

**RESEARCH AND EVALUATION OF
AUDIBLE OUTPUT PRINT READING AIDS FOR THE BLIND
A FINAL REPORT ^a**

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From July 1968 through September 1976, the Hadley School was under contract to the Veterans Administration to evaluate audible output inkprint reading aids for the blind. This report is a summary of the work done at Hadley during this period.

OPTOPHONE DEVELOPMENT

In August of 1966, Margaret Butow, an instructor of Braille Music Notation and receptionist at the Hadley School for the Blind, learned to use the Optophone. Developed at Battelle Memorial Institute in Columbus, Ohio, the Battelle Optophone was an inkprint reading aid with an audible output of tone patterns which sounded in accordance with the shape of the letters as the probe was moved along a line of print. Under contract to the Veterans Administration, Battelle had developed the Optophone and instruction manuals in its use in 1957-58. Ms. Butow took Optophone instructions from Harvey Lauer, Electronics Reading Specialist at the Veterans Administration Hospital at Hines, Illinois. The initial training was for 6 days, after which she continued working with the Optophone at the Hadley School.

The Battelle Optophone was about the size of a train case, and was limited to three sizes of print, from 10-point to 14-point type. It had a large wooden board on which the paper was held firmly; the board supported a bracket into which the probe was inserted. In the probe,

^a Based on work performed under VA Contract V101 (134) P-123, from July 1968 through September 1976.

there was a single vertical column of nine photocells which sounded tones as the probe was moved along the center of the line of print. A vertical line would sound several tones at once making a chord in the high and middle range. A horizontal line would sound fewer tones because fewer photocells saw the print. A diagonal line would sound one tone after the other, going up or down depending on which way the line was pointing.

The instruction manual, in IBM "Executive" type, had 200 lessons going from first-grade to eighth-grade reading level. There was also a great deal of supplementary material on which the student could practice.

Ms. Butow went through 30 lessons at Hines, and continued to work on the rest of the 200 lessons at Hadley. These lessons were finished in June 1967. They had been sandwiched between other work such as answering inquiries, handling applications for home-study courses, and teaching braille music notation. She was now able to read some of the typewritten correspondence she received, and proof-read her own typing out of the typewriter.

VISOTONER DEVELOPMENT

During 1966–1976, Mauch Laboratories of Dayton, Ohio was contracted by the Veterans Administration to build the Visotoner, an audible output reading aid smaller and more versatile than the Optophone. It also had a probe with a vertical column of nine photocells which was moved along the line of print, sounding tone patterns as letters and symbols were scanned. The magnification range was greater, and italic print could be read. Six Visotoners had been built by June 1967.

In 1967, the Hadley School for the Blind was contracted by the Veterans Administration to develop a home-study course, on tape, which would determine a person's ability to hear the Visotoner tone patterns.

Recorded Visotoner Course Development

The recorded course was designed to accustom prospective Visotoner users to the tone patterns, and to determine their ability to discriminate between tone pattern changes within letters, to hear silence between letters, and to hear direction of tone pattern movements up or down in the range. (For example, the tone pattern for the letter V starts at the top of the tone range, moves down sounding one tone after the other to the middle of the range, then moves back up again as the probe is moved across the letter. On the other hand, when an L is scanned, several tones all sound at the same time in a chord, ending up with a lower tone sounding after the others have stopped, denoting the horizontal line at the bottom of the L.)

Students were first sent an introductory tape containing a description of the Visotoner and a demonstration of the tone patterns of print letters such as the V and v. They were asked to describe what was heard in these letters. The second part of the introductory lesson contained nine series of letters—students were asked to count the number of symbols heard in each series. In the third part of the lesson, students were given eight capital and lowercase letters, and asked to say which was which. (No small letters with ascenders were used, because they would produce higher tones in the range, as all capital letters do.)

Students who completed these tasks successfully were sent the four tapes containing the 25 lessons for the Visotoner Screening Course. A lesson consisted of a description of no more than five, and no less than two, letters. The tone patterns of these letters were also demonstrated several times. The student was asked questions about the tone patterns of letters described in each lesson. A self-test, containing words using letters learned in that lesson and in previous lessons, was then presented. First the words were read with the Visotoner, then spoken and spelled. Then, in the test which the student was to submit to the Hadley School, the words were read with the Visotoner in a different order from the first time.

In the first lesson, the student was exposed to four letters: h, y, a, and A. In subsequent lessons, letters were taught in the following order: Wwm, Yohd, unvit. Lesson 5 taught no new letters, but contained a tone-pattern test (students were asked to tell what kind of tone patterns they heard in 12 letters) and a symbol-counting task which also contained 12 series of letters.

In lessons 6 through 13, the letters were taught in the following order: brfg, Le, pl, jTME, hbIk, DcqR, Rs, and fs. Symbol-counting practice was given in every other lesson; 3, 5, 7, and 9.

In lesson 8, some common punctuation marks were taught.

Lessons 11 through 15 gave letter-combination practice, so that the student would become accustomed to hearing combinations of letters (such as th) as patterns rather than letter-by-letter.

Using a print reading aid involves a combination of letter-pattern and word-pattern recognition, and also the ability to read by context, anticipating what one is going to read next. Therefore, lessons 16 through 18 exposed the student to sentences and paragraphs, partly spoken and partly read with the Visotoner. The student was asked to submit the list of words he thought he heard read with the Visotoner.

Lesson 19 gave a short description of numbers.

Lessons 20 and 21 dealt with sample lessons from the Battelle course: Battelle lessons 2, 3, 6, and 7 were used. The third lesson and the seventh lesson were read with the Visotoner, and each word was spoken after it was read. The second and sixth lessons were read with the Visotoner and

not spoken. The student was asked to write down any words he recognized that were heard in the lessons read with the Visotoner, and submit this list to the instructor.

Lessons 22 through 24 dealt with the Visotoner controls: magnification adjustment, probe alignment on the center of the letters, and lamp control adjustment. Examples of misalignment of the camera, and incorrect adjustment of the magnification and lamp control, were given—these could be clearly illustrated on a tape. The student was given ten examples each of misalignment of the probe, incorrectly adjusted magnification control, and incorrectly adjusted lamp control, and was asked to tell the instructor what was wrong in each situation.

Lesson 25 was a five-part review. Included were: questions on tone patterns, on symbol counting, lamp control adjustment, magnification adjustment and probe alignment. Students were also sent a tape-recorded description of capital and small letters, and numbers. Each example was described verbally, then read with the Visotoner several times so that the student could become accustomed to its tone pattern.

The Visotoner Screening Course was put on cassette in 1971. During the past 8 years, 200 introductory tapes and cassettes were sent out. As in any home-study course, there were a good number of “non-starts.” Of 95 students who submitted their response to the introductory lesson and were enrolled in the Screening Course proper, 38 students completed the course. Of the 38, 10 were taught to use the Visotoner at Hines VA Hospital, the Hadley School and in England. Of these 10 people, 3 are now using Stereotoners, 2 have died, 1 did not complete training, and 4 have returned their Visotoners because they did not continue to practice reading after they left the center.

The course had certain points at which the student would discontinue sending lessons because the material became too difficult. When students were asked to describe the tone patterns of the letters in lesson five, they would discontinue the lessons. Lessons 16 through 18, where students were asked to guess words read with the Visotoner, would cause others to discontinue. Lessons 20 and 21, where students were exposed to a good deal of Visotoner code with few spoken hints, would cause other students to drop out of the course.

The Visotoner Screening Course was a good way for anyone to find out at home, in leisure time, about the tone patterns of letters produced by the Visotoner. He could determine his feelings about listening to an audible output reading aid, and with feedback from his instructor determine his ability to hear the tone patterns. With the development of the Stereotoner, the Visotoner Screening Course was slowly phased out in 1973. It was not completely discontinued until March 1976, because even though its description of equipment was out of date, the course still enabled students to hear the tone patterns of letters as produced by the Visotoner—which were similar to those produced by the Stereotoner.

