

**BELL TELEPHONE LABORATORIES
INCORPORATED**

SUBJECT: Telephone Aids for the Deaf -
An Overview - Case 38794-43

DATE: January 16, 1970

FROM: C. A. Argila

ABSTRACT

This Memorandum For File is the first in a series of Memoranda documenting the author's study of the problem of deaf telephone aids. It describes the psychological problems concerned with deafness as they apply to telephone communication, actual deaf telephone equipment (both here at Bell Telephone Laboratories and elsewhere) and some recommendations for future work in this field. This work was done on an out-of-hours basis by the author because of his personal interest in the subject.

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MEMORANDUM FOR FILE

1. Introduction

Because the telephone is a device for transmitting the spoken language, those persons who are unable to hear form the only major handicap group which cannot use the telephone. A sample survey conducted by the National Health Survey in 1963 estimated the number of persons with no useful hearing ability at 1,000 per 100,000,⁶ i.e. one percent of the population, or around two million people in the United States. Considering this incidence, it appears that the Bell System has overlooked a large potential market in telephone aids for the deaf.

Because of personal interest, on an out-of-hours basis, the author recently conducted a review of what work had been done and was being done here and outside of the Bell Labs in aiding the deaf to utilize the telephone. Also, a number of deaf persons used some specific telephone aids and their reactions were solicited. It is the purpose of this memorandum to give a brief description of the results of this work. As background, a discussion is included on the condition of deafness, its distinction from mere lack of hearing ability, and how these factors affect the ability of the deaf to utilize some type of telephone communication scheme.

2. The Condition of Deafness

Contrary to popular belief, deafness involves more than merely a loss of hearing. A person who has lost his hearing before the ages of two or three years old has not only

lost his ability to hear but has lost his ability to learn spoken language, hence affecting his thought patterns (that "little voice" we think in) and presenting a serious handicap to the learning of English. A person who has lost his hearing after becoming well acquainted with the spoken language has a considerably milder handicap. We shall speak of the former person as being (prelingually) deaf and of the latter person as being without hearing (or postlingually deaf).

Because the prelingually deaf lack an acquaintance with the spoken language, their voices are often extremely difficult or impossible to understand. Knowing this, many deaf refuse to even use their voice. Furthermore, their lack of facility with English prevents most deaf from even communicating via written notes with a hearing person, each one find the others version of written English to be unintelligible. The following is a sequence from a conversation between two 13-year-old boys; it illustrates the "peculiar" structure common to the written English of most deaf:

Before I go Africa Washington drove drove on
truck bump smoke. Before I drove drove closer
destroyed tires all four destroyed. So took hot-
dogs tie a around. That I drove drove all lots dogs
chased wished hot-dogs. Drove drove arrived Washington.
Home in tree. Opened doors.

Switzer and Williams²⁰ phrase it best by saying, "These characteristics are not indicators of intellectual shortcomings. They are rather inherent in the disability." In fact, deaf children appear to have slightly higher average IQs than their hearing peers. One study⁶ cites a sample of seventeen deaf children whose IQs average 111.5.

This lack of facility with English of the average deaf person should be taken into account in designing communication aids. Deaf telephone aids which utilize some form of encoding or decoding requires a relatively high command of the English language. These aids, therefore, will be of little use to the average deaf, but perhaps quite usable to a person who has merely lost his hearing.

3. Modes of Communication

3.1 Encoding and Decoding

Encoding and decoding involves translating English into some visual form by the speaker and then decoding this by the listener. The American Manual Alphabet, for example, is a form of encoding and decoding in which each letter of the Roman Alphabet corresponds to a distinct hand position. As far as telephone communication schemes are concerned, encoding and decoding is often used; for example, Morse code flashed visually. However, except for the manual alphabet, most deaf have a strong aversion towards encoding and decoding. In a telephone conversation with Mr. G. M. Smith of AT&T Co, Mr. Arthur Jillett of the Crotched Mountain School for the Deaf states: "The congenitally deaf have already had too much of a problem learning language itself. They resist the use of any code, matrix, code book, or other additional step in the communication process. They definitely dislike Morse code."¹⁷

3.2 Lipreading

Lipreading is the art of understanding a speakers words without hearing his voice solely by watching his lip and facial movements. Nearly all deaf persons lipread to some extent. However, as Mr. E. Bloom, Jr. of the Murray Hill Labs, himself deaf from birth and an excellent lipreader, states: "Lipreading is ninety-five percent guesswork and

five percent skill." This is a result of the nature of spoken English which is not an "outside" language, such as Spanish.²⁰ Successful lipreading requires a good command of the English language, a command which is usually overestimated by the hearing speaker, as well as a good understanding of the context of the conversation.

