite meteoric progress in mainstream LD research since the early 1980s, research on LD in the deaf population remains a quaint backwater (see Samar et al., 1998, for a review). But why has the research community sailed boldly west of the Pillars of Hercules to a New World of knowledge about LD in hearing people, only to cower ignorantly back on the Rock when confronted with the unknowns of LD in deaf people? As with Gibraltar, there are two principal reasons for this colonial isolation: the folly of governments and the seeming impenetrability of the terrain.

Today, there is acute state and federal government recognition that LD is a family of neural development disorders producing lifelong educational, personal, social, and career challenges for 10-20% of hearing children and adults. Vast government-supported research is accordingly underway to develop advanced diagnostic and remedial approaches to this growing public health issue. Simultaneously, many states still do not recognize the possibility that deafness and LD may co-occur. For example, New York State's definition of LD, following closely the long-standing federal definition established in P.L. 94-142, states that "the term does not include students who have learning problems which are primarily the result of… hearing… disabilities." Since in practice a child's deafness is *ipso facto* taken as the primary cause of learning problems, deaf children are typically excluded from concomitant classification as LD in mainstream school settings.

Gallaudet's 1997 annual survey of schools and programs estimates the incidence of LD in deaf children to be approximately 8.4%-11%, making LD the largest secondary disability affecting deaf people. Yet, government disability policy has long placed the issue of LD in deaf people outside the purview of school disability personnel and the deafness research community. Consequently, there has been little advocacy for research to prove that LD exists in deaf people or to understand its characteristics, causes, and educational impact. Among scores of existing clinical and research publications on LD, only a handful of exploratory papers have struggled to announce, as Mauk and Mauk (1992) did, that "somewhere, out there… children with hearing impairment and learning disabilities [must exist]."

In fact, one of the first populations actually known to be susceptible to the sort of neural damage that might cause LD was deaf children, not hearing children. In the early 1980s, LD was the putative disability left to explain a hearing child's specific learning problems in language, math, or other cognitive areas after ruling out verifiable sensory, neurological, bilingual/bicultural, or behavioral

Learning Disabilities continued on page 3

"…government disability policy has long placed the issue of LD in deaf people outside the purview of school disability personnel and the deafness research community. Consequently, there has been little advocacy for research to prove that LD exists in deaf people or to understand its characteristics, causes, and educational impact."

Notes of Note

Frank Caccamise has just published *Signs for Legal and Social Work Terminology*, part of the Technical Signs Project, with Marilyn Mitchell, NTID, Shirley Herald, Arkansas Administrative Office of the Courts, and Daniele Burch, Sign Language Services International. The Technical Signs Project was established at NTID in 1975. Its goal is to promote effective communication through the establishment of a nationally-based system for sharing sign language used by skilled signers for technical or specialized communication. There is now a series of sign language videotapes in 24 technical/content areas, books for 9 of these 24 areas, and one book which discusses the principles and methodology of the project. For a listing of the videotapes and books in the series, a list of vocabulary and sentences on each videotape, or a general/national list of sign language materials for technical communication, contact Caccamise at (716)475-6420, e-mail *FCCNCR@RIT.EDU*

Notes of Note continued on page 3

Solving Our Own Y2K Bug

At an NIH-sponsored workshop in 1998, I was asked to make a presentation on "the research agenda in deafness for the next 5 to 10 years." In preparation, I requested input from a variety of researchers and university officials. The responses reflected general agreement about the key issues, but very different proposed agendas depending on individuals' backgrounds and primary job responsibilities.

It is important to note, at the outset, that I have had concerns about "the agenda" for some time. In earlier columns, I have lamented the gap between research and application. One colleague recently complained about "eye-rolling" from teachers and school administrators when we try to explain why our research is relevant to everyday teaching-learning activities. However, another colleague rolled her own eyes while complaining about the need to justify federally-funded educational research in terms relevant to educational issues(!). Coming from another direction, an educational administrator recently complained to me that researchers have been trying to understand and improve the reading abilities of deaf students for 100 years with little progress, and that maybe it was time to "just move on."

