READING AIDS FOR THE BLIND

Harvey L. Lauer
Electronic Reading Machine Specialist
Central Blind Rehabilitation Center
Veterans Administration Hospital, Hines, Illinois 60141

SCOPE OF THE ARTICLE

This article concerns inkprint reading aids for people who cannot use optical aids or closed-circuit TV systems. Available reading devices and some current research are described and discussed. The paper concerns work with adults, though there are many implications for children.

HISTORY

Before escorting you into the microcosmic world of reading aids, let me supply some background. In 1913, a British physicist, Dr. E.E. Fournier d'Albe described a reading aid for blind people and later built a crude model. A young woman, Mary Jameson, demonstrated it. Then a British engineering firm, Barr and Stroud, redesigned it and built six copies. Several blind persons have used them down to the present. Miss Jameson, the first user and teacher of the skill, is today active in the field.

The British device is the first member of the optophone family. Optophone is the name for a class of machines which converts letter shapes into tone patterns. As the probe or camera is moved horizontally, each tone responds to an assigned portion of the letter along its vertical axis. For example, a letter V is heard as a descending scale of sound followed by an ascending scale. The letter I is heard largely as a chord because several of the photocells “see” the print simultaneously.

Through the years, several designs of optophones have been built. The British machines first had five channels or tones; then they were given a sixth. Twenty years ago, I read that Mary Jameson was reading her mail and checking her typing, and I decided to seek an opportunity to use a reading aid. So 10 years ago, I learned to read with a device the size of a train case which had nine tones. It was called the VA-Battelle optophone. For many years after World War II, the VA was responsible for most reading-aids research done in this country, and this machine designed at Battelle Memorial Institute, Columbus, Ohio, was a VA project. In 1966, I taught Margaret Butow to read with it. She is now teaching the use of the Stereotoner at The Hadley School for the Blind, Winnetka, Illinois.
In 1967 the Visotoner came onto the scene. The Visotoner is an optophone made by Mauch Laboratories of Dayton, Ohio, under VA sponsorship. In that year, I began working full time as a reading-aids specialist in the VA. In 1973 Mauch Laboratories began manufacturing the Stereotoner. It is the latest form of optophone, and I shall describe it later.

OTHER AUDIBLE DEVICES

Over the years, a number of designs have been proposed. The RCA A2 reading machine was a project of the 1940’s. It used a raster which scanned vertically. The Canadian lexiphone and the Russian optophone are among research efforts of the 1960’s. There are also basement laboratory designers who propose reading aids consisting of single-channel optical probes. These make good light detectors but have severe limitations as reading aids.

TACTILE OUTPUTS

One of the first reading aids to have a tactile output was the Visotactor. It was built by Mauch Laboratories in the early 1960’s. Its eight vibrating pins are felt by four fingers of the right hand. Several people learned to use it, but it is now considered obsolete and is not presently used. Extensive research is going on at Smith-Kettlewell Institute, San Francisco, California, on tactile outputs for sensory aids. Other efforts throughout the world range from the modest to the ambitious. Parts of the body including the back, the stomach, and the forehead are under consideration. Most recently, electrical stimulation of the brain is being studied.

THE OPTACON

The Optacon is the result of extensive research begun in the early 1960’s at Stanford Research Institute and Stanford University. It has been on the market for 3 years and is manufactured by Telesensory Systems, Inc., Palo Alto, California. The firm’s president, Dr. James C. Bliss, had a large part in the Optacon’s development.

The word Optacon derives from optical to tactile converter. It measures 2 × 7 × 9 in.; the instrument has a probe or camera, electronic circuits, and a matrix of vibrators. The matrix or array of vibrators consists of six columns and 24 rows and is felt by one finger. The array vibrates in the shapes of the print symbols as the user tracks the print with the camera held in his other hand.

Eight hundred Optacias have been sold throughout the world. The price is $3,450, and a service contract is available costing $200 per year after the first year. A number of data processors are among its most enthusiastic users.
A newly-designed tracking aid is available. Another accessory is a visual display monitor by which a sighted teacher can monitor the student's reading. A blind teacher can do this by connecting another Optacon to the student's machine. Usually the teacher's own machine is used for monitoring.