3.3 The Language of Signs

All persons are endowed with an elaborate vocabulary of facial expressions and gestures which convey distinct emotions. Christopher Brannigan and Dr. David Humphries in Birmingham, England catalogued one hundred thirty-five such distinct gestures and expressions.²⁵ The deaf, deprived of the natural acquisition of spoken language, have formalized these signs into the "language of signs" (dactylology).

The language of signs was first formalized by Abbe de l'Epee in Paris, about two hundred and fifteen years ago. It qualifies as a language, per se, distinct from English or any other language. This is attested to be many American deaf who travel to Europe and are able to communicate quite well with European deaf via Sign Language, even though neither knows the other's "spoken" language. Sign Language is a language of ideas, not words, nor is it a word-by-word translation of English. To each sign may correspond many English words. An elementary manual on Sign Language by Riekehof,¹⁴ for example, contains over one thousand formal signs. Sign Language should not be confused with the American Manual Alphabet (finger spelling) described earlier.

4. Deaf Telephone Aid Devices

Devices to enable the deaf to use the telephone may be categorized as verbal, those devices which require the deaf user to have a relatively good command of English, and nonverbal,

those devices which do not. We shall examine these categories separately.

4.1 Verbal Deaf Telephone Aids

Verbal deaf telephone aids universally require the deaf user to translate his statement into English and code the English statement for transmission over the telephone. Similarly, to receive a statement, the deaf user must usually decode the statement as it is received over the telephone. Schemes of this sort are slow, costly on toll connections, and require a great deal of patience from the deaf user.

A simple device for sending code is the CODE-COM[®] set shown in Figures 1 and 2. It is basically a sending key and combination flashing light/tactile sensor. The deaf user sends a message with the sending key, usually via Morse Code, and receives messages by detecting the code visually from the light or tactually from the transducer. Some deaf persons were shown the Code-Com set on October 11, 1969 at a combination evaluation/demonstration; these, as well as other deaf the author has spoken with, unanimously express dislike for the Code-Com set and for Morse Code.

During the course of this study, the author spoke with a Telephone Pioneer who had demonstrated the Code-Com telephone set to a group of deaf persons. He told the author that those deaf who read lips learned how to use the Code-Com set without much trouble but non-lipreading deaf had difficulty using the Code-Com set. This is to be expected since the Code-Com set, being an English orientated device demands a high command of English from the deaf user. Those deaf who appeared to have a higher lipreading ability actually were exhibiting their better command of English which enabled them to more easily use the Code-Com set. The other deaf, who are in the majority, did not possess this command of English.

A somewhat more sophisticated verbal aid, developed by Mr. J. R. Nelson of the Murray Hill Labs, involves encoding an English message with the "Meacham Code"⁸ on a TOUCH-TONE[®] dial and decoding the message from a matrix of lights in the same configuration as the Touch-Tone dial. We have nicknamed this system "TOUCH-VU". A Touch-Vu set is shown in Figures 3 and 4 at the October 11, 1969 evaluation/demonstration; the Touch-Vu set was received with considerably more interest than the Code-Com set. With some practice all of the deaf persons present were able to send simple messages, and with considerably more trouble, receive them. Appendix I contains some simple messages sent by the deaf as they were received by a deaf person. These messages demonstrate the lack of facility with English of these deaf, as well as their attitude towards the Touch-Vu set; it was considered more of a toy than a practical communicating device. One deaf woman even went so far as to tell the author that she would like to have a device such as Touch-Vu in her home; however, when the author asked her if she would pay ten dollars per month for Touch-Vu service, she quickly changed her mind.

Mr. Nelson has improved the type of display on the Touch-Vu system to allow actual visual letter readout,¹⁰ as shown in Figure 5 and even typewriter output,¹¹ as shown in Figure 6. However, problems of encoding the message on the Touch-Tone dial still exist.

A device identical with Touch-Vu but working on the rotary dial principal was developed at New Mexico State University. This device, called "DIALCOM", is as awkward as Touch-Vu. However, an elaborate code was prepared for use with Dialcom² which enables most words and phrases to be coded by a three-digit number. For example, "beer" is coded 703,

"all right" is coded 128, etc. Certain codes correspond to word endings ("-ment" is 140) and shorter codes are used for frequently used phrases (1 is "yes" 3 is "I don't know"). The code is based on "Basic English", hence all desired statements could be phrased with it.

