It is nearly axiomatic for papers about the language of deaf children to begin with a litany of language problems. Lags in reading achievement, difficulties in comprehending and writing English syntax, and limited English vocabularies are cited in support of this position. These articles often proceed to talk about the “language deficiencies” of these children and the effect that this “lack of a language” might have on cognition. Such statements, however, neglect the fact that many deaf children possess competence in a human language, American Sign Language (ASL). As in the case of hearing children who are exposed in a normal way to a spoken language, these deaf children display the expected pattern: skill in the structure and content of the language of their community. Thus, these children exhibit not language deficiencies but rather gaps in their knowledge about English, the language of the cultural majority in the United States. In this chapter we describe our initial attempts to improve their written English skills, using their ASL competence and interactive video technology.

ASL has been variously characterized as derivative of English, or organized around properties of gesture, most likely because of its unusual mode of transmission—the visual–gestural mode. It is neither English nor gesture; its structure, although unlike English in a number of important respects, is not unusual given the class of human languages. At all levels of representation, from the internal structure of the sign (Padden & Perlmutter, 1987) to its
rich morphological structure (T. Supalla, 1985) and its complex syntactic and discourse constraints (Lillo-Martin, 1986; Padden, 1988), the rules of the language conform to every constraint known for human languages. Children who have been exposed to ASL in a timely fashion acquire it in much the same pattern as hearing children acquire spoken language (Newport & Meier, 1985), without need for explicit or laborious instruction.

Until very recently, schools and programs for deaf children were not likely to recognize that competence in ASL might be a viable tool for teaching deaf children about English. Largely because of confusion about signed languages and how they compare to oral languages, many schools embarked instead on programs to alter signs in attempts to make them represent written English. The best known of such attempts are the artificial manual English systems (e.g., Seeing Exact English). The motive underlying the development of manual English systems is understandable: Because the deaf child does not hear well enough to access spoken English directly, why not instead use signs to represent English? Manual English systems use ASL signs and add invented forms to represent written prefixes, suffixes, and other grammatical elements of English. These forms are then produced in English word order.

There has been heavy criticism of such systems, among them, that invented forms violate structural rules of ASL and natural signed languages in general, resulting in forms that are unwieldy and unnatural (Baker, 1978; Charrow, 1975; Marmor & Petitto, 1979). S. Supalla (in press) has demonstrated that young deaf children fail to use certain manual English elements used frequently by their teachers presumably because they are not learnable. Furthermore, although the systems purportedly represent written English, they can do so only partially. The invented forms refer to elements of written English, for example by incorporating the first letter of a prefix or suffix into a sign, but these invented elements do not represent English elements in their full alphabetic form. Thus, children who learn manual English still need to learn how to match forms to their English translations for the reason that the forms are not themselves English words. Additional discussion of the difficulties of using manual English to represent written English can be found in Ramsey (1989). However, the urgency that underlies inventions such as manual English is a very real one: the need to introduce deaf children to written English.

Given that many deaf children are competent in ASL, it would seem logical to use competence in this language as a part of their education about English. But until very recently, there has been little effort to explore how to use ASL both to teach about various school subjects and to teach English. There have been calls for greater use of ASL in education of deaf children (e.g., Barnum, 1984; Johnson, Liddell, & Erting, 1989; Kannapell, 1985; Strong, 1988), but few concrete proposals have been made for how to use the two languages jointly. To date, the idea of bilingual instruction in ASL and English has amounted largely to tacit recognition of ASL as one of several strategies available to teachers for explanation, but not as a central part of a teaching curriculum.

There have been, however, a few attempts to use the two languages jointly. Kannapell and Goodstein (1979) developed a set of videotapes for deaf adults in which ASL explanations were given for commonly used English expressions and idioms. The expressions appeared on captions underneath a signer's translation of them. Here the focus is on translation of specific expressions and phrases, to teach the meaning of specific English content. Another approach to using the two languages jointly has been to call students' attention to differences in the ways in which ideas are grammatically expressed in ASL and English (e.g., Akamatsu & Armour, 1987; Schneiderman, 1986; Strong, 1988). For example, Strong (1988) presented videotape versions of stories presented first in ASL then in strict manual English. Children were encouraged to look for differences in presentation in the ASL and English stories, with the goal of developing metalinguistic awareness. In a third approach, children at Kendall School in Washington, DC, review videotapes of their own stories before beginning to write (Mather, in press). Watching the videos helps the children to think about writing as recreating a story to be told to someone. In this approach, written English is not directly in the video, but takes place in the form of a separate task elsewhere.

