Research and Development of a Versatile Portable Speech Prosthesis

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Research and Development of a Versatile Portable Speech Prosthesis

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Summary

The Versatile Portable Speech Prosthesis (VPSP) is a synthetic speech output communication aid for non-speaking people (see Figures 1-2). It was intended initially for severely physically limited people with cerebral palsy who are in electric wheelchairs. Hence, it was designed to be placed on a wheelchair and powered from a wheelchair battery. The VPSP has been dubbed the "Talking Wheelchair," though the name is misleading because it can easily be separated from the wheelchair.

The VPSP is "versatile" because it is designed to accept any means of single switch, multiple switch, or keyboard control which physically limited people have the ability to use. It is "portable" because it is mounted on and can go with the electric wheelchair. It is a "speech prosthesis", obviously, because it speaks with a synthetic voice for people unable to speak with their own voices.

The advantages of speech have been eloquently expressed by Michael B. Williams, a writer with cerebral palsy and a disabled people's rights activist:

Advantages of Speech Output Devices Over Communication Boards

* The "speaker" need not be physically close to the "listener" to transmit a message.

* The "speaker" can communicate:
  **when the "listener's" back is turned.
  **when the "listener" is in another room.
  **with a group of people.
  **with people who have vision problems.
  **with people who have difficulty reading.
  **with small children.
  **in the dark.
  **words he/she can't spell.

* The "speaker" can make up his own "fun" or "crazy" words.

* The "speaker" can create "throw-away" lines for future use quickly in conversation.
SUMMARY

The project was initiated in May 1978 and completed in November 1981. One prototype unit was built and tested with users and avenues were pursued by which to make the results of this research available to the user population.

This report will explain how the project developed, how it was conducted, the results of testing with users, and future plans.

The VPSP Research Team, as listed on the title page, acknowledges important contributions by other people to this project. Donald Vargo from NASA Headquarters in Washington, D.C. helped to acquire funding, initiate the project, and assist its progress through completion. Joseph Traub of National Institute of Handicapped Research (NIHR) was supportive of the project and encouraged clinical evaluation using NIHR funding. Alfred Lubienski of Votrax in Troy, Michigan was very supportive of the overall effort in improving synthetic speech applications technology for non-vocal people, donated Votrax equipment to the project, and has maintained active interest in its progress.
Figure 1.
VPSP showing CRT in front and CPU, speech synthesizer, and wheelchair battery in rear. Typical single control switch is on seat of wheelchair.

Figure 2.
VPSP showing Everest and Jennings Model 3P Electric Wheelchair on which components have been placed.
Background

Various estimates (Bureau of Education for the Handicapped, 1976; Firing, 1978; National Academy of Sciences, 1971; National Center for Health Statistics, 1971; National Institute of Neurological and Communicative Disorders and Stroke 1976; Rehabilitation Engineering Center U. of Va., 1978; Shanks, 1960) suggest that there are about two million people in the U.S. with speech impairment, or about 1% of the total population. The number of people requiring communication aids or speech prostheses is difficult to assess from the available information. Estimates of the number of those with a serious or disabling speech impairment range from roughly 200,000 to 1 million, or .01 to .05% of the total population. While there are a number of communication aids with visual and printed outputs, speech can provide faster and more efficient communication, easier group or classroom participation, telephone conversation, the ability to communicate with children who cannot read, a way to interrupt or initiate communication and the psychological benefit of being able to speak.

Some commercially available devices offer speech capability, but they all have major failings:

* The vocabulary is limited to pre-stored words or phrases, which limits a user's conversation.
* User-created vocabulary items cannot be stored when the aid is turned off.
* Phoneme-programmable speech synthesis requires extensive user training in order to achieve intelligible speech.
* Message construction for those individuals that cannot use keyboards is painfully slow and frustrating.

Beginning in 1974 the Man-Machine Integration Branch (now the Man-Vehicle Systems Integration Division) of the Ames Research Center, National Aeronautics and Space Administration conducted extensive psycholinguistic human factors research on applications of synthesized speech in airline cockpits. Transfer of this technology to solve the communication problems of the non-vocal appeared promising. Research and patient services at the Rehabilitation Engineering Center, Children's Hospital at Stanford, are aimed at providing technology to augment the capabilities of multiply involved, severely physically disabled persons.
BACKGROUND

Accordingly, Children's Hospital at Stanford submitted a proposal to NASA-Ames and received a grant in April, 1978 to research and develop a prototype device that would meet the objectives desired.