Another approach to verbal deaf telephone aids, and the one most commonly used by the deaf, is the teletype. One such installation in the home of Mr. and Mrs. E. Bloom, Jr. is shown in Figures 7 and 8. Because of the high cost of Bell System service, the deaf have developed their own teletype service which parallels the Bell System service. The Teletypes for the Deaf Distribution Committee of Indianapolis, Indiana aids the deaf in obtaining out-of-service teletypes; such teletypes are usually obtained at no charge from a telephone company or Western Union. Applied Communications Corporation of Menlo Park, California sells an acoustical coupler/converter (the PHONETYPE at \$239.50 plus shipping) which is used to connect the teletype to the telephone line.

To those deaf who have a good command of English and who can afford it, the teletype system is very useful. It has one drawback, however, compared with the systems previously discussed. The teletype system demands that both parties in a conversation be equipped with compatible teletype equipment. In contrast, any hearing person who has a Touch-Tone telephone may communicate, at least in emergency situations, with a Code-Com or Touch-Vu equipped deaf person, the deaf person responding with his voice. In areas where a large concentration of deaf teletype users live telephone answering services have been hired and supplied with teletypes; these answering services now provide an interface between the deaf teletype user and a hearing person with a conventional telephone.

A compromise between the Code-Com/Touch-Vu systems and the teletype system is the so called "Poor Man's Teletype" by Mr. J. R. Nelson. The "Poor Man's Teletype" uses a commercial portable electric typewriter, actuated by a Touch-Tone decoder according to Meacham's Code. It can also send sequences of Touch-Tone signals to print on a receiving typewriter. Hence, deaf persons equipped with the "Poor Man's Teletype" can communicate with each other exactly as with standard teletypes, but now a hearing person with a Touch-Tone telephone can print a message onto a deaf person's teletype, receiving a response from the deaf person with his voice. For this reason, as well as its lower cost, the author considers the "Poor Man's Teletype" to be a better deaf telephone aid than a teletype.

4.2 Nonverbal Deaf Telephone Aids

With the exception of one application of PICTUREPHONE[®] communication, the deaf telephone aids discussed below might be considered as verbal, rather than nonverbal. However, we have included them here because they require no explicit encoding or decoding process.

The first nonverbal technique is the so called "visual speech" in which a visual display, usually an oscilloscope or spectrograph, is used to display spoken speech. In general these devices require extensive training on the part of the deaf user to even establish a minimal vocabulary under laboratory conditions; actual usage under "rapid fire" conversation conditions is even more difficult. If the deaf person cannot use his voice, "visual speech" is even less useful for a telephone conversation. In cases where the deaf person can use his voice a simple application of visual speech has been found useful.¹⁶ An oscilloscope is connected to the telephone so that

the deaf user can see the speech patterns produced by the hearing party. With some training, the deaf user can distinguish between the words "yes", "no" and "maybe" by their patterns on the oscilloscope screen. The deaf user can now engage in a simple conversation by means of a "Twenty Questions" scheme. For example, when receiving a call, the deaf user might reply:

 Hello, I am totally deaf, but I have a device which enables me to see the words "yes", "no" and "maybe." Please respond to my questions with one of these words.

 Do you wish to continue this conversation?

·
·
·

The Code-Com set has a small light which is modulated by the speech of the other party. In theory, the deaf user can use this light to distinguish between "yes", "no" and "maybe." However, the October 11, 1969 evaluation/demonstration did not establish this.

Picturephone service has the potential of being a very useful telephone aid for the deaf. On October 29, 1969 Mr. and Mrs. E. Bloom, Jr., both congenitally deaf, participated in an evaluation of Picturephone (Mod II) service. The evaluation was concentrated on lipreading and using signs. Figure 9 shows the Picturephone service in use. Figure 10 shows the clarity of Picturephone transmission. The resolution on the Picturephone set was adequate for lipreading. However, as would be expected, the deaf users preferred to use Sign Language (Figure 11); again the resolution on the Picturephone system was no deterrent to communication.

A demonstration of Picturephone (Mod I) transmission on long distance connections was made on December 14, 1968,

between groups of deaf persons in Chicago, New York City and Washington, D. C. in conjunction with the New York University Center for Deafness Research.²⁴ Their findings correspond with the authors. Dr. Edna Levine, their director, states that "...for the thousands of deaf and hard of hearing persons in this country...a new dimension for communications has been achieved."

At the October 11, 1969 evaluation/demonstration of the Code-Com and Touch-Vu sets, questionnaires were distributed to the deaf present requesting their comments and suggestions for future telephone aids for the deaf. Though no mention was made of the Picturephone system, nearly all the replies contained a reference to a visual-type aid. A sample of these questionnaires are included in Appendix II.