Visotoner Instruction in England

In September 1969, Ms. Butow was sent to London, England, to work with three students for a 2-week instruction course in the use of the Visotoner. The Veterans Administration had loaned two Visotoners and a Battelle Optophone to St. Dunstan's Rehabilitation Center. One of the Visotoners was loaned to Mary Jameson, the pioneer reader who used the six-tone British Optophone developed in 1918. She had also used the Battelle Optophone, so was familiar with the nine-tone code of letters. She liked the clarity of the Visotoner output, and also the aid's portability. She did not use the Visotoner without the Colineator tracking aid, a plastic plate to which a metal rod was attached. The probe was connected to the metal rod, and this enabled the reader to keep the probe going straight along the center of the line of print.

The other Visotoner was loaned to a blind public school music teacher in Birmingham, England. He had used the British Optophone. His main purpose in wanting a reading device was to be able to read material in the classroom. He, too, liked the clarity of the nine-tone output, and the portability of the Visotoner. Ms. Butow worked with him for 2 days. He heard the code well, but had difficulty tracking the print, even with the Colineator, because it was difficult for him to relax his hands on the probe.

The third student who used the Battelle Optophone was another music teacher, from Sheffield, England. He had completed the Visotoner Screening Course in May 1969, and came to London for Optophone lessons. He heard the code very well, and even correctly identified the words used in the symbol-counting questions in the course. Ms. Butow worked with him and Ms. Jameson half-a-day each for 8 days. Both students made good progress and were reading independently by the end of their training. All three of the students have sent recordings of their reading to the Hadley School. The student from Sheffield tried reading single-staff music notation, which is print music for an instrument that does not use chords, such as a flute. This was a slow process, however, and current reading-aid users generally do not try to read print music.

The student from Birmingham has tried the Stereotoner, as has Miss Jameson. Both have used it for short reading tasks.

The student from Sheffield returned his Optophone when he married in 1972.

Visotoner Instruction at Hadley

No students were taught to use the Visotoner at the Hadley School until the spring of 1971. In 1970 Hadley expanded its facilities to include more office space for faculty and conference rooms, and larger recording, printing, and library facilities. The addition to the building was completed in January 1971.

A blind typist from up-state New York completed the Visotoner Screening Course in November 1970; her responses showed that she had excellent ability to hear the tone patterns of the letters. She came to Hadley for a 2-week training course in April 1971. Although she did hear the code well, her hands were very tense holding the probe, and she had difficulty tracking the print at an even, rhythmic pace. She went through 38 lessons in the Battelle course. She went home reading slowly, but independently. Although she practiced for several months, she found her tracking skills did not improve, nor the tension in her hands lessen, so she returned the Visotoner in the spring of 1972.

A second student was taught to use the Visotoner in the fall of 1971. She is also from up-state New York, and is a legal secretary. At the time, she was a part-time instructor in English for the Hadley School. As such, the Veterans Administration loaned her a Visotoner. She completed the Visotoner Screening Course in the spring of 1971 with a grade of A. She had excellent ability to hear the code, and good tracking skills. She progressed through 68 lessons in the Battelle manual, and also tried to read other typed material such as the minutes of a meeting she attended. She did all this reading in the 2-week training course. She used the Visotoner on the job and at home, and would periodically send tapes of her reading to her instructor. She was loaned a Stereotoner in February 1973 — at that time she came in for 2 days of orientation to the Stereotoner. She is still using the Stereotoner for short reading tasks such as reading personal mail and checking her typing in the typewriter.

In 1972 one student was taught to use the Visotoner. She was a typist for an insurance company in Iowa. She completed the Visotoner Screening Course with a grade of A in June 1972. She took the 2-week training course at Hadley in October 1972, and completed 70 lessons in the Battelle training manual. She is married, and has an infant daughter to care for, so she is no longer working and does not use the Visotoner.

Two other people, after receiving Visotoner Screening Course tapes, did not submit lessons in the course but are now using Stereotoners. One is a blind veteran from San Diego, California, who took training with the Visotoner at the Western Blind Rehabilitation Center VA Hospital, Palo Alto, California, in 1972. He first heard the tone patterns of letters on the screening course tape. He was an excellent student, and was timed in 1975 by staff of American Institutes for Research at close to 80 words a minute with the Stereotoner. (A further description of this man's ability may be found in a report evaluating the Stereotoner by the American Institutes for Research.)^b

^b Final Report, December 1975, Evaluation of an Ink Print Reading Aid for the Blind: The Stereotoner. American Institutes for Research, Palo Alto, California. This work was sponsored by VA Contract V101(134) P-163.

The other student received the screening course tapes in 1972, but did not submit lessons. However, he liked the tone pattern code and 2 years later bought a Stereotoner and instruction manual from Mauch Laboratories. He is a 23-year-old blind medical transcriber from Massachusetts. He sent to Ms. Butow at Hadley, in 1974, a tape of his reading on which he had recorded part of a lesson in the American Institutes for Research Stereotoner training manual. His ability to hear the code, and his tracking skills, are excellent. He uses the Stereotoner for several different kinds of reading tasks including reading all his own personal mail, reading medical records, and checking his typing (in the typewriter) at work. He has had no formal instruction in the use of the Stereotoner.

Visotoner Demonstrations and Publicity

The Visotoner was demonstrated at an exhibit of the Hadley School at the following conventions—

American Association of Workers for the Blind, Miami, Florida 1967; Chicago, 1969; and Virginia, 1971;

Blinded Veterans Association, San Francisco, California, 1968;

American Council of the Blind, Charlotte, North Carolina, 1969;

National Federation of the Blind, Chicago, Illinois, 1971 and 1972;

Regional Conference of the Mid-Atlantic Association of Workers for the Blind, New York City, New York, 1971;

Illinois Association of Workers for the Blind, Chicago, Illinois, 1969, 1970, and 1971.

The Visotoner was demonstrated at several service club meetings in the Chicago area, from 1968 through 1972. The Visotoner was also exhibited by the Hadley School at the convention of the National Rehabilitation Association held in Chicago in 1971, and at the Alumni Association meetings at the Wisconsin School for the Visually Handicapped, 1968, and the Indiana School for the Blind, also in 1968. Descriptions of the Visotoner, written in 1967 and 1970, were distributed at these conventions.

Publications

An article describing the Visotoner Screening Course, and student training at Hadley up to that time, appeared in *The Rehabilitation Teacher* for June 1971 under the title "Print that Plays a Tune." The *Anchara*, quarterly magazine published by Delta Gamma Women's Fraternity, described Ms. Butow's work at the Hadley School, including her work with the Visotoner, in an article titled "Unique Teacher." In the *Bulletin of Prosthetics Research BPR 10-22* (Research Conference Issue) Fall 1974, a paper appeared titled "Teaching the Stereotoner: Its Problems and Rewards," in which Ms. Butow described aspects of the

program during the period October 1973–June 1974. And under the title “Instruction In, and Evaluation of, Reading Machine Techniques,” reports of the Hadley School program appeared in the Highlights of Other VA Research (Sensory Aids) section of the Bulletin of Prosthetics Research, in issues from 1968 through 1975.

A GLANCE AT SOME ALTERNATIVE ROUTES

A Tactile Aid Evaluated

In 1967, Mauch Laboratories, Dayton, Ohio, built the Visotactor, which is similar to the Visotoner probe but with a tactile rather than an audible output. In the side of the probe, there were four slots into which the reader inserted the index, middle, ring and little finger of his hand. In each slot there were two pins which vibrated when black print was scanned. All of the pins would vibrate on a vertical portion of a letter, and the center ones would vibrate on a horizontal line such as a dash. The Visotactor was evaluated at the Hadley School by Margaret Butow after she had initial instruction in its use from Harvey Lauer at Hines Hospital. Only six Visotactors were built, and one successful user was trained at Mauch Laboratories.