And now, we are at the meat of the matter. I believe that basic research into the understanding of the language and cognitive abilities of deaf learners has now put researchers in a much better position to contribute to education than ever before. Advances in educational theory, methodology, and technology give us new avenues for the enhancement of educational opportunities for deaf and hard-of-hearing students. Take reading: Forty years ago, we did not know that deaf students who signed rather than spoke "had language." Twenty years ago, we did not know that deaf readers could acquire the phonological skills (apparently) necessary for optimal reading. And five years ago, we did not know that mentally representing text as sign language required more memory capacity than representing the text as spoken language. Armed with better tools and better knowledge of how to use them, we are in a much better position than ever before to improve the reading abilities of deaf students. Is anyone still paying attention?

When I asked other researchers the "research in the next millennium" question, the greatest number predicted the need for research on new technologies, and especially cochlear implants. Second place went to educational issues relating to early intervention and bilingual/bicultural programs. English literacy came in a close third, followed by a number of "also-rans." Interestingly, only one person mentioned research on teachers and teaching.

What does it all mean? Well, there is a piece missing. After my 1998 presentation, it was pointed out that I forgot to ask teachers and school administrators the same question I asked my university colleagues. Gulp! Perhaps that tells me something about myself, as well as something about the real nature of our educational Y2K bug. Let's see what teachers and administrators have to say, and let me rethink this. Stay tuned for the spring column, where I will take up where I left off.

Marc Marschark, Director, CRTL

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Gail Kovalik, Editor

Samar's current research interests include assessment of language and other cognitive skills, and the origins and identification of attention deficits and learning disabilities in the deaf population. He has published numerous research articles in the area of deafness, including articles on the assessment of language skills, the neural and cognitive mechanisms of language and spatial skills, the control of visual attention, and applications of captioning technology in the classroom. For more information, he can be reached at VJSNCR@RIT.EDU

Learning Disabilities continued from page 1

causes. No actual evidence existed then that any developmental neural damage underlay the learning problems of such children. Yet for deaf children it was known, as Sabatino (1982) pointed out, that "frequently, the very pathology or etiology resulting in sensory impairment also destroys neurons."

Nevertheless, the government's logic of LD classification in the early 1980s and long after was this: the absence of known etiologies of early neural damage identifies hearing children with learning difficulties as having LD, while the presence of such etiologies disallows deaf children with learning difficulties from having LD! Sabatino referred to this logic as an act of "idiocy." Its ironic legacy is that today we have overwhelming scientific evidence for a neural basis of LD in hearing people, yet we have seen no direct evidence for a neural basis of LD in deaf people.

"Deafness introduces a ruggedly varied landscape to the cognitive, cultural, and language terrain, which may camouflage many standard signposts of LD."

Notwithstanding the folly of governments, reliably identifying LD in the deaf population is a daunting task. Deafness introduces a ruggedly varied landscape to the cognitive, cultural, and language terrain, which may camouflage many standard signposts of LD. Recently my colleagues at NTID, Gerald P. Berent and Ila Parasnis, and I undertook to navigate this terrain in two research studies on English language learning disabilities (LLD) in the deaf population.

English Language Learning Disabilities in the Deaf Population

The influence of deafness on language development complicates the diagnosis of LLD. Deafness introduces complex interactions between audiological, cognitive, cultural, and language factors that create enormous variability in English language skills in reading, writing, vocabulary, grammar, meaning, and discourse. Without foreknowledge of the relative influences of deafness versus LLD on the English language skills of particular individuals, classifying individuals as having LLD using existing assessment instruments is risky.

Our current explorations are aimed at discovering more reliable diagnostic markers for English LLD in deaf individuals. A marker is a characteristic behavior that selectively identifies an individual as having LLD. Using the more advanced literature on LLD in hearing people as a guide map, we tried to identify a few frontiers that would yield to new research inroads: the first is the realm of intuition and experience of teachers at the front line of deaf education, and the second is the inner activity of the brain's visual system at the front line of cognition.