5. Weakness of Present BTL Work

The review of work at Bell Labs pointed out a need for more effective work to enable the deaf to utilize the telephone. Today:

- a.) No one department or person is in charge of research, development or coordination of deaf telephone work, or, for that matter, any special telephone work for the handicapped.
- b.) It is nearly impossible to determine what work is being done on deaf telephone aids. An excellent memorandum by C. D. Stockbridge, "Medical Work at Bell Telephone Laboratories - Who's Doing What,"¹⁹ provides some coverage, but being dated August 1, 1968, it is of limited usefulness.
- c.) The persons directly involved with development of deaf telephone aids appear to be not completely aware of deafness as a psychological condition as opposed to loss of hearing as a physiological con-

dition. Consequently, the few deaf telephone aids being developed are not as useful as they might be for the average deaf.

- d.) The most useful deaf telephone aids being employed today are renovated teletypes, and these are of use only to a minority of the deaf population. Furthermore, this project is not sponsored by the Bell System.
- e.) The deaf telephone aid, the Picturephone system, is, it appears to the author, being developed without sufficient consideration of the psychological considerations of deafness and how the deaf Picturephone user will interface with the Picturephone system.

For the deaf to realize the full potential of Picturephone service, questions such as the following must be answered: How will the deaf user place person-to-person or collect calls? How will the deaf user be informed of the progress of his call (ringing signals, busy signals, etc.)? How will the deaf user communicate with an assistance operator? In areas where there is a large concentration of the deaf, can the deaf user obtain assistance from an operator familiar with manual communication? Perhaps interactive displays can be provided in lieu of an assistance operator. Mr. J. J. Horzepa⁴ proposes a system for interactive alphanumeric display of Picturephone services and features; this is a beginning, but it should be developed with the deaf user in mind.

6. Conclusions

The condition of deafness is psychological as well as physiological. In designing telephone aids for the deaf, the psychological factors must be incorporated. Systems of encoding and decoding will not, in general, be accepted by

the majority of the deaf. Teletype is a good aid, particularly the "Poor Man's Teletype" of Mr. J. Nelson, for those deaf who have a high enough command of English to converse fluently in the language. Video telephoning is an excellent telephone aid for the deaf. It enables the deaf to lipread or use Sign Language fluently. It is the only aid which provides the deaf with the fluency and intimacy in communication which they desire. The usefulness of the Picturephone system to the deaf could be further increased if the needs of deaf users were given greater consideration during the Picturephone system design.

7. Recommendations

The author feels that steps could be taken to help the Bell System better meet the communication needs of the deaf. These are:

- a.) That a committee be established to advise the Bell System on telephone aids for the deaf. Members of this committee should come from the deaf community itself.
- b.) That one organization be assigned responsibility for coordinating all Bell Labs work on communication aids for the deaf.
- c.) The "Poor Man's Teletype" be considered for adoption as the Bell System Standard for "Teletype Style" telephone aids for the deaf.
- d.) That the needs of the deaf user be given greater consideration in the planning of Picturephone service.


C. A. ARGILA

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See next page

Att.

Figures 1 to 11

Appendix I

Appendix II

Bibliography

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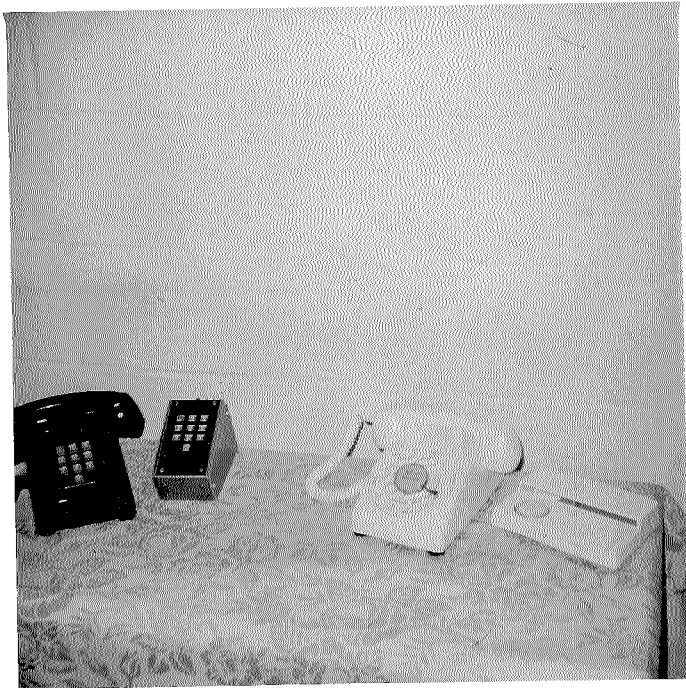