A team was assembled, consisting of Maurice LeBlanc of the Rehabilitation Engineering Center of Children's Hospital at Stanford; Charles Lingel, Consultant Engineer; Dr's Carol Simpson and Douglas Williams, of Psycho-Linguistic Research Associates (PLRA); and Dr. Gene Schmidt (later replaced by Mr. Gary Steinman) and Luke Brennan of the Stanford Biomedical Applications Team.
Objectives

The goal of this project was to develop and test a VPSP for use by severely motor-impaired, non-vocal people. The original proposal (Children's Hospital at Stanford, 1977) listed the project objectives as:

* The vocabulary will be easily programmable by the naive user.
* The user will be able to store, retrieve, and edit his/her own vocabulary.
* The intelligibility of the speech will be improved.
* There will be a user control interface to allow operation by severely physically involved people.
* It will offer advancement toward:
  # Providing the voice prosthesis with some "linguistic competence" so it can anticipate message phonology and syntax.
  # Making the voice prosthesis more interactive with the user.
  # Making the prosthesis tolerant of user errors, so as not to waste the user's time.

Design of the original version of the VPSP was completed in May 1979. Additional user controls were added by November 1979. The final VPSP features which are significant advances are:

* Speech output from normally-spelled English text.
* Enabling the user to create, store, retrieve, and edit his own vocabulary.
* Improvement in the intelligibility of the speech over any synthesized speech communication aid commercially available.
* Choice of user controls, and standard plugs and software interface to make changing controls a plug-and-go operation.
* Providing the voice prosthesis with some "linguistic competence" so it can anticipate message phonology and syntax, thereby increasing communication speed.
* Making the voice prosthesis tolerant of user errors. It is highly interactive, allowing optional automatic verification, and several choices of error removal.
Approach

The task of designing the software for the VPSP was intimately entwined with the user's capabilities. The interface between the VPSP and the user had to be designed in a way that would make it easy for the user to learn to operate the device and that would maximize speed of communication. The speed problem was especially important for the 1-switch users that the VPSP project initially addressed. The task was made more difficult by the fact that the very people who could best tell us how they wanted the device designed could not do so because of their inability to speak. The solution to this problem lay in assuming that there would be great similarity in the perceptual and cognitive functioning of the 1-switch, non-vocal population and the able-bodied population. Basic principles of good human factors design, taken from the literature, were simply applied to the VPSP design. Examples of these principles are:

* Immediate, unambiguous feedback by system to user's input.
* Consistent ordering of command sequences, of elements in visual displays, and of system behavior to user inputs.
* Consistent, unambiguous meaning for special symbols.
* Elimination of computer jargon—operations are named in familiar terms.
* Elimination of linguistics jargon—language elements are named in familiar terms.

It was decided to use a cathode ray tube (CRT) display as the means for the VPSP to "communicate" with the user. The CRT was chosen for its flexibility in display layout and alteration, despite the disadvantages of large size, power consumption, and fragility.

A search of the literature revealed a dearth of experimental data on user performance pertaining to the design of visual displays of any sort for use in x-y scanning display and control systems. Some considerations are obvious from the mathematics of the x-y scan operation. However, questions regarding the arrangement of letters and words within the matrix could not be answered from available literature. Thus, it was decided to perform some short experiments to resolve these questions.

Page Layout Research and Design: Able-bodied individuals served as subjects in a set of psycho-linguistic experiments that compared different formats for the display of visual information to the user, with the displays being simulated with printed sheets of paper. Certain principles
of psycholinguistic design, derived from this research (see Simpson, et. al., 1979 and Simpson, 1980) were then used to guide the VPSP design for the 1-switch and joystick versions. Visual search time for words in a row/column layout was found to be faster with a syntactic layout than with layouts arranged alphabetically, by word frequency of usage, or randomly. As used here, syntactic layout has the words arranged in columns by syntactic category and these columns ordered according to syntactic surface structure order. The experiment on visual search times for layouts of letters for spelling new words compared alphabetical to grapho-phonotactic layouts. Grapho-phonotactic layouts are analogous to syntactic layouts in that letters are arranged in columns according to their position category in the spelling of English syllables with the columns ordered from left to right according to orthographic (spelling) surface structure order. The position categories and rules for orthographic surface structure order were derived from the work of Benjamin Whorf (1940) and translated from Whorf's phonemic analysis into a corresponding orthographic analysis.