Ideas were considered for developing a home-study course to determine people's ability to handle a tactile reading aid output, similar to the Visotoner Screening course. This did not prove feasible, as no way could be found to determine a student's tactile knowledge of letter shapes under controlled conditions. It would be like writing a person a letter describing to him how to hold a guitar without seeing if he does it right.

Probably the reason so few became successful Visotactor readers was that the probe was not built to accommodate different sizes of hands. Also, since there were only eight channels in the probe, the tactile “image” of the letter was not felt too clearly.

Optical Character-Recognition is Applied

In 1970, Mauch Laboratories built three prototypes of the Cognodictor spelled-speech character-recognition reading aid. The case, which contained the character-recognition equipment and the recording of the letters, was about the size of a Perkins Braille Writer. The probe was a Visotactor, connected by a cable to the case. As the probe was moved along the center of the line of type, one would hear the letters spelled as they were scanned, and could also feel the letter “shapes” vibrating in the probe as it moved along the line.

Very precise tracking by the operator of the Visotactor was needed to get the character-recognition equipment to say the letters correctly. If

the Visotactor probe was too far above the centers of the letters, the character-recognition equipment would see descenders and the voice output would say letters like g, j, p, and y. The character-recognition equipment in the Cognodictor did best with IBM Selectric "Delegate" type style, and the IBM "Executive" type found in the Battelle course lessons. The Cognodictor was evaluated at Hines VA Hospital, the Western Blind Rehabilitation Center in Palo Alto, California, and the Hadley School.

In 1971 a Visotoner was connected to the Cognodictor case, and the reader heard the tone patterns of the letters through an earphone and the voice output through a speaker. Recordings were made at the Hadley School of the Cognodictor output, and sent to Mary Jameson in England to get her impressions. She liked the voice output, and was intrigued by the future possibilities of a spelled-speech reading aid.

The Cognodictor is currently being improved upon at Mauch Laboratories. The next prototypes will be greatly improved, able to recognize many different kinds of type fonts.

Because of technological advances such as improved voice outputs, microcircuitry, and more compact computers, character-recognition equipment will be a part of the reading aid of the future, which will "speak" in relatively natural-sounding language.

NEW DIMENSION FOR SOUND: DEVELOPMENT OF THE STEREOTONER

In 1971, there was considerable discussion about developing a different audible-output-code print reading aid from the Visotoner. Two Visotoners were combined so that two vertical columns of photocells saw the print at the same time. This device was evaluated at Hines Hospital and the Hadley School: it did not improve the legibility of the print.

Then a Visotoner was connected to a box which had two earphones and 18 volume controls—two for each of the nine tones. The volume of each tone could be adjusted individually for each ear. This device was also tested at Hines Hospital, the Western Blind Rehabilitation Center in Palo Alto, and the Hadley School. After many experiments with different volume control adjustments for each tone in each ear, it was found that the most legible signal was produced with the lower tones louder in the left ear, and the higher tones louder in the right ear. (All tones were heard in both ears, but with the volume adjustments described.) This arrangement made it easier to hear the distinguishing features of letters like V, J, and y, to give a few examples, because the left-to-right movement of the probe was heard, as well as tone-pattern changes.

In 1972 Mauch Laboratories built three Stereotoner prototypes which were tried at two VA Blind Rehabilitation Centers, and at Hadley. The

Stereotoner has several advantages over the Visotoner. It is smaller, lighter in weight, has a greater magnification range (can be used to read print from half-an-inch high to about four-point type), can read light print on a dark background, and has a more readable, binaural, output with which to produce the tone patterns of the letter shapes.

The present form of the Stereotoner was developed under contract to the Veterans Administration during 1971-73. The Stereotoner is housed in a small case which is worn on the chest; in the case are the rechargeable battery, the operating controls, two earphones which are attached to the neck strap, and the probe which is moved along the line of print producing tone-pattern pictures of the letters scanned. For example, the letter L produces a chord sounding seven tones at once, then a lower tone in the chord hangs on longer showing the horizontal line at the bottom of the letter. A V produces a wavy tone pattern going first down and then up the tone range. A small v also produces a wavy tone pattern, sounding fewer tones because the letter is shorter than its upper-case counterpart.

The tone patterns are produced by a vertical column of ten photocells in the probe which respond to the contrast between the print and the paper. The reader learns to interpret the tone patterns as shapes of print letters and symbols.

The reader holds the camera in one hand and uses a metal ruler tracking aid with the other hand to help move the probe straight along the center of the letters on the line. The tracking aid has a magnetic strip which can be used on a metal surface to help keep it more stable, so that the reader will not have to hold the aid so firmly.

STEREOTONER EVALUATION STUDY

In December 1972, a conference was held at the Veterans Administration Central Office in Washington, D.C. Attending the conference were staff members of the present Research Center for Prosthetics, Veterans Administration, New York; Visotoner instructors from the Western Blind Rehabilitation Center, VA Hospital, Palo Alto, California; Central Blind Rehabilitation Center, Hines, Illinois; and from the Hadley School. Also attending the conference was an Optacon instructor from the Massachusetts Commission for the Blind, and members of the Committee on Prosthetics Research and Development (CPRD), National Research Council, National Academy of Sciences. A decision was reached at this conference to ask American Institutes for Research, Palo Alto, California, to do a research and evaluation project for the Stereotoner. At that time, they were completing a research and evaluation project of the Optacon in public and residential schools (using blind school children as subjects), under sponsorship of the U.S. Office of

Education.

In the proposed study, which was to be sponsored by the Veterans Administration, with some of the equipment purchased by the CPRD, adults would be the subjects rather than children. The Veterans Administration was to order 50 Stereotoners from Mauch Laboratories; the CPRD, National Research Council, would order 15 more Stereotoners to be used by nonveteran students of the Stereotoner who were to be trained at the Hadley School. The Stereotoner would be taught at the three VA Blind Rehabilitation Centers in West Haven, Connecticut, Palo Alto, California, and Hines, Illinois. Each center would teach 12 students. At the Hadley School, 12 Chicago area blind students would be selected for training. The other three Stereotoners purchased by the CPRD were to be used at American Institutes for Research. A blind resource teacher in a public school and one of his students were taught to read with the Stereotoner.

American Institutes for Research agreed to do a research and evaluation project with the Stereotoner, and also agreed to develop new training materials for the students which would replace the Battelle course. In May 1973, staff members of American Institutes for Research, and the three Stereotoner instructors at Hadley, Hines, and the Western Blind Rehabilitation Center, held the first Stereotoner training-materials conference at Palo Alto, California.

Student Aptitude Assessment

At that time, it was agreed that a quicker way to assess potential students' aptitude for the Stereotoner audible output code needed to be developed. From experience with the Visotoner Screening Course, it was known that a good Stereotoner user should be able to hear tone-pattern changes within letters and words, hear the direction of the tone patterns (tones moving up or down the scale) and hear the silence between letters and words—that is, count series of symbols accurately. With this in mind, the Auditory Selection Test was developed at American Institutes for Research, and was recorded using Stereotoner sounds at Hines.

The test has three Sections.

In the first section, the student was given series of four letters each—three alike and one different. He was asked to say the number of the symbol that was different from the other three.

In the second part of the test, the student was given series of symbols to count. He was to say the number of symbols he heard in a series.

In the third part of the test, the student was given two-letter, three-letter and four-letter words—again a series of four words. He was asked to tell the examiner giving the test which word was different from the other three.

There were 84 items in the test.

When 36 sighted and blind subjects, among the three centers, were given the test to see if there would be a wide variation of scores, their scores ranged from 4 to 35 items missed out of the 84. At the second Stereotoner training materials conference, held at American Institutes for Research in Palo Alto, California, in August 1973, it was decided that prospective candidates for the research and evaluation project who missed more than 25 items on the Auditory Selection Test would be considered unlikely to learn to read print with the Stereotoner, and therefore would not participate in the project.