**THE STEREOTONER**

Designed under contract with the VA Research Center for Prosthetics, the Stereotoner is manufactured by Mauch Laboratories, Inc., Dayton, Ohio. It measures 4 x 5 x 1 ½ in. and is usually worn on the chest while reading. As its probe is moved along a line of print, a 10-tone (10-channel) code is heard stereophonically in earphones. Each tone is heard at a different volume in each ear. High tones are heard louder in the right ear and softer in the left. With low tones, the situation is reversed. The letter V which was described earlier also sounds as if it moves from side to side. The price of the Stereotoner is $1,120. About 75 machines have been sold.

A ruler-shaped tracking aid is provided. This facilitates tracking for users, but beginners need a more elaborate version. Monitoring is done by connecting a second set of earphones. An accessory which permits visual monitoring is also available. About 25 people are using Stereotoners, most of them having been trained within the past year, so data on long term usefulness are not yet available. Several typists are among the enthusiastic users of the Stereotoner.

**DEMONSTRATIONS**

After years of lecturing and demonstrating, I have concluded that the biggest mistake an interested person can make is to form a firm opinion either for or against a given reading aid after a lecture and brief demonstration. Few people are equipped to judge their ability or lack of ability to learn to use rapidly presented tonal or vibratory patterns. Even fewer people understand the several tasks involved in using an aid — the interaction between man and machine.

Typically, the demonstrator slowly presents to the observer some simple letter shapes. This is done to show the principles of operation and the intelligibility of the signals. The experience leads some to conclude that the skill is easily mastered while others are frightened by its apparent difficulty.

The observer's reaction seems to depend as much on his self-image and his perception of reality as he does on his abilities and the quality of the demonstration. On some occasions, however, a skilled user demonstrates by reading normally while the observer listens to the sounds of the Stereotoner or feels the output of an Optacon. The observer then
reacts in whatever ways he customarily reacts to the performance of a well-trained athlete, magician, or psychic. Such diverse reactions also occur as people watch braille being read for their first time.

Demonstrations are suitable for the casually interested. For the deeply interested, we should provide demonstration, experience, tests, and counsel.

**TRAINING**

Learning to use a reading aid is much like learning a second language. Self-training is not recommended. From 2 to 4 weeks of fairly intensive training is given, which should be followed by several months to a year of regular practice. Ideally, before a wise decision is made, several hours of experience and tests with each machine are needed.

**UTILITY**

Reading aids are used chiefly for tasks requiring small but important amounts of reading. These include checking one’s typing (often while still in the typewriter) and reading correspondence, bills, memos, definitions, recipes, currency, etc. Reading handwriting is seldom attempted and rarely done. Few people read books and newspapers because braille, recordings, and radio are much faster. Speech compressors should soon cost under $200. They will make reading by listening even more efficient. Some business machines can be equipped with braille or audible outputs which do not require use of a reading aid. These alternatives should be studied and reported to consumers.

On the other hand, many developments in technology and standardization favor the use of reading aids. For example, a typewriter equipped with an erase feature used by a blind typist equipped with a reading aid add up to an efficient and rewarding combination.

Reading aids provide for improvements in the lifestyles of certain people. It takes many people a year or so to reorient their habits and skills before they know exactly how the aid will fit into their lives. The decision whether to acquire an aid and be trained is made more difficult by the changing environment of modern life, the newness of the aids, lack of good studies of their utility, and the glamorization of sensory aids for the blind.

**STUDIES OF UTILITY AND READING RATES**

At present, reading rates and the usefulness of reading aids are difficult to assess accurately. Most testing has been done while students are in intensive training where rates and utility are naturally low. After training, data are usually obtained through questionnaires and telephone interviews. Generally, such data are unreliable because users’
estimates of their reading rates are often inaccurate, and their estimates of how efficiently they use their aids are very subjective. What is additionally needed is an independent study of people who have used reading aids for at least 1 year, and those who have discontinued their use. A test battery should be given to determine reading rates and skills at whichever tasks are appropriate to individual users. Anything short of such a study runs the risk of being a disservice to consumers and organizations who invest time, money, and effort. When the successful users are identified, we can give informed counsel to candidates.