Secondary variables studied in the second experiment were letter clusters, affixes, and boxes around categories. (See Simpson, 1980 for details) Results of the experiment showed alphabetical layout to be faster than the syntactic analog of letter layout, which we are calling grapho-phonotactic layout. Also, displays with letter clusters resulted in longer search times than those with single letters. However, actual users of the 1-switch VPSP greatly preferred the grapho-phonotactic layout, and also found it slightly faster than the alphabetical layout. It should be noted that visual search time for a desired item is only part of the time required to retrieve that item when one is using an x-y scanning system. The number of scanning moves of the cursor for spelling words is smaller for the grapho-phonotactic layout than for the alphabetical layout. This feature probably explains the user's preference for the grapho-phonotactic layout.

Page Hierarchy Research and Design: As with page layout, there were many questions regarding the best hierarchy for the display pages in terms of the paths the user could take to get from one page to another. Accordingly the software was designed to be extremely flexible so as to permit easy restructuring of page hierarchy during the course of tests with actual users.

For the initial design, the page hierarchy was organized according to a simple syntactic surface structure similar to the early, phrase structure (pre-transformational) grammar proposals of Chomsky (1969). Separate pages dealt with declarative sentence structure,
and interrogative sentence structure, noun phrases, verb phrases and various semantic categories of words. In accordance with human factors principles above, the pages were given familiar terms as names — "words that name things," "action words," "make a new phrase," "ask a question." From the "make a new phrase" page the user could go directly to the "words that name things" page without going back to a main menu page — the "table of contents" page. From the "words that name things" page, the user could go directly to a page with a particular semantic category of nouns or adjectives, say "places" or "food" or "names of people", or "kind-of words". The VPSP kept track of the user's path through the pages, remembering up to 10 previous pages, in order. When the user had finished with a special purpose page, e.g. "words that name things", he or she had only to use a VPSP command called "return to previous page" in order to be returned to the page that held the words needed to continue with the general sentence type (declarative or interrogative) that was under construction. The diagram in Figure 7 illustrates this phrase structure style of page hierarchy. An arrow from one page to another indicates that one can go directly from one to the other in the direction of the arrow and be automatically returned to the first using the "return to previous page" command.

Observations of frequency of "page" usage by users showed that very few of the special purpose semantically organized "pages" provided were used often enough to warrant their inclusion in a production VPSP. Overlapping semantic categories for many frequently used words required duplication of a given word on several pages in order to make it easy to find. As a result of this observation, most content words - nouns, adjectives, adverbs, and verbs - were placed in a large, alphabetically ordered "dictionary" comprising 25 "pages" with a total of 925 words. The dictionary was developed by analyzing several lists of frequently used words taken from written, conversational, and basic daily living vocabularies (Kucera and Francis, 1967; French, Carter, and Koenig, 1930; and Bliss, 1975). The only semantically-based "pages" that were retained in the final VPSP were calendar words (days of the week, months), numbers, time words (before, after, until ...), and places (closet, living room, kitchen, museum, hospital ...). In contrast to the semantically based pages, users made extensive use of the syntactically based pages for making declarative statements, asking questions, possessives, connector words (of, and, but, or, perhaps, maybe, in, the, a, this ...). Also frequently used were the morphologically based pages for suffixes - one for prefixes and one for endings. The dictionary and the grapho-phonotactic spelling pages were also used extensively.
The observations of experimental results, then, determined the following VPSP software design features:

* For those versions that use indirect selection via a single switch or a joystick, letters on the spelling page are arranged grapho-phono-tactically.
* Layouts of words on sentence construction pages and the links among pages are syntactic rather than alphabetical or semantic.
* The dictionary is alphabetical.