There are at least two challenges in using ASL and English together as part of a bilingual approach. First, how is English to be represented? Given the dissatisfaction with manual English systems, what are some alternatives? How else might English be taught to deaf children? Second, how should the two languages be used jointly as part of a concerted instructional approach? There are many possibilities for combining the two; what are the effects of the different combinations?

The advent of videotape technology allows us to address these issues about a bilingual ASL/English instructional approach in a new way. This technology makes it possible to manipulate in traditional and unusual ways combinations

1The term bilingual, as we are using it here, differs from the typical usage of the term in that the situation involves only the primary (signed) form of one language, ASL, and only the coded (written) form of the other, English. As such, this approach is more consistent with the notion of a monoliterate bilingual approach rather than a true bilingual approach. The use of only signed ASL arises from the fact that there presently exists no system for writing ASL that has been developed for other than scholarly purposes. The use of only written English arises from the fact that deaf children cannot readily perceive English in its primary (spoken) form. The loss of hearing precludes normal auditory access, and lipreading, at best, presents only a partial representation of English to a hearing-impaired person. Lipreading is not the form of transmission for which English was developed; studies have indicated that English phonemes are not readily discriminable on the lips and that the absence of experience with auditory speech hinders deaf individuals in learning to lipread as evidenced by findings that hearing individuals lipread as well or better than deaf individuals trained in lipreading (for a review, see Mogford, 1987).
of signed and written text. The technology not only makes it possible to present signed material and written text alternately, with the ability to switch easily and rapidly between ASL and written text, but also affords a novel possibility not otherwise available in real life: to juxtapose the two simultaneously, within the same visual field, using a rich variety of visual combinations.

We describe here an experimental project that uses videodisc technology to explore various possibilities for using ASL and English cooperatively in the instruction of deaf children. With it, we are able to examine theoretically different modes of presentation and different types of juxtapositions. The software, HandsOn, has been in use at a residential school for deaf children for approximately 1 year, and continues to undergo modifications based on user feedback and ideas for new possibilities of presenting the two languages. At this point, we are not able to offer conclusions about how the two languages might be most effectively used together to foster improvement in written English skills for deaf children. That is what we are currently investigating. We offer here, rather, a description of HandsOn, as it currently exists, and report on students’ and teachers’ reactions to the approach.

**EQUIPMENT**

HandsOn runs on an IBM InfoWindow® system. The hardware components of this system are an InfoWindow display monitor, an IBM personal computer, and a videodisc player. With this system, video can be overlaid with computer output, thus allowing both ASL video and English text to be simultaneously presented on one monitor, with the text appearing on top of the video. InfoWindow also makes available touch screen technology, thus allowing HandsOn to be accessible even to very young children. In most cases, students indicate their choice of task by touching the screen. The writing tasks require standard keyboard entry.

To date, two videodiscs have been developed for this project. Each contains several stories signed in ASL as well as signed feedback and questions for use with the questions component of HandsOn (see later). These materials have been signed by the second author, a third generation signer of ASL. To permit flexibility in developing tasks and changing the text, no audio was recorded on these first two discs. The materials on the first disc were stories, such as Goldilocks and the Three Bears and J. J. Flournay’s Idea for a Deaf State that were designed to be of interest to different ages. The story of Goldilocks and the Three Bears was chosen to be of interest to younger children, with the story of J. J. Flournay’s Idea for a Deaf State appropriate for the most advanced of the elementary school students. The stories ranged in length from 3–6½ minutes. The second disc dealt with various science topics (e.g., plants, dinosaurs, planets). Again the goal was to provide a range of interest and difficulty levels. To make the stories appropriate to a wide range of reading abilities and interest levels, we developed both “easy” and “hard” versions of the signed stories. The students (or teachers) select, at the beginning of a session, whether they want an “easy” or a “hard” story. The difference in difficulty in the two levels is apparent at all levels—conceptually, as well as in English vocabulary and syntax. For example, in the story about Dinosaurs, the story begins by focusing on differences between plant-eating and meat-eating dinosaurs and discusses the fact that there are no longer any dinosaurs alive on earth. For students who have selected the “easy” version, the story ends at this point. For students who have selected the “hard” version, however, the story continues and presents theories about why dinosaurs became extinct. The stories on this second disc were shorter than the first, ranging from 2½ to 3½ minutes.