Since American Institutes for Research has already published their research and evaluation report of the Stereotoner, discussion here will center on students trained at the Hadley School.

Stereotoner Training at Hadley

From 1972 through June 1973, there was a Hadley office in Tel Aviv, Israel, which served Israeli students with home-study courses. The director of that office, an American citizen living in Israel, expressed an interest in the Stereotoner. She took the Visotoner Screening Course, completing it with a grade of A in December 1972. In April 1973 she came to Hadley School for a 3-week Stereotoner training course. The Hadley School had purchased a Stereotoner for her from Mauch Laboratories. Because the new Stereotoner training manuals were not yet ready, the Battelle course was used. She progressed through 50 lessons in that course.

Although she heard the code well, her hand holding the probe was very tense, and she had a great deal of trouble pacing her reading. Mauch Laboratories built a magnetic coupler which would attach the Stereotoner probe to the metal rod on the Visotoner Colineator, but the probe would easily become detached from the coupler in the hands of a tense student.

There is a straight-edge metal ruler with a rubber roller through the center of it which is used to keep the Stereotoner probe going straight across a line of print. This ruler is held in place across the page by the reader's left hand in the center; when he wants to move the probe down to the next line to read it, he uses the fingertips of his left hand to move the aid down. The probe is moved down with the aid in the right hand. To see if the aid is straight, the reader moves the probe rapidly across the line to see if the tone patterns of the letters go higher or lower in pitch. This student used this aid quite successfully. She was primarily interested in checking her typing with the paper in the typewriter, and trying to read Hebrew. Since she was purchasing an IBM Selectric, she learned how to read typing in the typewriter during training. She also read a couple of letters she received.

After she completed training, she sent Ms. Butow two tape recordings of her reading. Her reading speed had increased, and she was able to track the print at a steadier pace. She still continues to use the Stereotoner for short reading tasks, primarily checking her typing. She also sent a set of print Hebrew letters of the alphabet, and a set of raised Hebrew letters which were duplicated on a Thermoform braille duplicator. Ms. Butow made a Stereotoner recording for her, describing the tone patterns of each of the Hebrew letters, and pointing out their distinguishing features.

In August 1973, four Chicago-area vocational rehabilitation counselors were contacted by Ms. Butow and asked to recommend prospective clients who might be interested in participating in the Stereotoner Research and Evaluation project. Each prospective student would be given the Auditory Selection Test at Hadley. A Stereotoner would be provided by the CPRD, National Academy of Sciences.

During the 2-year period of the project, 21 people were given the Auditory Selection Test and all of them received passing scores. Two of the people elected not to take the 3-week training course because they thought it would be too difficult, and felt that they wouldn't have the time or patience to continue to practice. Each prospective student was scheduled for the 2-to-3-week training course as soon after they were tested as possible. Several students were tested in August and September, and they were scheduled in the order in which they were tested, from October 1973 through June 1974.

The last student in the research project was taught to use the Stereotoner in August of 1975.

Instructional Materials

The staff of American Institutes For Research wrote a Stereotoner Instruction Manual which includes 14 units—3 lessons and a "Criterion Exercises" for each unit.

The first unit deals with equipment orientation and tracking practice.

The second through ninth units taught the capital and small letters of the alphabet, and numbers.

The tenth unit was used for building reading speed and skill. In this unit there were lessons containing letter combinations and words using these letter combinations, the 400 most-common words, and paragraphs for self-timed reading containing a given number of words to read in a certain amount of time.

The eleventh unit contains lessons on different kinds of print (book style) and two kinds of italic type.

The twelfth unit contains practice with print formats, in reading columns, tables, letterheads, and a form.

The thirteenth unit contains discussion on checking typing in the

typewriter, reading print of different quality (such as a carbon copy), identification of currency, and reading labels.

The fourteenth and last unit in the manual contains commonly confused letters to practice.

Four home-study units were also written on such subjects as leisure-time reading (magazines, personal mail), travel (reading of bus schedules etc.), recreation, reading menus, and business affairs (reading memos, bills, and bank statements). These were for the student to practice after he completed training. There were 12 lessons in each of these units, the 12th lesson being a criterion exercise which the student would record on tape, using the Stereotoner signals and his own voice, and send to his instructor for evaluation.

A weekly progress report on each student was sent to American Institutes for Research by the instructor. This included the criterion exercise scores for each unit, description of where the student was doing well, and problems he was having.

In all, 19 students participated in the Stereotoner program at Hadley. (Preliminary data were submitted on a 20th student who had purchased a Stereotoner on her own, in August 1975. Since American Institutes for Research was completing compilation of its data for the project, no follow-up data were collected on this last student.) Three of the students did not complete the training program successfully. One had difficulty hearing the code, which did not improve; one had difficulty operating the equipment (if she got lost on a line, or had the controls improperly adjusted, she could not straighten herself out), and the third was physically unable to complete the training because the intensive course was too fatiguing for him. A fourth student returned her Stereotoner after 8 months because she was having some health problems, and did not continue to practice at home.

The other 15 students are continuing to use their Stereotoners with varying degrees of skill, and in many different ways.

Students' Backgrounds

Ages ranged from 18 to 54 years old. One is a high school graduate, 15 have bachelor's degrees, 1 has a master's degree, 2 have some college experience, from 1 to 2 years, and 1 has a Ph. D. There were 10 men and 10 women in the project. Occupations are varied: an editor of a recorded magazine, medical records typists, a receptionist, computer programmers, a piano technician, psychologist, musician, and a program coordinator for a small private agency serving the blind. Seventeen students were congenitally blind, and three were adventitiously blind, having some visual knowledge of print letters. Most of the students knew their capital letter shapes, and the adventitiously blind students knew the meaning of different sizes and styles of print.

The Training: Learning to Use the Stereotoner

Students worked from 10 to 15 days, approximately six hours a day, on the course. The training materials used have been described earlier in this paper. The lessons in the beginning units were each one page long or less. Students completed from two to five lessons a day.

The Stereotoner produces the tone patterns of letter shapes in the following manner. The L is a straight vertical line with a horizontal line at the bottom coming off to the right. In the probe, there is a single vertical column of photocells which "see" the black print against the white paper. When the L is scanned with the probe, the first thing heard is a chord consisting of high and middle range tones all coming on at the same time. Then the horizontal line is heard as a lower middle range tone sounding by itself. The letter V, because it has two diagonal lines that converge at the bottom, starts on a high tone moving down the scale to a lower middle range tone, then back up to the top of the scale again. As the 0 is scanned, one hears middle-range tones spreading out to high and low middle range tones, then returning to the middle range tones at the other side of the circle.

Small letters (such as o, c, e, s, and a) sound fewer tones because they are shorter and have no ascenders or descenders. Letters with ascenders (such as h, d, b, k, and i) sound the high tones when the high tone photocells "see" the ascender. Letters with descenders (such as g, p, y, and q) sound the low-tone photocells when these see the descenders. Each symbol has something that distinguishes it from the other symbols, and the student learns to listen for these features as he reads. Generally students had more difficulty hearing horizontal portions of letters, because fewer tones were sounding as the camera scans the letter. Verticals, diagonals, and circles were easier to hear.

Students also had to learn to move the probe along the center of the line straight, with a steady hand, at an even, rhythmic pace. They were encouraged to listen for word patterns as well as letter patterns, so that they would increase their reading speed, by reading whole words at a time rather than letter-by-letter. Once the student had learned his letters and numbers, an effort was made to find things he would be interested in reading such as business and personal letters, utility bills, and pamphlets.