Except for the dictionary pages, words and phrases on most pages are grouped by syntactic category. But the syntactic structure of the page hierarchy is far simpler than even the simplistic phrase structure proposed by Chomsky. (Figure 4 illustrates this). The early hierarchical structure was compared to the final one in terms of longest switch closure distance between any two pages. Since 1-switch users get from one page to another by closing a switch when the cursor gets to the page they want (see section on VPSP Software below), the number of switch closures to get to a page, i.e. the switch closure distance to the page, is an indicator of time and difficulty to get to that page. It was found that the early structure had several pages that were as many as eight switch closures away from some of the other pages; in contrast, the maximum number of switch closures between any two pages in the new layout is four with the exception of the user's own text pages. The text pages can be from 2 to 6 switch closures away, depending on the user's position in the structure. In addition to the shorter switch closure distance between pages, the final version has more pages and more pre-spelled words than the original version of the VPSP. Thus there were multiple benefits of simpler hierarchical structure. A list of the final pages is shown on page 13.
PARTIAL DIAGRAM OF ORIGINAL
1-SWITCH VPSP PAGE HIERARCHY

* TOC

* A * in front of a page name means that you can go directly to that page from any other VPSP page.

→ User can go from one page to the other in direction of the arrow and can return to the original page using the *return command.

Figure 3.
* A * in front of a page name means that you can go directly to that page from any other VPSP page.

User can go from one page to the other in direction of the arrow and can return to the original page using the * return command.
List of Pages for 1-Switch and Joystick VPSP

Startup
Table of Contents #1
Table of Contents #2
Ask a question
Useful phrases
Make a new phrase
Spell new words
Connectors (this, and, but, of, some...)
Places
Acts (get, go, make, give, want...)
Time words (then, later, since...)
Calendar

Sound spelling
Prefixes for words
Endings for words
Possessives (my, his, our, your...)
Numbers
Dictionary
Directions to use talking wheelchair

20 blank user pages, each renameable by the user (each can hold 14 lines)
25 dictionary pages, each with 37 words
9 text pages, user programmable up to 512 characters
Research and Development for Keyboard System: It was assumed that keyboard users should have available the same sorts of functions provided by word processing software - insert and delete characters anywhere within the text, cursor movement in four directions, text displayed in multiple lines rather than just one line at a time. These functions were provided. An initial command syntax using labeled function keys for going to pages by name and clearing parts or all of a page was developed. This keyboard version was used in the evaluation with users described later. During that evaluation, all keyboard users and most of the experimenters, including the authors, were observed to repeatedly make the same mistakes in the order in which they used the function keys to go to new pages. So, after the evaluation, the command syntax was changed to make the "mistaken" order be the correct order for using the function keys. A pilot study with one keyboard user who had not been in the original evaluation and who, therefore, had equal exposure to each version of the keyboard system, showed a 22% to 58% reduction in time required to perform the various functions with the new version. He also expressed preference for the new version over the old version for all the functions tested - going to a new page, finding an existing page, and clearing a page. Although further testing of the keyboard system would have been desirable, time and project funds did not permit this.
The VPSP is a prototype device constructed mainly from off-the-shelf components. Its major technological contributions are in the area of human factors design. For research and development purposes it was designed to be portable on a standard electric wheelchair, and to be powered for several hours operation by the wheelchair batteries. Wheelchair mounting was chosen as a design factor because the majority of the target user population were so severely disabled that they would be confined to a wheelchair in any case. The device proved to be so useful that ambulatory patients often used it, and the wheelchair was a hinderance. The actual prosthesis has no requirement for wheelchair mounting if it were redesigned to optimize it for hand-portable use. A commercial version would be expected to be independent of a wheelchair. It was designed so that any of the user controls could be changed in seconds. Currently available controls include several varieties of single-switch, a joystick, a five-switch slot control, and a keyboard.

The hardware consists of a standard S-100 cardcage, a Cromenco Z-80 CPU, 16K of RAM, a 12cm (5 1/4") floppy disk drive and controller, and a custom video and memory-mapped synthesizer interface. This is all enclosed in an aluminum box and fits on the standard mounting brackets on the back of an Everest and Jennings wheelchair. The speech synthesizer is a Votrax ML-1, repackaged to reduce its size and to provide for battery power. The video display is a standard Hitachi 12cm (5") TV, modified for direct video input and located in any of several mounting spots, depending on user preference. The speaker is Radio Shack 12cm (5") unit in an 18mm (3/4") plywood box mounted on the side of the wheelchair. (See Figure 5-6).