The Language Learning Disability Survey

Many teachers of deaf children believe atypical English language behaviors can identify certain deaf children as having LLD (Elliott et al., 1988). Therefore, Berent, Samar, and Parasnis (1997) studied the intuitions of expert English language teachers of deaf students about the specific language behaviors that might distinguish deaf students with LLD from those without LLD. Such expert intuitions should help researchers select candidate markers to study empirically in the near future.

We constructed 30 survey items representing a broad range of language phenomena known to be difficult for both deaf students and hearing LLD

Learning Disabilities continued on page 4

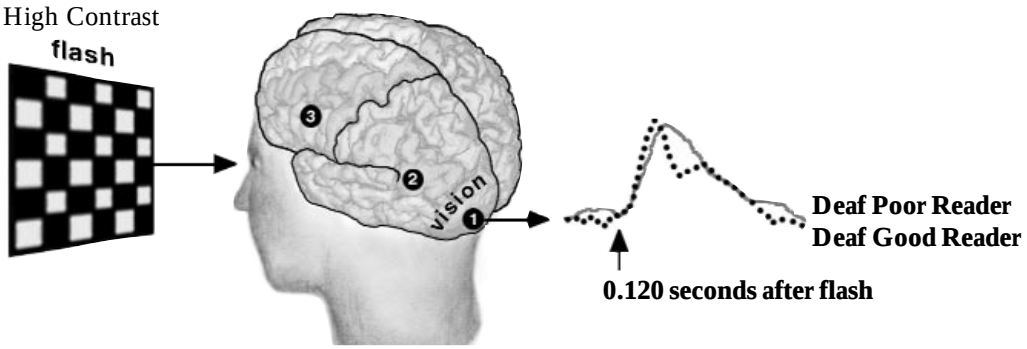
Notes of Note

Continued from page 1

In November, 1998, **Marc Marschark** presented an invited paper, "Interactions of Cognitive Processes and Reading and Deaf Learners: Understanding Differences" at the international "Action Communication Formation pour la Surdité" on literacy in Paris. The audience of 900 included parents and teachers of deaf students, school administrators, audiologists, and other professionals, both deaf and hearing.

Robert Whitehead's article "Voice onset time in speech produced by inexperienced signers during simultaneous communication," co-authored with Nicholas Schiavetti and Dale Metz (State University of New York, Geneseo), appears in the January/February, 1999, issue of *Journal of Communication Disorders* (v. 32, 37-49). Both of these articles address the issue of the temporal features of speech produced during simultaneous communication by inexperienced signers. In general, the results indicated that speech was significantly slower during simultaneous communication, however the temporal rules of spoken English were maintained.

Figure 1.
Sustained Pathway



Learning Disabilities continued from page 3

students, including specific lexical (e.g., understanding word meanings), morphological (e.g., knowledge of noun and verb suffixes), syntactic (e.g., question formation), and discourse (e.g., organizing sentences) processes. We asked 27 experienced NTID English language teachers to rate the level of difficulty that they would expect deaf students with and without LLD to have with each of the items. Then we determined statistically how strongly teachers agree that each specific language phenomenon would distinguish deaf students with LLD from those without LLD.

As with hearing LLD students, difficulties with spelling and certain discourse processes top the list of the most reliably cited indicators of LLD in deaf students (see Table 1, p.5). By contrast, teachers reported that differences between deaf students with and without LLD were subtle in more syntactic domains such as morphological feature processing (see Berent et al., 1997, for specific items and results).

Our results provide the first detailed map of the collective intuitions of expert English language teachers about the most and least distinguishing language characteristics of LLD deaf students compared with their non-LLD peers. Whether empirical studies of deaf students with suspected LLD will confirm the diagnostic validity of these characteristics remains to be seen.

An Objective Marker for Dyslexia

Dyslexia is present in 80% of hearing individuals with LLD and should occur at least as often in the deaf population. However, it is difficult to know if a deaf individual with poor reading skill is dyslexic simply by assessing reading and cognitive skills. We need a marker that is insensitive to the language variation caused by deafness but correlates well with the presence of dyslexia.

Such a marker may exist. Behavioral and brain imaging studies show that dyslexics display an underlying deficit in processing rapidly presented information. This so-called "generalized timing disorder" has many observable consequences besides dyslexia, including, importantly, delayed processing of simple visual patterns like the checkerboard in Figure 2.