**SOFTWARE**

HandsOn is written in HANDY, an experimental authoring language developed at IBM. It provides us with the ability to easily control multimedia materials, specifically video, and to easily obtain user input in terms of screen touches and keyboard entries. In addition, HANDY allowed us to collect data on computer usage by the students. Perhaps most importantly for the design of research software, its incremental and iterative method of programming allowed us to rapidly test out ideas, and to constantly change our software based on user feedback.

When designing HandsOn, we were guided by the principle that at any point in time students should have various options available, rather than being presented with a pre-programmed instructional sequence. As a result, students using HandsOn make their own choices about which story and which activity option to use at each point in time. Thus, each student receives a unique instructional “sequence.” Shown in Fig. 3.1 is an example of a computer screen from HandsOn that features the ASL video and the possible student choices at that point.

A goal in this project to explore ways that ASL and English can be used together in a bilingual instructional package without relying solely on word/sign translation. This motivation is prompted by the fact that, in some cases, there does not exist a one-to-one correspondence between an ASL sign and an English word; a concept that requires only one sign in ASL may require several words in English—or vice versa. We, therefore, are developing tasks that require students to interact with English and ASL in a story context, with translations between the two languages occurring at the sentence level.
For example, in one component of the program, the students "subtitle" ASL stories in English. This combining of text and video also takes full advantage of videodisc technology, providing a simultaneous display of the two languages that is not possible in real life.

Our initial evaluations of HandsOn dealt with making the system easily usable, without intervention from us, by teachers and students. This required observations of students' usage of the system and discussions with teachers. Based on this feedback, HandsOn has gone through several iterations since its initial prototype (see Hanson & Padden, 1989). We have also tested a variety of activity options. Based on feedback from both students and teachers, we have added, deleted, and revised these options. We discuss here five options that have been tried and found useful. Of these, four (Read a story, Answer questions about a story, Caption a story, Write about a story) focus on English, with ASL providing "help." The fifth option (Watch a story) focuses on ASL.

Read a Story. With the Read option, students read English text and can request the ASL version of the English sentence by touching that sentence on the computer screen. Thus, the use of English and ASL alternate, at the students' request. The ASL versions can be used to aid story comprehension and vocabulary development.

Answer Questions About a Story. With the Answer questions option, students are asked questions, in English, about the stories and must respond by using the keyboard to type their answer (in English). When students need help with an answer, they can scan the English text. ASL is introduced into this task in several different ways: touching the question on the screen provides the ASL version of the question, the students can request the Watch a story option to scan the ASL story for the answer, and ASL feedback about answers is provided.

Write a Story. With the Write option, students write an English summary of one of the stories. Students may either scan the English text or the ASL story to support their writing of the summary.

Caption a Story. With the Caption option, students are able to write an English "subtitle" for segments of the ASL version of stories, one segment at a time. The ASL segments can then be played back with their English captions overlaid on the sign to create the effect of subtitling the video. For deaf students, the effect appears much like the closed-captioning of a TV show or movie that they watch. Thus, during playback the English and ASL are simultaneously presented on the computer screen. Students can get help
with spelling or vocabulary by touching the screen to see the English version of the ASL segment to be captioned.

**Watch a Story.** With the Watch option, students watch one of the stories signed in ASL. The students have the choice, at any point in time, of touching the computer screen to get the English version of the ASL segment currently being signed.

**Student Population**

The target population for HandsOn was deaf children fluent in the use of ASL. For this reason, the first test site was a residential school with an extremely high proportion (about 50%) of students having deaf parents. These children of deaf parents learn ASL as a first, or native, language. Officially, for instructional purposes, teachers at this school uses a Total Communication or Simultaneous Communication approach, which involves the simultaneous signing and speaking of English. Students are encouraged to also simultaneously sign and speak English in class.

We initially designed HandsOn for use with children in approximately third through sixth grades. It assumes some basic reading ability on the part of the user. For example, all of the options (e.g., Read a story and Caption a story) as well as the touch buttons (with labels such as “see signs” “press for words”) assume the user can read common English words. Despite our early targeting toward the upper elementary school grades, however, we found that teachers of the younger students, even kindergartners, were interested in using the program. For now, these youngest students use only the Watch option. Given the interest expressed by the teachers of these younger children, we would hope to be able to develop a range of tasks that could be used by these children.

**Working With Students**

HandsOn is effectively used by students working singly or in pairs. When working in pairs, we have observed that the students interact constantly: discussing which story to select, which activity option to select, and often debating about which one of them gets to touch the screen or type the responses. They also constructively interact by helping each other with vocabulary when reading, and with all aspects of the writing when, for example, captioning or answering questions.