The single switch and the joystick inputs are memory-mapped, and the keyboard is interfaced via a standard TTL parallel port. The hardware was distributed around the wheelchair so as to maintain the balance and function of the wheelchair as much as possible. This objective seems to have been accomplished, for in the user evaluation trials, the VPSP was used at schools, at parties, in user's homes, and transported in buses, vans, and pick-up trucks without damage or problems. Further hardware details and photographs are included in LeBlanc, et al. 1980, and Simpson, 1979. An operation manual for the system is included as Appendix V of this report.
Figure 5.
VPSP Components: (A) computer, (B) speech synthesizer, (C) speaker, (D) CRT (standard Hitachi TV), (E) keyboard, (F) on-off switch, (G) wheelchair joystick control. Single switch and joystick controls for VPSP not shown.
User Controls:

Single Switch

Joystick

5-slot

Keyboard

Z-80 Computer
16 K Memory
Disc and Video Interface

5" Disc
(Long-Term Storage)

CRT
(Modified 5" TV set)

Votrax Synthesizer

Speaker

Figure 6.
VPSP System Block Diagram
Software

The VPSP software is modular. The various modules are combined into three different versions of the VPSP for varying degrees of user physical ability. These are 1) single switch, 2) joystick, and 3) keyboard. All three versions have in common the system boot, disk I/O, video I/O, and text-to-speech routines. Each version has its own user interface control driver. The single switch and the joystick versions have a common set of display "pages" (files) with user commands, pre-spelled words, and phrases to save time during text creation. A spelling page with individual letters and punctuation marks provides for unlimited message creation. In the keyboard version, the display pages are blank until written upon by the user via the keyboard. All three versions have some pages reserved for operating instructions, and all three versions provide message editing and storage commands along with the "talk" command. Each of the three versions is linked from appropriate modules and loaded onto one side of a floppy diskette, along with the "pages" (files) appropriate for that version. Each version, including the text-to-speech routines, occupies less than 16K of RAM. 60K of the available storage on the diskette is used for "page" (file) storage, less than 16K for program, and less than 1K for the system boot routine.

Single-switch system operation: A single button turns on the system, and a "startup" page is presented which gives the user a choice of eight cursor speeds, and a choice of verify "on" or "off", an option which is useful to those with poor controllable movements. When both choices have been made, the "Contents" page is displayed. This gives the user single-switch-closure access to a 925-word dictionary, a spelling page so he can make new words, a "numbers" page, a "calendar" page, pages of prefixes, endings, connectors, possessives, actions, times, places, and user-definable blank pages. If he wants to speak a pre-stored phrase, he merely selects the appropriate page, the line he wants to speak, and the "talk" command; the phrase will be spoken immediately. If he wishes to add to a stored phrase, or concatenate stored phrases, that is easy also. Any words or phrases he constructs may be stored on diskette by simple commands.

Joystick system operation: To switch to the joystick system, one changes the diskette and plugs a joystick, essentially four directional control switches and one selection switch, into the port previously occupied by the single switch. The joystick version is much the same as the single switch, except the "startup" page only presents the "speed" choice, which selects how fast the cursor moves when the joystick is held in one direction. The joystick can also be stepped from one item to the next. The pages are all the same as the single-switch version, but of course the cursor moves only under user control via the joystick. It can be operated much faster than the single-switch version, if a user has the ability to control a joystick. (See Figures 7-9).
Figure 7.
Table of Contents page for single-switch and joystick versions of VPSP.

Figure 8
Make-a-new-phrase page for single-switch and joystick versions of VPSP.

Figure 9.
Main dictionary page for single-switch and joystick versions of VPSP.
SOFTWARE

Keyboard system operation: The keyboard system is enabled by plugging in the keyboard and replacing the floppy disk. On system startup, it shows an alphabetized list of all existing pages. A page may be selected by typing its name and hitting the "GO" key. Any page may be spoken by hitting a "talk" key. The usual wordprocessing features (insert, delete, cursor move) are available for changing text on the screen. All commands are usable one-handed, or with a headstick. (See Figures 10-12).

All three versions adhere to some basic principles of human factors for software design. The user is always given feedback regarding system status. Error messages are explanatory, helpful, and friendly. Command syntax is designed according to the way users think it should be, not the way the designers (the authors) originally thought it should be. Nothing the user can do using the controls can hurt the system.
Figure 10.
A typical Table of Contents page for keyboard version of VPSP.

Figure 11.
A short message page from a user of keyboard version of VPSP.