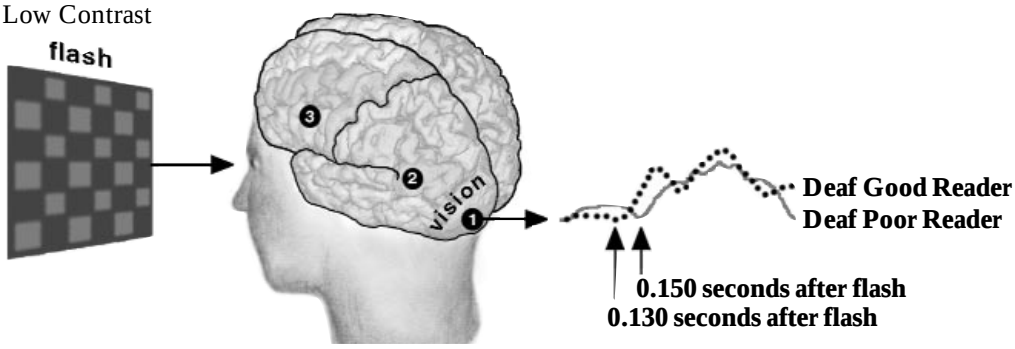
The eye sends information about visual scenes to the visual cortex at the back of the brain over two physically separate neural pathways. The "sustained" pathway sends information about fine details of images. The "transient" pathway sends information about rapid image movements and is very sensitive to the timing of visual events. Both pathways are important for reading. The transient pathway in particular probably turns off the flow of distracting visual information rapidly between fixations during reading, while the brain extracts the identifying features of letters. The transient pathway but not the sustained pathway is damaged in dyslexics, one manifestation of the underlying generalized timing disorder.

If we could detect this transient pathway damage, we could identify individuals who possess a generalized timing disorder and therefore might be dyslexic. Presumably, deaf individuals without dyslexia should have normal transient pathways, even if their reading skills are poor due to certain consequences of deafness. If so, then the status of the transient visual pathway is a potential marker for dyslexia in the deaf population that circumvents the confounding influences of deafness on English language development.

We recently obtained direct evidence for this possibility in a brain wave study of the transient pathways of seven deaf good readers and 4 deaf poor readers (Samar et al., 1999). Of course, we could not reliably select deaf dyslexic students to study. We could identify deaf poor readers, however, among whom we presume there is a large number of dyslexic individuals. If the transient pathway is damaged in deaf dyslexics, then we should see evidence of this deficit in the group results of a sample of deaf poor readers compared with a sample of deaf good readers that, by definition, must not include dyslexics.

Our volunteers graciously allowed us to paste electrodes on their heads over the points labeled 1, 2 and 3 in Figures 1 and 2. We then recorded their brains' electrical voltage responses while they viewed flashing visual checkerboard patterns on a monitor. One pattern had high contrast between the dark and light checks. This pattern primarily activates the sustained pathway. The other pattern had low contrast between the dark and light checks. This pattern primarily activates the transient pathway. Using multivariate analyses of the electrical responses, we found that the transient pathways of the deaf good

Figure 2.
Transient Pathway



readers detected the low contrast checkerboard quickly, as early as 0.075 sec. after it flashed. However, the transient pathway of the deaf poor readers did not detect the low contrast pattern until much later, nearly 0.300 sec. after it flashed.

The brain wave responses traced in Figures 1 and 2 illustrate this timing delay. For the high contrast pattern (sustained pathway), deaf good and poor readers both had brain waves with a large peak that started to develop at about 0.120 sec. after the flash. However, for the low contrast pattern (transient pathway), deaf poor readers required an extra 0.020 sec. for the large peak to develop compared with deaf good readers. Livingstone et al. (1996) found similar brain wave results for hearing dyslexics.

"Our data provide the first direct evidence that dyslexia in the deaf population has a neurological basis. They also indicate that dyslexia in the deaf population may be caused by the same underlying generalized timing disorder as in the hearing population."