At the end of their training, students could read from two to ten words a minute. Each student was given a criterion test developed at American Institutes for Research which contained words, sentences, and paragraphs. The test had an answer form, on which the instructor would mark with a pen the words read correctly and the words missed, and submit it to American Institutes for Research. At the end of training the students could read quite independently. They knew when the magnification and lamp control were improperly adjusted, and could correct

them accordingly.

Each student was given a manual containing the four home-study units, which had a variety of reading tasks similar to those the student would meet in everyday situations. Three of the students completed all four of the home-study units, sending to the instructor recordings of the criterion exercise for each unit. Three more students have partially completed these units.

How Former Students Use the Stereotoner

Students who have continued to practice after completion of their training use the Stereotoner in several ways. Many read all or part of their personal and business mail. Some only identify their mail to find out what needs to be read by a reader, and what can be discarded. A receptionist checks her typing in the typewriter, and finds out if the letterhead is rightside up before it is put into the typewriter. One student who works for the Chicago Transit Authority, improving transportation for the physically handicapped, reads bus and train schedules. The families of two students who were living at home stopped reading their mail to them, and though it was hard at first, these students were eventually able to read newsletters they received, and letters from friends and relatives which were typed. One computer programmer has "debugged" programs he has written. The piano technician who wanted to have a Stereotoner to read his mail, now reads it—bills, ads, newsletters and business letters. A student at the University of Illinois in Champaign has read instructions on a pay phone, and also uses the Stereotoner to identify currency, besides reading his mail and short articles in magazines.

The last student in the Research and Evaluation project was trained in August 1975. The instructor had a letter from this student in March 1976 stating that although she did not practice with the Stereotoner at first (because she was moving to a new home) when she got settled she reviewed the lessons in the training manual, and now is able to read most of the mail she receives. (Only data on her initial training were submitted to American Institutes for Research.)

STEREOTONER STUDENTS, AFTER THE RESEARCH PROJECT

From November 1975, through June 1976, four students have been participating in the Hadley School Stereotoner training program.

In October 1975, a Stereotoner was purchased for the Swedish Association of the Blind, Stockholm, Sweden.

Aid for a Sighted Instructor

In November, Mr. and Mrs. A., (Mr. A. is involved with sensory aids

research at the Swedish Association) came in for a 2-week Stereotoner course. Mr. A. is blind, and uses the Optacon tactile print-reading aid. Mrs. A. is sighted, and she wanted to learn to teach the Stereotoner.

Mauch Laboratoreies has built a "Reflex Viewer" which sighted instructors can use to teach the Stereotoner. The Reflex Viewer has a Plexiglass plate to which the straightedge tracking aid is clamped after the paper is put on the plate. The plate is placed in a metal frame which has a mirror at the bottom of it. The frame is 8½ inches across, and 11½ inches long, and 4 inches high. By looking at the mirror, the instructor can see what the student is reading while the student is reading it. He also can see if the probe is moving through the center of the line, or if it is twisted or tilted.

The A.'s were both given the Auditory Selection Test, and received passing scores. Because of Mr. A.'s previous knowledge of print, and ability to keep the camera straight on the center of the lines (because he has used the Optacon) he was reading independently in the training manual at the end of the first week. Mrs. A. worked with him, using the Reflex Viewer, and she learned to understand the relationship between the tone patterns and the letter shapes. They took the Instructional Manual, and planned to get it translated into Swedish. They also took the Auditory Selection Test and the Stereotoner pretraining cassettes back to Stockholm, and were going to look for a student who would have a good learning potential and enthusiasm for the Stereotoner. So far as we know, they have not taught any students the Stereotoner up to this time.

In January 1976, a blind physiology professor came in for Stereotoner training. He had taken and passed the Auditory Selection Test in the fall of 1975, and scored in the lower passing range. He had difficulty hearing the high tones on letters with ascenders, and also was confused (as most students are) by the small a, e, o, s, and c. At the end of his course, he was reading at one word a minute. He was asked to make recordings for the instructor of the third lesson in each of the Alphabet units, but none have been received.

In March, a student who had been given the Auditory Selection Test at Hines in January, was accepted for training at Hadley. She is a chiropractor in full-time practice. She wanted to learn to read with the Stereotoner primarily for pleasure — to be able to read articles in magazines, and books in which she was interested. Her ability to hear the code, and her tracking skills, were quite good — but she found the Stereotoner more difficult to learn than she expected. She finished the training course reading at 2 words a minute. She was also able to read from a book on playing bridge in which she was interested. Because she has her family to read her mail to her, and she does very little typing, she

did not continue to practice the Stereotoner at home, and is interested in selling it.

In June 1976, a blind couple from Canada who had purchased a Stereotoner came into the training program. They were given the Auditory Selection Test in August 1974, and neither of them achieved a passing score on the test. In spite of this, and against the advice of the instructor, they purchased a Stereotoner. The husband uses the Optacon slowly, and because it was thought he could work fairly independently, and because they had purchased a Stereotoner, they were both accepted for training. The wife uses binaural hearing aids, and due to a severe orthopedic problem has poor coordination. During the first week, the instructor worked with each student 2-to-3 hours a day. The wife achieved no success in understanding the code or in tracking the print, and her training was discontinued after a week. Also, the husband was not able to work as independently as he had thought. The instructor worked with him alone for the next 10 days, and at the end of that time he was able to read very slowly. He had also looked at his typing in the typewriter, and looked at currency. He was shown how to make a Stereotoner recording, and asked to send tapes of some of the lessons on self-timed reading in the speed-building unit of the instruction manual. Since the wife wore binaural hearing aids, she listened to the Stereotoner in mono in one ear, and instructions in the other ear.

OTHER ACTIVITIES

The New Tests, Manuals, and Materials

In March 1976, American Institutes for Research, Palo Alto, California, under their contract with the Veterans Administration to develop new Stereotoner Training materials, purchased the services of the Hadley recording facilities to duplicate cassettes to be used in future Stereotoner training programs. In all, 26 Auditory Selection Tests, 28 pretraining course cassette sets (3 cassettes each), 75 Stereotoner Drill and Practice cassettes, and 50 sets of home-study unit cassettes (5 cassettes each) were duplicated. These cassettes were delivered at the end of April to Harvey Lauer, at Hines VA Hospital, Blind Rehabilitation Center, to be distributed to the VA blind rehabilitation centers at Palo Alto, California, and West Haven, Connecticut, and to Mauch Laboratories, Dayton, Ohio, and the Hadley School.

American Institutes for Research staff had revised and shortened the Auditory Selection Test from 84 items to 40 items. They had also written a print manual to be sent along with the test. The test is recorded in stereo, and should only be given to a prospective student using a stereo cassette recorder with earphones. The one administering the test should

also listen to the recording through earphones. The test will be sent to anyone who has access to a stereo cassette recorder, and who will designate someone to administer the test. The new tests are self-scoring, so that the examiner can tell the prospective student what his aptitude will be for learning to use the Stereotoner in the light of his test results.

To date, four Auditory Selection Test cassettes, plus examiner manuals, have been sent out by the Hadley School to state agencies serving blind people. Two test scores have been reported back to the Hadley School, one from a rehabilitation agency in Alabama, and the other from a rehabilitation agency in Maryland. The two students tested scored 37 and 39 correct out of the forty items, respectively. At this time no plans have been made to schedule these students for training. Both students have been sent the Stereotoner pre-training cassettes.

Materials for Self-Taught Preparation for Training

The Stereotoner pre-training cassette set consists of three cassettes. They describe the Stereotoner and the training program, tell where training is available, and give many examples of the Stereotoner tone-pattern code of print letters and symbols. The student is given examples of word as well as letter patterns, a description of the alphabet with the letters in the order in which they are taught in the Instruction Manual, a description of the controls of the Stereotoner, and control-adjustment instructions. Along with the cassettes, the student receives a set of raised letters which he is encouraged to examine while listening to the sound patterns of the letters. Students are given examples of different kinds of word patterns, such as bay, day and say, and sentences with different word lengths such as "Here I am now; I am now here." This kind of practice encourages the student to read word-by-word, as well as letter-by-letter. The cassettes tell the student immediately what is heard with the Stereotoner, and no lessons are required to be submitted by the student. The cassettes are completely self-teaching, and give the student an idea of the Stereotoner tone patterns, and the kind of training provided.