In the absence of suitable followup data, there is little to be said about reading rates. Attainable rates vary widely. A minority of users read around 10 words per minute. Speeds in excess of 60 words per minute are fairly rare. A low-speed user with lots of time to spend may be happier than a high-speed user who is in a hurry. It will be possible to predict more accurately the attainable reading rates of candidates when further research results are available. We look forward to the research findings of two projects conducted by the American Institutes for Research, Palo Alto, Calif. These are the Optacon Project sponsored by the U.S. Office of Education and the Stereotoner Project sponsored by the VA.

COMPARABILITY

To make a facetious beginning, both Optacon and Stereotoner can "see" the print. There are differences in the range of sizes and colors which each machine will accommodate. There would be little value in listing these specifications without adding pages of information about the world of print.

Reading by means of the sense of hearing requires less hardware, so the Stereotoner has less circuitry and fewer moving parts. This gives it advantages in size, cost, and maintenance. One hand is also free for handling materials or tracking. These advantages, however, only help those people who can learn well its 10-channel audible code.

Since the Optacon has 24 rows of vibrators, it delivers more information or detail about letter features than does the Stereotoner. This additional information, however, is useful only to those who can perceive this detail with a finger.

A choice machine should be based on testing and trials. Experience has sadly shown that it is a mistake to base one's decision on such things as proficiency with braille, musical background, or attitudes about the signals.

Each of my students is given tests and experience with both machines. Of my last eight students, four were taught the Optacon and four the Stereotoner. This means only that I did the best I could with the available materials. It does not mean that 50 percent of the people need each
BLIND TEACHERS

I teach the use of both machines. I have been trained with both, and I can read with both, but I personally use the Stereotoner. This is because the tonal code was first available to me and because I have higher potential for it. It is very advisable for a blind teacher to use one machine proficiently. The second machine should be learned to the point where the teacher can completely monitor his student's reading.

HUMAN FACTORS IN LEARNING THE SKILL

Learning to use a reading aid is like learning a new language. Patterns must be apprehended subconsciously as letters and words. For example, the Stereotoner code is in my subconscious. To install the Optacon code in my subconscious would require much motivation and practice.

There develops a complex, “intimate” man-machine relationship. The degree of involvement or “love affair” one has with a reading aid is greater than the investment needed in becoming a skilled typist but less than the investment needed in becoming an accomplished musician. Occasionally, we encounter the exceptional person who learns the skill quite easily. Such people have either exceptional ability or exceptional motivation.

The following is an example of one among several interesting hypotheses. This man-machine relationship seems to favor the type of person whom the psychologist Dr. Stanley Martindale calls verbal over the anomic person. He says the verbal person (30 percent of the population) is one who relates best “self to object,” and the anomic person (70 percent) relates best “self to person.”

One caution we give to potential students is to keep an open mind about their abilities and lack of abilities. We also recommend that newly blind people first avail themselves of other needed rehabilitative services before they consider a reading aid. Those who have remaining vision should also first try low-vision lenses and closed-circuit TV systems. Generally, students who are learning to use a reading aid find the training to be challenging and rewarding.

MY SUGGESTIONS

Based on my experience, I also submit the following suggestions: 1. Students should be encouraged to learn the skill only when long term loan or purchase is highly probable. 2. Agencies which lend reading aids should do thorough followup to see that the aids are in use and not in closets. 3. There should be a rental option for those who buy aids.
need not apply to agencies for the blind. Agencies can transfer the aids to other users if necessary.

**TRACKING AIDS**

I must discuss tracking aids or my colleagues will count me remiss. Some users and most beginners do not have the coordination needed to track print well by hand. Tracking aids have often been inadequate because of initial over-optimism as to the difficulty of the task and because designers who work hard to miniaturize both hardware and costs are reluctant to admit that their “brain children” need mechanical help. Suitable tracking aids for current reading devices became available some time after production models first appeared. Teachers who do not have experience with a good tracking aid do not know what they and their students are missing.

Beginners may also be helped by motor-driven pacing aids. The modern versions are expensive and complex, but the British had a simply operated one for their first Optophones. Good instructional manuals have been slow in coming, but the new ones are greatly improved thanks to the American Institutes for Research and the equipment developers.