Our data provide the first direct evidence that dyslexia in the deaf population has a neurological basis. They also indicate that dyslexia in the deaf population may be caused by the same underlying generalized timing disorder as in the hearing population. This finding opens clear passage for the development of neural imaging techniques to differentially diagnose dyslexia in the deaf population by using the status of the transient visual system as a specific marker.

Sailing West

Our results suggest that substantial similarities may exist in the characteristics and underlying mechanisms of LD in deaf and hearing people. Developments in the mainstream of LD research, then, may guide us beyond the edge of the known world of LD in the deaf population. True, there be monsters ahead, but there be riches, too. It's time to leap off the Rock.

Table 1.
Expert English Language Teachers' Intuitions About Potential Markers for LLD in Deaf Students (all levels of agreement were statistically reliable).

Strong agreement among teachers
- Spelling Ability
- Discourse Knowledge (e.g., following directions, organizing sentences)
- Spatial/Temporal Relations (e.g., distinguishing prepositions such as *before*, *after*, *between*)

Moderate agreement among teachers
- Lexical Access and Knowledge (e.g., recalling words, using idioms)
- Question Formation (e.g., using and understanding yes/no- and wh-questions)
- Pronouns (e.g., using and understanding pronouns and their antecedents)

Weak agreement among teachers
- Speech Acts (e.g., using structures for requesting, persuading, and negotiating)
- Cause/Effect Relationships (e.g., using and understanding conjunctions such as *because*, *although*, *so*)
- Constituent Movement (e.g., using and understanding passive and relative clause sentences)
- Morphological Features (e.g., using and understanding suffixes for tense, agreement, and number)

Illustrations by Marie Buckley

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Samar, V.J., Parasnis, I., & Berent, G.P. (1999, June). *Deaf poor readers' pattern reversal VEPs reveal magnocellular system deficits.* Paper accepted for presentation at the 11th Annual American Psychological Society Convention, Denver.

Samar, V.J., Parasnis, I., & Berent, G.P. (1998). Learning disabilities, attention deficit disorders, and deafness. In M. Marschark & D. Clark (Eds.), *Psychological perspectives on deafness* (Vol. 2, pp. 199-242). Mahwah, NJ: Lawrence Erlbaum.

Chris Monikowski teaches courses in American Sign Language, ASL/English interpretation, and second language acquisition. Her areas of interest include second language acquisition, assessing language proficiency, and distance learning for interpreters and interpreter educators. For more information, she can be reached at CEMNSS@RIT.EDU

Chris Monikowski is an assistant professor in the Department of American Sign Language and Interpreting Education at NTID.

Bill Clymer is an associate professor in the Department of Educational Resources at NTID.

Online Technologies as Applied to Interpreting Education

By Christine Monikowski, E. William Clymer, and Gary Long

RIT has been offering distance learning courses since 1979, is the third largest provider of distance learning in the nation, and is a recognized national leader in this field. RIT distance learning degrees offer the same quality as on-campus programs and offer the added flexibility of allowing the students to learn at a time that is convenient for them. In an effort to begin to understand the instructional, technical and logistical issues related to offering online instruction, we initiated the "Discourse Analysis Prototype." This pilot course was a result of Monikowski's CRTL fellowship to facilitate and support the pursuit of innovative technology-related instruction methods.

This small pilot was selected because it required careful instructional analysis of content, and instructional materials and presentation strategies could be delivered using established RIT Distance Learning methods using FirstClass, an Internet client server software. The content taught was typical of that found in interpreting education. This was significant because NTID marketing research indicated that sign language and interpreter training were the subject areas of most interest to potential users of NTID distance education.

Discourse analysis is the logical level of analysis for interpreters, as it conveys the overall "point" of a message. Interpreters often spend considerable time on the analysis of words, signs, sentences, and sign; by the time they arrive at the overall meaning, they have run out of time. This leads to a common complaint about new interpreters: they seem to include the main points and information, but the overall meaning is somehow missing. "Discourse analysis is the study of how communication is structured so that it is socially appropriate and linguistically accurate" (Hatch, 1992, p.1). The focus of our discourse analysis project was turn-taking in an educational setting, an often problematic feature for interpreters.