Figure 1 - CODE-COM Set



Figure 2 - CODE-COM Set in Use



Figure 3 - TOUCH-VU Set



Figure 4 - TOUCH-VU Set in Use

15
105



Figure 5 - TOUCH-VU Set With
Alphanumeric Display

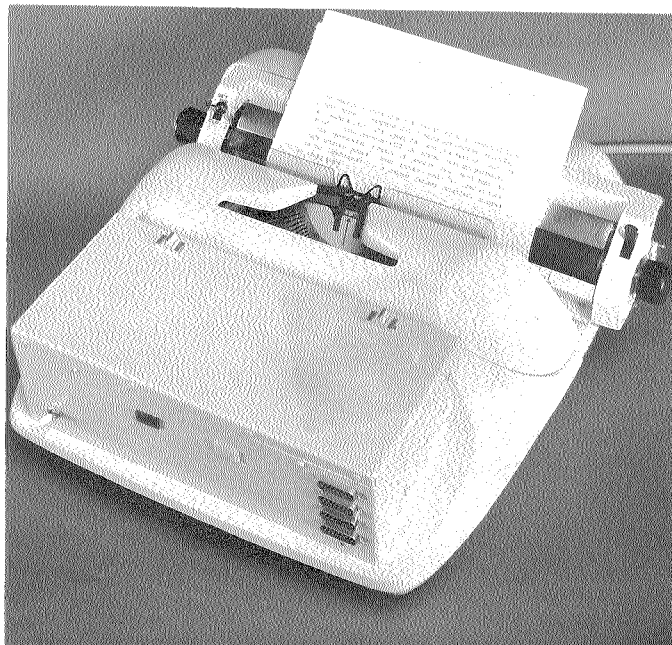


Figure 6 - TOUCH-VU Set With
Typewriter Display



Figure 7 - Typical Teletype
Installation

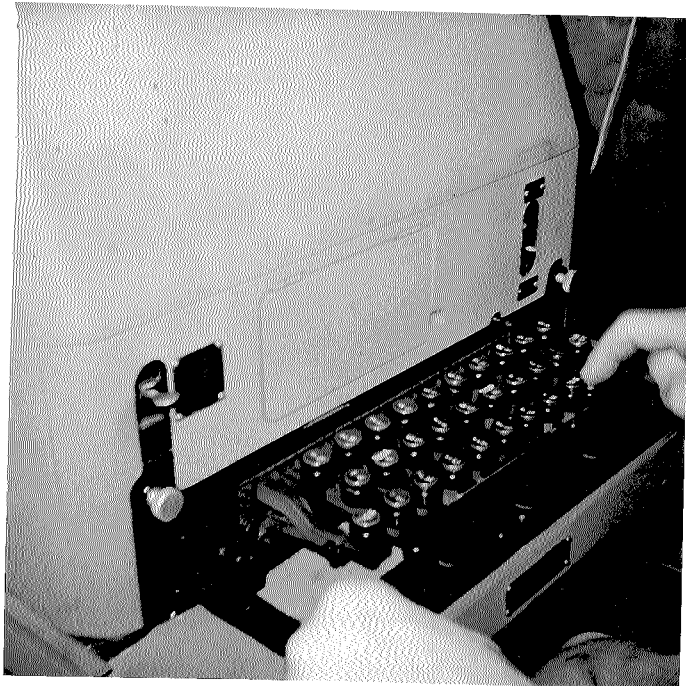


Figure 8 - Teletype Keyboard



Figure 9 - Mr. and Mrs. E. Bloom, Jr.
Communicating on PICTUREPHONE



Figure 10 - Lipreading on PICTUREPHONE

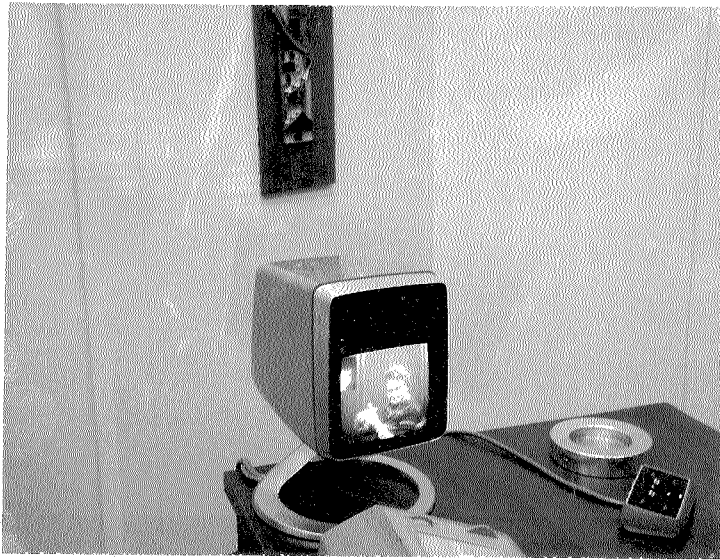


Figure 11 - Using Sign Language
on PICTUREPHONE

25
135

Appendix I - Sample Messages Sent With
the "TOUCH-VU" Set on October 11,
1969 Demonstration.