Some familiarity with using computers was not assumed, although all students had some experience through the CAI program already in place at the school. This prior experience with computers, combined with children’s natural inclination to use the computer, allowed students to be able to work through the stories by themselves. We note, however, that although the students were able to work by themselves, it was often beneficial to have a teacher present. The teacher was helpful not so much in moving students through software, but rather in adding supplemental information, for example, related to the story content. We return to this point later.

The program was used by students during class periods of 25 minutes. This time constraint, unfortunately, limited the amount of time that students could work at one sitting. In one class period, students would generally either watch a story, and then read the story or answer questions about it, or would read the story and then answer questions about it. Often there was not time to complete the reading or question answering component in the class period. We learned from our first videodisc, that the stories were too long to be practical within this time constraint. The shorter stories of the second disc were more amenable to the practical constraints of the school setting.

**Working With Teachers**

The teachers initially received HandsOn with somewhat wary enthusiasm. The teachers were receptive to the notion of using ASL for instructional purposes. But although they were fascinated by the technology and its potential for instruction, the new hardware was somewhat intimidating. Their enthusiasm for this new approach gradually persuaded many to try HandsOn. After trying it they came to realize that the equipment and software were easy to operate. Also, designation of one of the teachers as a local authority on the project has been extremely helpful in providing teachers with an on-site person who could answer questions and deal with any problems that might arise. As noted previously, HandsOn is still experimental, and the teachers are to be commended for their willingness to help test this software, despite its occasional “bugs,” and for freely offering suggestions for its improvement.

**Using HandsOn**

Anecdotally, we can report that students enjoy using HandsOn, as shown in Fig. 3.2 They are excited that the computer can now include something that is central in their daily lives, their signed language, and they look forward to their time with the computer.

Significantly, we have also received enthusiastic feedback from teachers. Particularly relevant was one story told to us by a teacher about one youngster, fluent in ASL, who, despite being in upper elementary school, had never seemed to grasp reading. The teacher reports working with this student on
the Read a story option, repeatedly demonstrating to the student how to go back and forth between the English and ASL version of a story. At one point, the youngster suddenly pointed to an English word on the computer screen and spontaneously made the sign for that word. According to the teacher, this was the first time that the youngster had actually understood the connection between the two languages.

The most effective joint use of ASL and English has been the Read a story option. With this option, students read the English text of a selected story, scrolling up and down through the story. At any point in time, they can request an ASL translation of an English word or sentence by touching that word or sentence on the computer screen. In all cases, the ASL version is of the entire English sentence for the word touched.

When reading a story, many of the students tend to sign the stories “aloud.” This signing is not an artifact of our bilingual instructional approach, but rather a result of more general reading aloud in the classroom. Being able to observe students’ “reading” in this way proved quite useful for us in terms of understanding how the children were progressing. We were able to observe that students would readily touch the computer screen to get the ASL version of the English text when they did not know an English word. Many new vocabulary items were learned this way. When these students asked for the ASL version, we then observed them using the ASL sign for the English text throughout the remainder of the story.

A teachers’ presence is useful in correcting sign errors when students sign the stories aloud. These errors in signing occur because of the lack of complete one-to-one correspondence between ASL signs and English words. In this respect, English homographs are particularly problematic. For example, the English word “right” has different sign translations depending on whether the meaning of “right” refers to directionality, legal issues, or correctness. In this context, we observed that the children would sometimes translate an English homograph into the wrong sign, thus making their signed English sentence semantically incongruous. At this point, a teacher’s input is useful, either in directly correcting the sign, or in instructing the student to request the ASL version of the sentence in question. It is notable that without this teacher intervention the students rarely questioned their own signed renderings of sentences, even though their own incorrect sign choices for particular words would result in nonsensical ASL and English sentences.

Probably due to its interactivity, the Answer questions option is the most popular option among the students. Students sometimes choose this option before they have either watched or read the story, and realize, once the questions are asked, that they will need to step back and go through the story before they can answer the questions.

With this activity option, students are presented with English questions about the stories, and must answer the questions by typing. The correct
answer is programmed to be key words or key phrases. For example, in response to the following question about dinosaurs, "What did the dinosaurs who walked on two legs eat?" the program would accept as answers "flesh," "meat," or "dinosaur." Students' answers must contain one or more of these phrases to be correct. If the answer is correct, the ASL feedback is some type of positive statement, such as GOOD. If the answer is incorrect, the feedback suggests that the student either scan the text or search the signed story to help find the answer. Although feedback could easily have been given in English or some computer graphics, the students enjoyed getting the feedback in ASL. Students are not directly provided with the answer until they make two incorrect responses. At this point, the correct answer is printed for them on the computer screen.