Project Design

The primary goals of this project were to ascertain whether the delivery of this type of linguistic instruction is feasible via distance learning, to identify those characteristics of the delivery system that are most effective and efficient, and to investigate the various technologies available for providing instruction via distance.

The equivalent of approximately three hours of lecture and demonstration related to the basic principles of discourse analysis were developed during the 1997/98 Winter and Spring quarters. All class materials, with the exception of a 34-minute videotape, were placed on the RIT's FirstClass server, so students could access them via the Internet. Students were asked to read materials and comment via e-mail. Additionally, students were asked to complete practice and test exercises related to their ability to identify various aspects of discourse analysis, and to analyze text segments and provide extensive comments and feedback regarding their "online" experiences.

Instructional Design

The challenge of this online instruction was to replicate the success of the lecture experience in a new format—one that could be accessed by learners independently, yet required interaction with other students and discussion/feedback from the instructor. This demands consideration of instructional objects and student outcomes first, and application of instructional design parameters to the instruction.

Because the instructor had successfully taught discourse analysis in a lecture format, the design team decided to videotape a simulated lecture to better understand presentation strategies, content presentation, questions and answers, and other aspects of the content that might not have become apparent during the content analysis. The initial videotape and a subsequent tape provided a great deal of clarification of the content and the sequencing of instruction. Additionally, analyzing the videotapes of the lectures assisted in identifying the nature of the content that had to be presented via the Internet.

Bill Clymer is an Instructional Developer whose primary professional responsibility is to determine how new technological innovations and applications can be applied to solving instructional and administrative problems in an educational environment. Additionally, he teaches in NTID's Applied Computer Technology Department. For more information, he can be reached at EWCNCP@RIT.EDU

The majority of Gary Long's research efforts have focused on the interplay of cognitive and social/emotional variables that impact on academic achievement for persons who are deaf. He has published extensively, and has also developed instruments that help researchers better understand the extent to which students identify with their schools, are actively engaged in learning, and feel that they can communicate clearly with their instructors. For more information, contact Long at GLLERD@RIT.EDU

Gary Long is an associate professor in the Department of Research at NTID.

Development of Materials

A packet was developed that included information about logging on to FirstClass, selected readings, and a videotape which functioned as a lecture-like instruction to the course as well as the source of examples for students to analyze features of discourse analysis in classroom settings. Content presentation followed the sub-topics, and folders were created within FirstClass to coincide with the separate units of instruction (see screen display, p.8).

Participants

Of the original twelve volunteers, eight signed on to the FirstClass system and completed the study. Of these, one was from California, one from Colorado, two from the Albany, NY, area, and four from RIT. They all agreed to pilot the discourse analysis instructional materials and received professional continuing education credit for their efforts.

Participants varied greatly with regard to their experience using the Internet. As we might expect, the ease or difficulty level of getting started with instruction was greatly influenced by their prior computer experience and the availability of other professionals in their work environment who were skilled with computers and the Internet. Five out of the six respondents had difficulty installing RIT's FirstClass system.

Results

As participants in our experimental course were experienced interpreters, most participants indicated that they were familiar with the content. They all responded positively to the exercise of analyzing student-teacher interactions from the actual classroom situations presented on the videotape and they had a number of ideas regarding ways to expand the course content (e.g., expand video to include adult and postsecondary teacher/student interactions, discuss other linguistic issues, include more readings, etc.).

The most important lesson that we, as developers of distance learning materials, learned was to control the pace of instruction. A number of students decided to go through the entire videotape at one time, while others chose to integrate the instruction on FirstClass with the video units more in the format specified in the course syllabus. Thus students and teacher were often out of synchrony with each other regarding student progress through the instructional materials.

In general, participants indicated that they had less interaction with other students and the teacher of this course than they do in other "traditional" classes. About half of the respondents felt that it enhanced their learning, while the other 50% were not sure or felt that the format did not enhance their learning.