Hello
Robert,

You looks
like a griffe

Do
you

Have
a girl
FRIEND

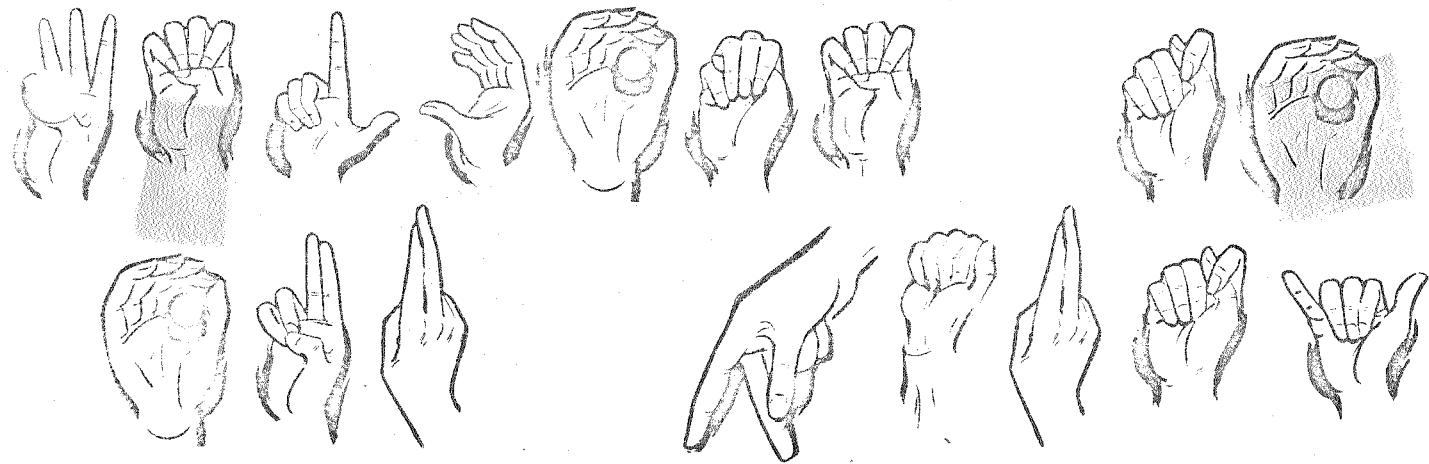
HOW

A

HOW
ARE
YOU

Hello/ SKUNK
Have/ how/ are
you/ been?

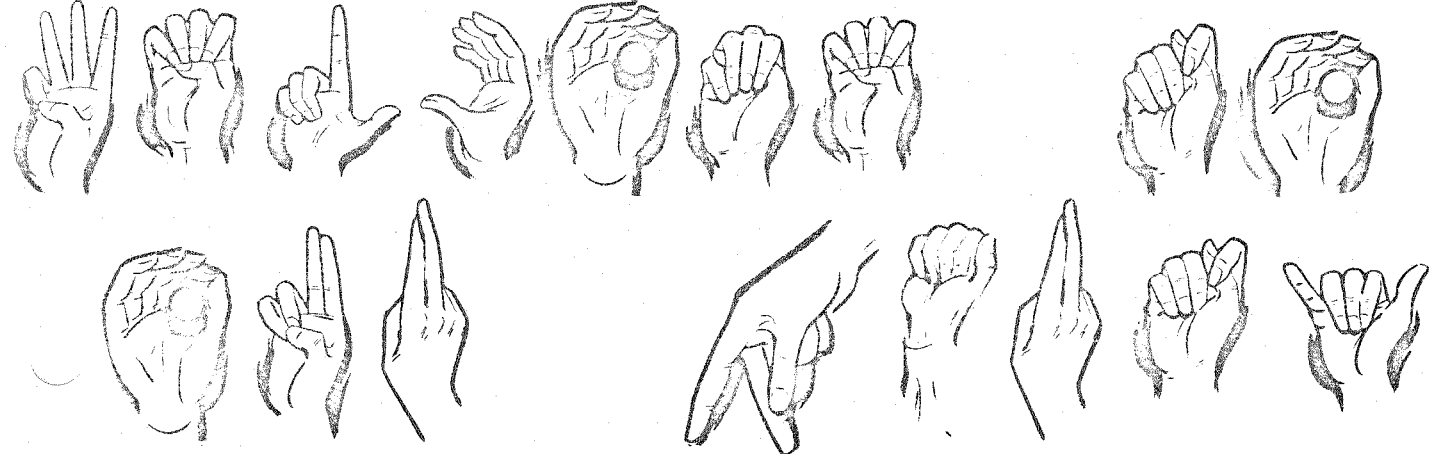
Appendix II - Sample
Questionnaires from October 11, 1969
Evaluation/Demonstration



dw

The telephone equipment which you will see demonstrated here this evening is highly experimental and cannot be obtained from your telephone company...So PLEASE DON'T CALL THE PHONE COMPANY (thank you). However, your suggestions and comments are welcomed. Please tell us what you think of these two telephones (Touch-Vu on the left, Code-Com on the right). Maybe you'll see your idea at our next demonstration! Please write your remarks below; Thank you.