**POPULATION AND FUTURE NEEDS**

Let us turn now to demographics. The American Foundation for the Blind, in its telephone survey of Optacon users published in *The New Outlook for the Blind*, February 1974, says: “AFB estimates that perhaps 10,000 people in the United States and Canada . . . might be potential users of the Optacon.” Further study may show this estimate to be a little high. I would say that several thousand people in the U.S. can use one reading aid or the other.

Now let us look at the picture for veterans. John Malamazian, Chief, Blind Rehabilitation at Hines Hospital, gives the following figures which he and others in the VA have compiled. Eighteen thousand legally blinded veterans have been identified. There may be 2 or 3 thousand more who have not yet been identified. About 4,000 are totally blind. Most are World War II veterans. Many of them lost their sight after leaving the military service. There are less than 1,000 totally blind people, mainly men, who are below age 55. I estimate that about 150 veterans will be interested in reading aids and will be eligible for them.

Let us turn to the world picture. According to the British Royal National Institute for the Blind which has facilities in all parts of the world, there are 15 million blind people in the world. Because of high incidence of blindness among young people in less developed countries, 5 million of this total are of working age. Though the literacy rate in
much of the world is low, a world market would certainly make produc-
tion of reading aids more efficient.

SOME PROSPECTS FOR THE FUTURE

So far, we have discussed what are called “direct-translation” reading
aids. Current machines, the Optacon and Stereotoner, do not (inten-
tionally) process data. Instead, they provide the user with signals depict-
ing the shapes of symbols “seen” by their electro-optical systems. Sup-
pose now that we add to such a direct-translation reading aid logic
circuitry so that it will give us the identities of letters. We would then
have an Optical Character Reader, commonly dubbed an OCR. Indus-
try has OCR machines feeding alpha-numeric data to its computers.
They are accurate, and they feed data faster than we humans could
handle it. However, they are bulky, enormously expensive, and too
limited in the number of type styles they will accommodate to cope with
the world of print faced by the office worker and homemaker.

Among several projects to build a personal OCR for blind people are
those of MIT, Israel, Canada, and the VA. The VA project conducted at
Mauch Laboratories will be described here.

Mauch Laboratories calls their design the Cognodictor. It incorpo-
rates a reading aid like the Optacon or Stereotoner with which the user
must track the print, adjust for print size, and read whichever symbols
the machine’s logic circuitry is not programed to identify. These include
numerals, punctuation, unusual print styles, and “damaged” print.
However, when so-called “good” print is encountered, the machine
“talks” to him in letter sounds or spelled speech. In short, the user must
learn to use a direct-translation machine with which he would read such
things as bank statements. However, when the body of a magazine article
is to be read, the minicomputer will function permitting reading rates of
100 plus words per minute. The cost will be several thousand dollars.

The concept of the Cognodictor was partially but successfully tested
with past designs. In 1971, several blind people, myself included, used a
model of the Cognodictor with spelled-speech output. In my opinion, at
the present rate of development, there will be a new prototype in 2 years
and a production model in 4 years. Some of my colleagues feel that less
time will be required.

Let us now look beyond the personal reading aid. A library book could
be transcribed into recorded form by a computer. This job may take a
team of computers. The spoken-English output of such a system is being
researched in a VA project at Haskins Laboratories, New Haven, Con-
nnecticut. This output would also be useful in a time-shared arrangement
with a large computer. Under such an arrangement, the user would
telephone the computer for service. He might then have to track the
print with his small machine with which he could also read indepen-
dently. The computer would then read "over his shoulder," so to speak, and speak to him over the phone in his native tongue. MIT and Stanford Research Institute have also done work in this area. Presumably, if and when computer terminals become common in our homes, then computers may also help us read. Our glimpse into the future has shown that future developments, rather than making present skills obsolete, could make those skills more valuable.

CONCLUSION

The Optacon is being well received by many. Its manufacturer has a training facility as do a number of agencies. The Stereotoner is being introduced into several training facilities including The Hadley School for the Blind. Hadley also has a pretraining tape-recorded course which will be revised for the Stereotoner. This recorded course will introduce the skill and prepare people for training at Hadley or elsewhere. As we learn about the Stereotoner's applications and the kinds of people who can use it, it should take its place among rehabilitation tools.

I do not state the case for reading aids as strongly as those who say that they open up a new world for blind people. I do state the case as follows: The reading aids offer certain people a bit of synthetic eyesight.