The cassettes are available in stereo, but they can be played on a monaural machine.

The drill and practice gives the letters of the alphabet, and numbers, and the 400 most common words, and sentences using these words. The purpose of the cassette is to give the student a good idea of the code, and help him build listening speed. The drill tape has been used during Stereotoner training by the student, as homework, and is given to the student after he completes training.

The Home Study Units

American Institutes for Research staff also developed a manual con-

taining four home-study units which introduce the student to various kinds of printed material which he will encounter in everyday life. Along with this manual, a set of five cassettes was provided. The cassettes describe each lesson in each of the four units, telling the student the kind of print he will encounter on each page, and how it is set up on the page. The student is encouraged to listen to the description of each lesson on the cassettes before attempting to read it. The fifth cassette contains a description of the complete home-study unit manual, and instructions on how to submit the criterion exercise in each unit to the instructor.

Learning to Teach the Optacon

In December 1975, Margaret Butow was asked by the administration of the Hadley School to learn to use the Optacon^b, and become a back-up instructor in their Optacon training program. In February 1976, she took the students' Optacon course at Hadley, and in May 1976, she took the teacher training course at Telesensory Systems, Inc., in Palo Alto, California. Her previous experience with the Visotoner and Stereotoner, in keeping the probe going straight on a line of print, and her knowledge of print formats and type styles developed with these aids, enabled her to build up skill with the Optacon in a relatively short period of time. In April, she was timed at Hines VA Hospital with the Stereotoner at 35 words a minute. A month later, she was timed at Telesensory Systems, Inc., in Palo Alto with the Optacon at 35 words a minute. Both time tests, in both instances, were given on high school level reading material with good quality print.

Stereotoner Demonstrations

The Stereotoner was exhibited by the Hadley School at the conventions of the American Association of Workers for the Blind, in Richmond, Virginia, 1971, and Cleveland, Ohio, 1973. It was exhibited by Ms. Butow at the AAWB convention in Atlanta, Georgia, 1975, for the Veterans Administration. It was also exhibited at the convention of the American Council of the Blind Convention in Chicago, 1974.

CONCLUSIONS

The Hadley School is a teaching center for both Stereotoner and Optacon reading aids, and is not in a position to market any sensory aid.

^b The Optacon (OPTical-toTActile CONverter) is a portable tactile-representation reading aid. To describe it briefly: it presents the output of a 144-element (6 x 24) hand-held sensing array (probe) in the form of a 144-point battery of vibratory tactile stimulators. Thus it might be said to produce a tactile "image" of a printed character as seen by the probe.

The publicizing of the Stereotoner should be done by the manufacturer or his representative. The Auditory Selection Test will continue to be sent to persons requesting it who have access to a stereo cassette recorder, and designate someone to administer the test to them. The Stereotoner pre-training cassettes will continue to be sent to agencies for the blind which request them, and to individuals who have passed the Auditory Selection Test and are interested in Stereotoner training. The 3-week training course will continue to be offered at Hadley, and students will be scheduled for this training as time permits. Students in either reading-aid program pay their living and travel expenses, but do not pay for their training — which is offered free of charge.

Because of the successful Stereotoner users taught primarily at the Hadley School during the Research and Evaluation project, it would seem that the Stereotoner would have some value as a print reading aid to a number of blind people. At the present time, no concerted effort is being made to publicize and market the Stereotoner. Several factors have contributed to the difficulties currently being experienced by those who would like to see the Stereotoner continue to be available. Although the binaural tone patterns of print letters are easier to hear, it is difficult to demonstrate this except on a one-to-one basis.

Ideally, the pre-training cassettes should be heard on a stereo cassette recorder with earphones. On a monaural machine, the higher tones are harder to hear, and the binaural tone patterns are not distinguishable (they are also harder to hear through stereo speakers than through stereo earphones). Many blind people do not have access to stereo cassette equipment; this limits the number of people who can hear the pre-training cassettes to best advantage.

Since the cassettes are self-teaching, there is no way to get the instructor any feedback from the student except by asking for general overall comments on the cassettes. This could be remedied by writing a supplementary questionnaire to which the students must respond before entering the training center.

Desirable Auxiliary Devices and Modifications

A good stable tracking aid is sorely needed for the Stereotoner. A student must concentrate on moving the camera along the center of the letters on a line of print, with a steady hand at an even pace, in order to get a good legible code signal which will enable him to hear the tone-pattern changes within the letters, and the silence of spaces between letters and words. A variation of one-hundredth of an inch above or below the center of the letters makes the tone patterns sound different. A greater variation than that causes the probe to miss either the top or bottom part of a letter depending on which way the student is moving it, with results that are distracting and confusing to the student. No current tracking

aid holds the probe firmly on the center of the line of print. The more the student concentrates on hearing the code, and keeping the probe going straight, the more tense his hand gets and he pushes against the aid, moving it below the center of the line, causing the code to be distorted, and the probe to miss part of the letters. (Mauch Laboratories has built a prototype of a Stereotoner "book reader" which they say will solve this problem.)

A wider, more stable base. — the Stereotoner probe is vertical, and narrow, and the beginning student will often tilt it at the ends of the lines to the right, causing all the tones to come on at the same time. If the probe were shorter, and had a wider, more stable base, this problem might be alleviated. A longer, more stable base was put on Ms. Butow's Stereotoner which she has used with a few beginning students, and there is a good deal less probe tilting.

An automatic pacer for the probe is another thing that would be helpful. This would move along a line of print without the aid of the student and would enable him to concentrate on hearing the code.

In November 1974, Ms. Butow demonstrated the Stereotoner for some sales people at Science Research Associates in Chicago. They showed her a spring-driven pacer which is used to help sighted people increase their reading speed. The pacer has a piece of opaque plastic which moves down the page, forcing the reader's eyes to keep ahead of it. One of these pacers was given to her, and she sent it to Mauch Laboratories to be modified for the Stereotoner. A prototype was built which moves the probe along the line rather than down the page. The probe was held in place by a clip; when the end of the line was reached, the student would push the probe back to the beginning of the line, move it down, and center it on the next line. When the student let go of the probe, it would move across the next line automatically. The student gets practice in hearing a legible correct signal, and centering the probe on the next line of print but does not have to keep it centered as he does when he is moving it along a line by hand. The prototype, which was sent to the Stereotoner instructors about a year ago, needed some further modifications to help keep the paper straight and hold the probe upright. So far as we know, these modifications have not been carried out.

The Science Research Associates' pacer costs less than \$100.00, but would probably cost about \$200.00 if modifications were made to use it with the Stereotoner. It would be a good training aid in a center, and inexpensive enough for a student to use at home to help build his reading speed, or for a student who had tracking problems.

It is our understanding that Telesensory Systems, Inc., has built a prototype of a similar pacing aid for the Optacon.

Character-Recognition Possibilities

Mauch Laboratories is currently working on the Cognodictor character recognition reading aid which will have a spelled and/or spoken-word voice output. The Cognodictor will be connected to a Stereotoner probe which will track the print, enabling the user who knows the tone pattern code to read print that might not be recognized by the Cognodictor—such as slanted print or other very unusual type styles or sizes. At this time, there is much research being done with character recognition equipment with spoken and/or spelled word output, and a probe which will track the print automatically. These devices would not be as portable as direct translation reading aids are. No date has been set for research and evaluation of the character recognition equipment at this time. Estimated costs of these aids would be too high for most blind individuals—there may always be a need for a direct-translation reading aid, such as the Stereotoner or Optacon, which can be carried from home to office and used primarily for small reading tasks.