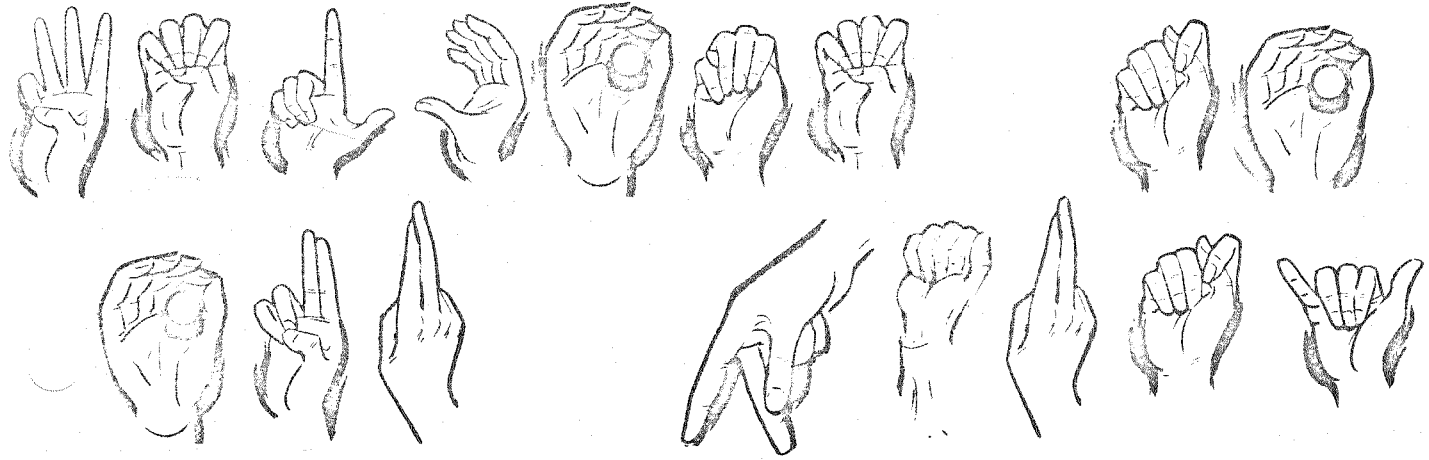
I am idea we can call to a deaf person on G. V. picture. We can see her to talk together.



dw

The telephone equipment which you will see demonstrated here this evening is highly experimental and cannot be obtained from your telephone company...So PLEASE DON'T CALL THE PHONE COMPANY (thank you). However, your suggestions and comments are welcomed. Please tell us what you think of these two telephones (Touch-Vu on the left, Code-Com on the right). Maybe you'll see your idea at our next demonstration! Please write your remarks below; Thank you.

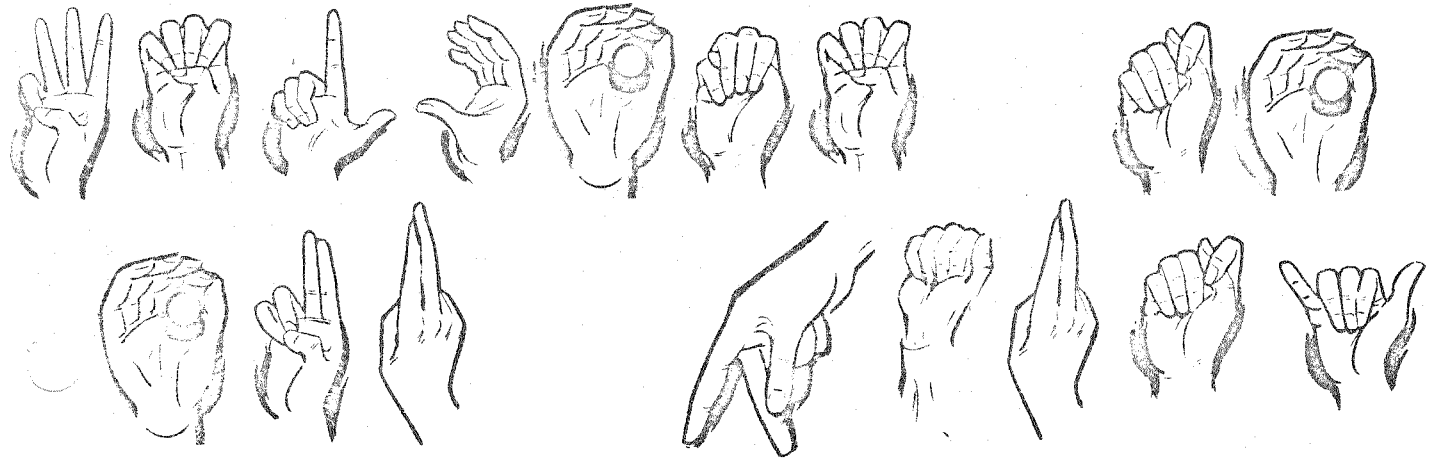
Good idea to have T.V. telephone because a person on T.V. will understand better with sign language.