Conclusions

By the end of the pilot project, the design team and students agreed that this distance learning format was effective for delivering discourse analysis instruction. Critical to the success of an expanded course would be the inclusion of more videos of actual classroom teacher-student interactions across grade levels (primary, secondary, and postsecondary). We believe that including some "hot topics" early on in the course and establishing an expectation for student participation in "chatrooms" would greatly enhance the interaction within the course and maximize the potential of the FirstClass delivery system. We are in the process of integrating the feedback, and plan to expand this unit into a complete Discourse Analysis course which could be offered to professional interpreters around the country.

Reference

Hatch, E. (1992). *Discourse and language education.* Cambridge: Cambridge University Press.

For more information about distance education at RIT, you can access their website, www.distancelearning.rit.edu.

Student comments:

"I felt students were able to give in-depth responses since they had time to organize their thoughts ahead of time instead of framing thoughts as they speak in class."

"I loved the format. I was able to work at my own pace."

"In a regular classroom I would have received more feedback from an instructor and would have heard more comments from other students."

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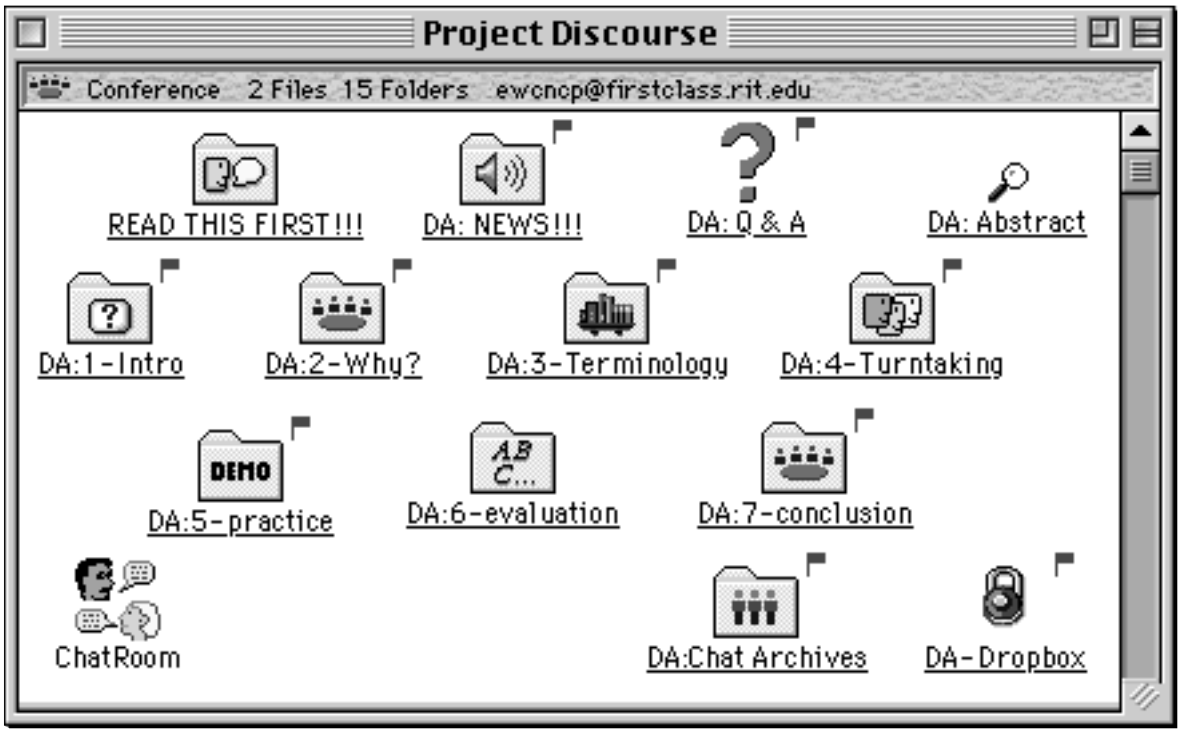
This display shows the main computer screen seen by students in a pilot study to determine if online technologies can be applied to interpreting education. Using this system, students were able to access instructional materials, complete homework and interact with their instructor and other students in the project. See the article on page 6 of this newsletter.