Students are generally inclined to scan the ASL story when they need help to answer a question. This scanning generally works well. Problems arise, however, when students, after having learned the answer in ASL, are then unsure about the English words or the spelling of the English words that they need for their answer. At this point, students can touch the screen and get the written English version of the ASL segment that contained the answer.

The two writing options are Write a story and Caption a story. The Write a story option is difficult to use within the constraints of students' keyboarding skills and class schedules. The Caption a story option was introduced to replace it. With the Caption option, students view an ASL sentence and then write that sentence in English. Given that the captions are each relatively short, limitations of class time and keyboarding skill are much less an issue than they were with the Write option. The ASL segment and its English version, overlaid on the signs, can be played back, allowing for the exciting ability to simultaneously display the two languages. It is possible to caption an entire ASL story in this manner and play back the story, from beginning to end, with its captions. The effect is that of a subtitled or "captioned" movie.

We noted earlier on that the students often had difficulty in knowing the English word for a particular sign and would have to ask a teacher for help. The software was modified so that students could get help with their vocabulary and spelling by touching the computer screen to get the English version for the signed segment they were to be captioning. To prevent students from copying the English version, the version disappears from the screen before they begin typing their caption. Thus, help is provided, but the students are not able to simply copy answers. Students take great care to correct their typographical errors and to work on their spelling and grammar.

The one case in which ASL is used as the dominant language is the case of the Watch a story option. With this option, students can watch one of the ASL stories from beginning to end, or, through the use of touch panels that use VCR symbols, can fast forward through the story or go in slow motion either forward or backward. Students, from time to time, make use of the capabilities for viewing the story at fast speeds or in slow motion. Many can still follow the ASL story at the fast speed, and prefer to view it at this speed in order to save time. Although the slow motion has potential for clarifying signs, students, when they choose to view the video in this way, do so because they find it "interesting" or "funny" rather than for any educational benefit. It could be pointed out, however, that many hearing nonsigners who have viewed HandsOn have noted the potential of the slow motion capability for teaching ASL to nonsigners.

We were initially concerned that the students might focus exclusively on the Watch option, ignoring the English options. Since their comprehension would be superior in ASL, this would seem natural. Students often, however, did not stay only with the Watch option, probably, at least in part, because the other activity options afford more interaction with the computer. These students continue on to a different activity option for the same story rather than choosing to watch another story. Other students, however, did tend to skip from story to story just watching the signing. This is one of the cases in which teacher intervention provides the needed direction for the purpose of using ASL and English together.

POSSIBILITIES FOR THE FUTURE

HandsOn is still under development. From a technical standpoint, the project has been shown to be feasible. From the enthusiastic reactions of teachers and students we are encouraged about the potential of such a bilingual approach with deaf students. At present, we are beginning evaluations of the effectiveness of HandsOn as a teaching tool. For this purpose, we have two procedures. The first involves recording students' frequency of usage of different options in the software. The second experimentally tests for gains in reading and writing related skills following usage of HandsOn.

In addition, we continue to explore new activity options. One goal in developing these new tasks will be to explore options that could be used by younger readers than the current options readily permit, such as kindergartners and first graders.

Also, we hope to be able to give the teachers flexibility to write their own English versions of the ASL stories. This would allow the signed stories to be readily adapted to different reading levels. We are currently at work on an extension of the program that will allow this capacity for teachers to create the English text and questions.

HandsOn, as described here, is still in an early state. It represents the beginning of a two-part research strategy. The first part explores the use of a bilingual ASL/English instructional approach for teaching written English to deaf children. The absence of adequate ability in reading and writing
the language of the cultural majority presents formidable barriers to full participation in society. As mentioned at the beginning of this chapter, the idea of using deaf children’s ASL language competence to improve their written language skills is an approach that has largely been ignored in deaf education. We are hopeful that our work can make a contribution in this area.

The second part of our strategy explores the potential of interactive video in meeting the special needs of deaf children. The system we describe here is fully interactive, using touch responses and activity options that range from being extremely open-ended (as in the Write a story option) to tutorial in nature (as in the Answer questions option). The video allows for presenting a real person on screen to give instructions and feedback and, importantly for this particular application, to present the ASL materials. People who have seen demonstrations of HandsOn are quick to see possibilities for applying this technology to meet their own needs in working with deaf populations. They are also quick to think of ways of extending HandsOn, such as in teaching ASL to English speakers, and, more generally, in second language instruction. This chapter describes just one application of interactive videodisc technology.

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