dw

The telephone equipment which you will see demonstrated here this evening is highly experimental and cannot be obtained from your telephone company...So PLEASE DON'T CALL THE PHONE COMPANY (thank you). However, your suggestions and comments are welcomed. Please tell us what you think of these two telephones (Touch-Vu on the left, Code-Com on the right). Maybe you'll see your idea at our next demonstration! Please write your remarks below; Thank you.

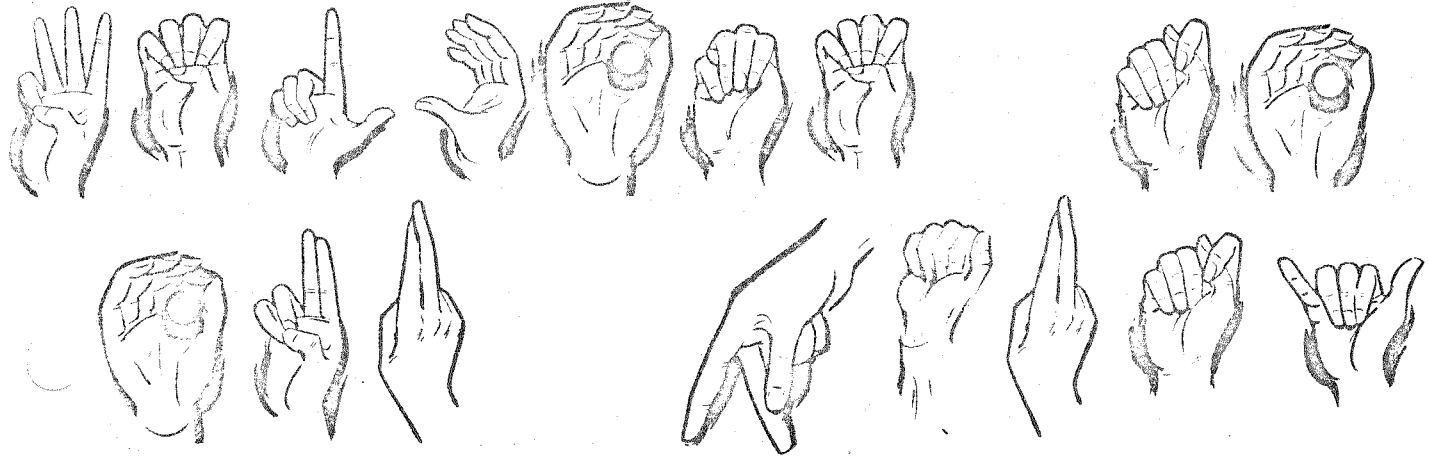
I'm a good idea. The deaf people call to deaf people on (television) at ^{of phone} sign of languages and they could understand clearly on television of I wish we will require ^{phone} about them near future.



dw

The telephone equipment which you will see demonstrated here this evening is highly experimental and cannot be obtained from your telephone company...So PLEASE DON'T CALL THE PHONE COMPANY (thank you). However, your suggestions and comments are welcomed. Please tell us what you think of these two telephones (Touch-Vu on the left, Code-Com on the right). Maybe you'll see your idea at our next demonstration! Please write your remarks below; Thank you.

Watching - Person Picture TV, with 200005 SIGNS
Present uses my hand language sign, with TV picture
talk 1971.



dw

The telephone equipment which you will see demonstrated here this evening is highly experimental and cannot be obtained from your telephone company...So PLEASE DON'T CALL THE PHONE COMPANY (thank you). However, your suggestions and comments are welcomed. Please tell us what you think of these two telephones (Touch-Vu on the left, Code-Com on the right). Maybe you'll see your idea at our next demonstration! Please write your remarks below; Thank you.

*idea, that telephone with on
Television and talk can't
sign see man on T.V.*

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