Figure 12.
A larger message page from a user of keyboard version of VPSP.
Clinical Evaluation

An essential part of the approach to the project was an objective evaluation of VPSP with several users, to insure that it was easy to use and effective. Funding was obtained from National Institute for Handicapped Research NIH Grant G008005817 to Children's Hospital at Stanford, Rehabilitation Engineering Center to perform a clinical evaluation of the VPSP. Handicapped persons, ranging from institutionalized severely impaired cerebral palsy patients to ambulatory stroke victims were asked to help and were paid a small honorarium. They each were given a maximum of two hours training, and sent home with the device for a week. Measurements of communication speed were taken, and all users answered questionnaires about the device. The results from five subjects were reported in the progress report, (LeBlanc, et. al, 1960) and are summarized in Figure 13. A sixth used the VPSP extensively after that report, and her results are reported in Appendix I. All users felt that the VPSP was a great help to them.

The communication speeds are given in words per minute to facilitate comparison with other data in the literature. It is important to note that the speed to construct test messages on demand measures only a part of the entire process which we shall call "communication of intentions". It starts by giving the user a simulated intention (or thought) to communicate, namely the test message. The listener (experimenter) is already present and attending to what the user is about to communicate. The message is constructed in any of several possible ways, all of which affect the message construction time. Slowest will be messages which must be spelled out letter by letter. Fastest will be messages which the user happens to have previously composed and stored in the system (if the system permits this). The test messages used for comparison of VPSP to "own system" were partly of the first type. Others made use of some of the pre-spelled words on the VPSP pages. In one case, the entire message was present on a page of "useful phrases". For any subject, the range of words per minute varied by at least a factor of four for short sentences depending on how much of the message could be composed from words that were already on the pages. This effect was also present for systems such as word boards that contained words as well as letters, although word boards cannot hold anything close to the more than 1000 pre-spelled words in the VPSP. The words per minute data given here can be used to determine how fast the particular VPSP users in this study could compose new messages, after using the VPSP for a week. They have no bearing on the words per minute rate for messages the user has composed at leisure and then stored for later retrieval and talking.

For the 1-switch version, a speech of 500 words length retrieved in 27 seconds at VPSP speed 5 (one cursor move per 0.85 sec) and then spoken in real
time at a speech rate of 125 words per minute results in an actual communication speed of 112 words per minute.

Nor can the comparative words per minute data allow us to compare the times it would take a VPSP user to communicate an intention using his or her "own system" versus the VPSP. Consider the individual who wants to ask to have a friend over for dinner and has to do this with a wordboard. How long does it take from the time this wordboard user thinks about wanting to make this request to the time that another individual realizes there is something the wordboard user wants to say? This time must be added to the total time for communication of intention. With the VPSP the individual can compose or retrieve a message without assistance and can make him or herself heard when he or she is ready to speak. Two of the VPSP features that all users found highly desirable were the ability to interrupt and speak when they wanted to and the ability to store messages that had taken considerable time to compose.

One of the secondary, but important, findings of the VPSP evaluation has an impact on all scanning control and display systems. It was observed that those single-switch system users with a lot of uncontrollable movement had a very difficult time making any voluntary action within a uniformly paced time frame such as that produced by an automatically moving cursor. The x-y scanning control and display system for the VPSP had been chosen because this is something of an industry standard for a wide range of aids for the disabled. A comparison of the words per minute rates on the 1-switch VPSP for subjects LL and DA, who had this problem, to those for subject SS, who did not, shows the magnitude of the problem. See Figure 12. The 1 to 4 words per minute rate of SS is probably more representative of the rate that is to be expected of a 1-switch VPSP user than are the rates of LL and DA.

Our findings indicate that there is a group of individuals who cannot operate any of the scanning aids that have been designed for them simply because of this problem while making voluntary actions on demand in time. Research is proceeding on this problem, as described in the "Benefits of VPSP Project" section.

The clinical testing results can be summarized as follows:

* Users had no conceptual problems using any version of the VPSP.
* Except for users who had difficulty making voluntary movements on demand in time, users had no problems physically controlling the VPSP.
CLINICAL EVALUATIONS

* Message construction time varied from 1 to 3 words per minute (wpm), with the one-switch version to 10 wpm with the keyboard. (Note: the 10 wpm rate was achieved with single finger typing. Obviously, someone able to use more fingers would have a higher rate).