IMPLICATIONS OF NTID RESEARCH

FOR DEAF AND HARD-OF-HEARING PEOPLE • NTID RESEARCH BULLETIN

Vol. 4 No.1 Winter 1999

In 1993, the National Technical Institute for the Deaf established the Center for Research, Teaching and Learning. A primary mission of the Center is to "foster advances in teaching and learning that enhance the academic, professional, social and personal lives of people who are deaf or hard of hearing." Among its other functions, the Center both conducts research relevant to that goal and supports research conducted by colleagues from across NTID. As part of our collaborative efforts, the Center regularly undertakes the collection and dissemination of relevant research findings from across NTID. Included for each publication is a description of the implications of the research findings the author thinks will be most relevant for NTID's audiences.

Shannon, N.B., & Meath-Lang, B. (1992). Collaborative language teaching: A co-investigation. In D. Nunan (Ed.), *Collaborative language teaching and learning* (pp. 120-140). Cambridge: Cambridge University Press.

The authors interviewed twenty-five teachers at NTID. Each respondent had experienced two or more successful team teaching relationships. The themes that emerged from the open-ended interviews are discussed, and the decoding exercises designed to convey attitudes toward collaboration are presented. The ideas necessary for successful team teaching included shared philosophy and values, willingness to reflect upon action, the ego strength of participants, and seeing collaboration in strong relational terms. The authors offer suggestions for the qualities that teachers who collaborate should have as well as warnings for administrators who are responsible for collaboration.

Implications:

While collaboration in the classroom is not new, there is little research to support the factors that ideally need to be present for a successful team teaching situation. Language teachers, specifically, can benefit from collaboration with those in other fields to create multiple perspectives, broaden classroom interaction, and elicit feedback from students. Additionally, administrators should allow teachers to self-select the team they will work with, when possible, and allow collaborators enough time to plan effectively.

Whitehead, R.L., Schiavetti, N., Whitehead, B., & Metz, D.E. (1997). Effect of sign task on speech timing in simultaneous communication. *Journal of Communication Disorders, 30,* 439-456.

The purpose of this investigation was to study the effect of sign complexity on temporal features of speech during simultaneous communication. Signing complexity was determined as sign task demand (base vs. elaborated signs), and type of sign movement (kinetic vs. morphokinetic). Selected temporal measurements of sentences produced with simultaneous communication were measured. Results indicated that signs with greater complexity were accompanied by significantly longer silent intervals before the experimental word. This is an indication of the preparation

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necessary to produce a more complex sign while trying to maintain as high a degree of simultaneity as possible.

Implications:
This study suggests that for young deaf children in the simultaneous classroom, it may be best to use simpler signs in order to reduce the temporal disruptions to speech that can occur with more complex signs.

Garrison, W., Long, G., & Dowaliby, F. (1997). Working memory capacity and comprehension processes in deaf readers. ***Journal of Deaf Studies and Deaf Education, 2,*** **78-94.**

This research studied deaf students' performance on memory span and component reading tasks that incorporated processes involved in higher level comprehension. The instruments developed in the study provide the basis for the measurement of functional working memory capacity, vocabulary knowledge, domain-relevant knowledge, and inference abilities. Multiple regression analysis was used to construct models which show the contributions of the independent assessments to reading comprehension ability. Overall, results suggest that working memory capacity operates as a general executive system, as indicated by significant correlations between subjects' performance on reading and nonreading tasks. Limitations in vocabulary knowledge continue to pose problems in reading for deaf individuals. General or procedural knowledge also plays a part in reading comprehension processes.

Implications:
The findings provide further support to the hypothesis that deaf individuals' cognitive processes are not different from those of hearing counterparts. Vocabulary and procedural knowledge should receive greater attention in related academic programs.

If you would like to obtain information in an area beyond what you see listed, you can write to the first author of closely related papers, c/o NTID. If you are unable to obtain one of the publications on this sheet from your local library, you may send this form to: Educational Technology Resource Room, National Technical Institute for the Deaf, 52 Lomb Memorial Drive, Rochester, NY 14623-5604.

___ *Shannon and Meath-Lang. Collaborative language teaching: A co-investigation.*
___ *Whitehead, et al. Effect of sign task on speech timing in simultaneous communication.*
___ *Garrison, et al. Working memory capacity and comprehension processes in deaf readers.*

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