RECOMMENDATIONS

1. An organization should be found which is already involved in promoting sensory aids, that will publicize and market the Stereotoner. The reason the Veterans Administration contract with the Hadley School is being terminated as of September 30, 1976 is because research and evaluation of the Stereotoner has been completed. It would seem that the Stereotoner is a viable reading aid for a number of blind people. By using the Auditory Selection Test (with examiner's manual), and the pre-training cassettes, prospective Stereotoner users can get some idea of the tone patterns of print letters and symbols as produced by the Stereotoner, and what is involved in learning to use the Stereotoner. The Hadley School will continue to provide these materials, and Stereotoner instruction upon request, but it is not within the province of the Hadley School to go out and look for prospective students.
2. The development of the improved tracking aid, and the automatic reading speed building pacers, should be completed. These aids should be made available to past as well as to future Stereotoner users.
3. The Stereotoner probe should be made more stable, so that the user will be able to move it along the center of print letters without tilting it.
4. A questionnaire to which students must respond before entering Stereotoner training should be added to the pre-training tapes. A prospective user could be asked to describe the differences he hears between letter patterns and word patterns he hears on the cassettes. He could also be asked to describe the kind of material he would like to read. He could be asked to describe in his own words print letters and symbols he thinks

he knows. He could also be asked how much time he plans to spend on practicing his reading.

5. A method should be worked out to train more sighted Stereotoner instructors. Mauch Laboratories has built a "Reflex Viewer"—a Plexiglass plate mounted over a mirror so that the instructor can see what the student is reading at the same time he is reading it. This device should be improved.

CONCLUSION

The work over the years with the Visotoner, Visotactor, first Cognodictor prototype, and the Stereotoner has been challenging, interesting, sometimes frustrating, but always rewarding. The nonveteran Stereotoner users taught at the Hadley School showed on the whole that the Stereotoner can be a usable print reading aid.

In the evolution of reading aids, we seem to be in a holding pattern. The direct translation reading aids are available, but a relatively small number of the blind population can use them because they require good manual dexterity and coordination, good audio or tactile discrimination, and intensive training in their use. The next generation of reading aids will be the character recognition equipment which will involve little training on the part of the student, but a great deal of sophistication and technological versatility on the part of the equipment. What will be done in the meantime? Should the Stereotoner be considered as an alternative reading aid? Our opinion is that there still exists a need for reading programs using the Stereotoner.

Despite the strictures mentioned previously, Hadley School for the Blind is always available to provide students with the necessary materials and the skilled tutorial services of Ms. Butow. Perhaps in the future, there may be a need to develop a home-study course for people to become accustomed to the voice-output of character recognition equipment presently under development.

STEREOTONER USER SURVEY

A telephone survey of people who were known to have purchased Stereotoners, or who participated in the AIR research and evaluation project, was conducted in August 1976. Twenty-five out of 28 people were contacted. (No veterans were contacted.) The survey was made to determine in what ways people are using the Stereotoner a year after completion of the American Institutes for Research report.

Two of the people had been given Stereotoner instruction at the Blind Rehabilitation Center, VA Hospital, Hines, Illinois, one at the Western Blind Rehabilitation Center, VA Hospital, Menlo Park, California, and

one at the Hadley School, before the instruction materials were developed by American Institutes for Research. Two people have not taken formal instruction—one of these is self-taught and the other is trying to learn to use the Stereotoner with the help of a sighted friend.

The survey covered the following areas: time spent per day or week using the Stereotoner, reading tasks performed, ease or difficulty in operating the equipment, maintenance and repairs, impressions of the instruction, and suggestions for improvement of the equipment.

People were also asked to give their reasons for not using the Stereotoner.

Background of the Readers.—Of the 25 people contacted, 13 are between the ages of 20 and 30; 11 are between 30 and 50; and one person is over 50 years old.

In educational achievement, 2 people have high school diplomas; 2 have some college; 17 have bachelor's degrees; 2 have master's degrees and 2 have Ph. D.'s.

Occupations include 5 teachers, 2 computer programmers, 1 optical designer, 1 chiropractor, 1 musician, 1 piano technician, 1 college student, 8 typists, 2 in public relations, and 3 currently unemployed.

All but 3 are blind from infancy or early childhood.

There are 12 women and 13 men.

Results of the Survey

Five people are not using the Stereotoner for any reading. Three of the five expressed a desire to get back to it again, one has learned to use the Optacon and prefers it, and one has sufficient sighted help to get desired reading tasks done. Two others use the Stereotoner occasionally to check typing out of the typewriter; they read about a half-hour a week. One person who completed training in June is working in the instruction manual about 1 hour a day.

The other 17 people are using the Stereotoner on the average of 8 hours a week.

Ease or difficulty in Operating the Stereotoner.—All 20 readers have used the tracking aid on a metal surface so that the ruler will be held in place more firmly. But 17 of them do not use the tracking aid at all for short reading tasks and for checking typing with the paper in the typewriter. For longer reading tasks, 12 people use the tracking aid without the metal strip. Six people use the tracking aid on a metal surface exclusively.

In matters related to the size and clarity of printed characters, 14 people said they came across print of different sizes and styles from ordinary typing. When this occurred, they would adjust the magnification control to read it unless it was just a few words. Three people said

they use the Stereotoner for reading their own typing or typed letters they receive, where the print is almost the same size all the time—they do not use the magnification control. Seventeen people said they use the lamp control to adjust for print of different quality.

TABLE 1.—*Reading Tasks Performed with the Stereotoner*

Reading Task	Number of people reporting the task
Identifying personal and business mail	17
Reading typed personal and business mail	17
Checking typing with paper in the typewriter	17
Proofing typing with paper out of the typewriter	17
Reading newsletters and memoranda	10
Reading pamphlets	10
Reading bills	11
Reading bank statements	5

Reading Tasks Performed.—Table 1 shows the reading tasks most often performed with the Stereotoner and the number of people doing these tasks: Table 2 shows the reading tasks for which the Stereotoner was used less frequently.

TABLE 2.—*Less-Frequent Tasks Performed on the Stereotoner*

Reading Task	Number of people reporting the task
Occasionally reading short magazine articles	17
Reading books to build up speed	12
Reading directions on food packages	5
Reading menus	4
Reading a paper tape calculator	1
Reading business cards	1
Reading bus and train schedules	3
Checking lights in the house, on meters, on multiline phones	7
Checking letterhead to see if sheet is right-side-up when inserting in typewriter	4
Collating mimeographed pages	3

All of the people said they have encountered very small or very large print in material they have tried to read, but none said that they ran across much light print on a dark background. (This may be due to the fact that light print on dark background may appear to be pictures rather than print.)

When encountering unfamiliar material, 17 people said that they first look for legible print which can tell them whether the material is right side up. Then they look for return addresses, headings or paragraphs.

None of the people have had their reading timed since the completion of the American Institutes for Research Stereotoner Project. Seven people would not estimate their reading speed on good quality print. Six estimate their reading speed to be between 20 and 60 words per minute. Four people estimate their reading speed to be from 2 to 10 words a minute.

Maintenance and Repairs. — The most frequent repairs of the Stereotoner have been battery and probe cable replacements. The battery lasts for approximately a year, and 13 batteries have been replaced. Seven probe cables have been replaced. One magnetic strip for the tracking aid had been replaced. Three other people have said that their magnetic strips had come off the tracking aid but they have not felt it necessary to have them replaced.

Impressions of the Training. — Twenty-one people have had formal instruction in the use of the Stereotoner. Two people have had no formal instruction, and two others are instructors of the Stereotoner and Optacon who took their formal training before the new instructional materials were produced. The people who had taken formal instructions were asked the following questions: Were the training sessions too long or too short? In what areas would you like to see more emphasis in the training course?

Seven people were satisfied with the instruction course as it was. Thirteen people thought there should be more emphasis on operation of the equipment (magnification and lamp controls), more exposure to the "real world of print" including package labels, different type styles on the same page, and different kinds of numbers—also, more emphasis should be placed on whether the page is right-side-up. One person thought the course should be spread over a longer period of time with shorter training sessions. One person thought that techniques should be developed to encourage people to read word-by-word instead of letter-by-letter. The person who was self-taught had initially worked 6 hours a day for 2 weeks.

Suggestions for Improving the Stereotoner. — People were asked the following questions about improvements in the Stereotoner: Should the lamp

and magnification controls be put in a different place on the probe? Should research be done to change the tone pattern code? Would a one-line pacer which moves the probe along the line automatically, but is moved to the center of the next line manually, be helpful? Should it be possible to operate the Stereotoner on house current as well as battery? Should the shape of the probe be changed?

All 25 people were asked for their impressions of the Stereotoner construction, and suggestions for improvements in the operation of the Stereotoner: 15 people thought the shape of the probe should be changed so that it would be less likely to tilt and easier to handle, and 16 people thought that the magnification adjustment should be put in a different place so that the probe would not have to be taken off the page when changing to a different size of print. One person suggested that the magnification control be put on top of the probe rather than the side.

All of the people thought they would like to see the "Book Reader"^c tracking aid become available.

When asked if they would like to see the tone pattern code changed, 20 people said they were satisfied with it the way it is, using ten tones; 5 people thought it would be interesting to add more tones to the output, or have them further apart on the scale. When asked if they would like to have the Stereotoner operate on house current as well as battery, 12 people thought that this would be helpful. Twelve people thought the one-line pacer would be useful as a training aid, and to help build up speed in letter recognition.

One person who uses the Stereotoner to read typing with the paper in the typewriter thought that protective padding should be put around the case so that it wouldn't get knocked around so much when phone calls interrupted typing. Two people thought it would be helpful to read red or purple print; it is believed that more people might have desired to read red or purple ink if this question had been specifically included in the survey.

A computer programmer thought that it would be useful to read CRT (cathode ray tube) computer output.

Survey Conclusions

The Stereotoner is a useful reading aid for people who have the ability and patience to work with it. The ability to read at one's own convenience is valued by the Stereotoner user even for the smallest reading tasks, such as checking typing with the paper in the typewriter, or identifying

^c "Book Reader" Mauch Laboratories has built a prototype of a "book reader" tracking aid which would align the probe with the print on any size page. This book reader is described in detail in the June-July 1975 Annual Report from Mauch Laboratories. Copies of this report are kept at the Research Center for Prosthetics of the Veterans Administration, New York, New York.

personal and business mail. People use the aid in ways which are easiest for them, but they are reluctant to try new reading activities because at first these may be time-consuming until skill is built up. For example: when people were asked if they read directions on food packages, half of them said they had never tried it, but since they had now been told it could be done, would probably try it in the future.

People who have done the best with the Stereotoner are those who have had the time to work with it immediately after completing instruction. If they became involved in too many other activities, and gave themselves less than an hour a day in practice, their skill would diminish, and they would not be able to build it up again. Eight people thought that reading with the Stereotoner was too slow to meet their reading needs; it was easier to get material read in other ways. A Stereotoner user needs to have good auditory skill, good manual dexterity and coordination, perseverance, patience — and motivation.

Recommendations Based on Survey Responses

1. The probe should be modified so that it tilts less and is flatter on the page.
2. The “book reader” and “one line pacer” devices should be produced, and made available to present as well as future Stereotoner users.
3. More followup should be done with users so that accurate reading speeds may be obtained.
4. Followup training should be provided several months after completion of instruction so that people may have supervised exposure to the “real world of print.” During the basic course, they are too busy learning the code, and operation of the controls of the Stereotoner.
5. Techniques should be developed to encourage people to read word patterns as well as letter patterns, and ways should be found to help people relax more while reading.
6. People should be encouraged to be more venturesome in their attempts to read different kinds of material.
7. A similar survey could be made of 25 Optacon users with similar age range, occupations, and educational backgrounds.

Telephone Survey Questionnaire

(The following material includes some of the preliminary explanation, and the complete list of questions, used in the telephone survey of people known to have purchased Stereotoners, and participants in the AIR Stereotoner research and evaluation project.)

This questionnaire is designed to determine in what ways people who have the Stereotoner audible output print reading aid are using it. Instruction in the use of the Stereotoner will continue at the Hadley School. Auditory Selection Test cassettes with their instruction manuals,

and Stereotoner pre-training cassettes will continue to be supplied on request. Since these activities are no longer research, but provide information and instruction, the contract between the Veterans Administration and the Hadley School is being terminated as of September 30, 1976.

Seven areas are covered in this questionnaire: reasons for no longer using the Stereotoner, time spent in using the Stereotoner, reading tasks performed, estimate of ease or difficulty of reading tasks, maintenance and repairs, impressions of the instruction, and suggestions for improving the Stereotoner.

- I. Are you using the Stereotoner?
 - A. Yes
 - B. No
 - C. If not, please explain
- II. Estimate your time spent in using the Stereotoner?
 - A. Hours per day
 - B. Hours per week
- III. Reading tasks performed
 - A. In the home
 1. Reading typed personal letters
 2. Reading or identifying other mail such as ads
 3. Reading newsletters and pamphlets
 4. Checking typing with the paper in or out of typewriter
 5. Reading books and magazines
 6. Reading short articles in books or magazines
 7. Reading menus, bus and train schedules
 8. Reading bills and bank statements
 9. Reading directions on packages, labels on bottles
 10. Identifying currency
 11. Checking house lights
 - B. In business
 1. Reading typed business letters
 2. Reading memoranda
 3. Reading reports
 4. Reading case records
 5. Identifying file folders
 6. Proofing typing with paper in or out of typewriter
 7. Checking letterhead to see it is inserted in typewriter properly
 8. Reading and filling out forms
 9. Checking which light is flashing on multiline phone
 - C. In school
 1. Reading assignment schedules

2. Reading articles in textbooks
 3. Using card catalog in library
 4. Reading contents pages in books to tell your reader what to read
- D. Describe any other uses you make of the Stereotoner.
- IV. Describe the ease or difficulty in reading with the Stereotoner.
- A. Do you use the tracking aid on a metal surface to enable you to use the magnetic strip to keep the aid straight?
 - B. Do you use the tracking aid without the magnetic strip?
 - C. Do you read without the tracking aid?
 - D. Do you read with the magnification and lamp controls adjusted properly?
 - E. Are you able to read very large or very small print?
 - F. Do you run across much light print on dark background?
 - G. How do you handle poor quality print?
 - H. What do you look for when you encounter unfamiliar material?
 - I. Has your reading been timed within the last 6 months?
 - J. Estimate your reading speed on good quality print.
- V. Maintenance and repairs:
- A. How often has Stereotoner been repaired?
 - B. What kind of repairs?
 - C. How often has battery been replaced?
- VI. Impressions of the instruction:
- A. Were sessions too long or too short?
 - B. What could be emphasized more in the instruction?
 - C. Suggest new materials you think might be included in future course.
- VII. Suggest any improvements you would like to see in the Stereotoner.
- A. Could probe be modified? In what ways?
 - B. Should the magnification and lamp controls be in a different place?
 - C. Should the tracking aid be modified? In what ways? Mauch Laboratories has built a prototype of a "book reader" tracking aid; would this be helpful?
 - D. Do you think the tone pattern code should be changed? If so, how?
 - E. Would it be helpful to use the Stereotoner on house current?
 - F. There has been some discussion of a one-line pacer which would move the probe automatically along the line of print, but centering it on the next line would be done manually. Would this device be helpful?