* Retrieved user-stored message for any of the versions were spoken at 100 wpm or better, including access time.

* Rates for users own system—which included wordboard, pencil and paper, and a Handivoice 120—ranged from 0.3 wpm with a word board to 12.8 wpm with pencil and paper.

* Except for the pencil and paper system, these systems had no capability for retrieval of user-stored messages.

* All VPSP users wanted to keep the VPSP.

In addition to the formal clinical evaluation, professional opinions were solicited from two individuals who are experts in the field of assistive communication devices: Dr. John B. Eulenberg, Director of the Artificial Language Laboratory, Michigan State University, and Judy Montgomery, Director of the Non-Oral Communication Center, Fountain Valley, California. Their letters are included in Appendix III. Also in Appendix III is a letter from Michael B. Williams, a non-oral person who used the keyboard VPSP at the 5th West Coast Computer Faire. Several of his suggestions were implemented in the second generation keyboard version.

Another goal of the VPSP project was to improve synthesized speech intelligibility over that available with commercial devices. A controlled, comparative intelligibility study of VPSP and the Handivoice was performed. Mean VPSP intelligibility scores were more than twice those of the Handivoice. (See Appendix II for the complete study report).
<table>
<thead>
<tr>
<th>Subject/System</th>
<th>WORDS</th>
<th>SENTENCES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single-Switch Users:</td>
<td>Mean (WPM)</td>
<td>Range</td>
</tr>
<tr>
<td>DA</td>
<td>VPSP 1284 (.04)</td>
<td>904-1664</td>
</tr>
<tr>
<td></td>
<td>OWN Wordboard 146 (.32)</td>
<td>104-188</td>
</tr>
<tr>
<td>LL</td>
<td>VPSP 577 (.14)</td>
<td>382-772</td>
</tr>
<tr>
<td></td>
<td>OWN Letterboard 72 (.99)</td>
<td>47-98</td>
</tr>
<tr>
<td>SS</td>
<td>VPSP 58 (1.1)</td>
<td>36-87</td>
</tr>
<tr>
<td></td>
<td>OWN (none tested)</td>
<td></td>
</tr>
</tbody>
</table>

**KEYBOARD USERS:**

<table>
<thead>
<tr>
<th></th>
<th>WORDS</th>
<th>SENTENCES</th>
</tr>
</thead>
<tbody>
<tr>
<td>IS</td>
<td>VPSP 12.6 (5.4)</td>
<td>6-28</td>
</tr>
<tr>
<td></td>
<td>OWN Pencil/Paper 14.8 (4.8)</td>
<td>10-24</td>
</tr>
<tr>
<td>BW</td>
<td>VPSP 8.5 (8.0)</td>
<td>4-17</td>
</tr>
<tr>
<td></td>
<td>OWN Pencil/Paper 5.8 (11.6)</td>
<td>4-8</td>
</tr>
<tr>
<td>PA</td>
<td>VPSP 8.1 (8.3)</td>
<td>6-11</td>
</tr>
<tr>
<td></td>
<td>OWN Handiovoice 22.1 (3.1)</td>
<td>6-30</td>
</tr>
</tbody>
</table>

**Figure 13.**

Means and ranges of times, in seconds, for subjects to compose test words and sentences. Average words per minute are shown in parentheses (WPM).
Negotiations with Manufacturers

Part of the purpose of the VPSP project was to get the device manufactured if testing showed it would be a useful product. The reception by the handicapped community - users, therapists, and users' relatives - was encouraging as evidenced by the large volume of inquiries received. Over 2000 fliers were distributed and more than 200 inquiries from individuals and institutions representing ten different nations plus the media coverage listed in Appendix IIII testify to the public interest in the VPSP. This, together with the evaluation results was encouraging enough so that invitations were sent to all manufacturers of aids for the handicapped who had shown interest during the project, and others who might be interested in manufacturing such a product.

In May 1980, a manufacturers' conference was held at Fairchild Auditorium on the Stanford Campus (see Figures 14-16) to show prospective manufacturers the VPSP and solicit their proposals for manufacturing it in quantity. Four manufacturers responded with proposals, and in August clarification of their responses was asked for since the original proposals had been insufficiently detailed to allow one to be chosen. All revised proposals were requested by October 1, 1980. On the basis of the responses submitted by that time, a decision was made on October 20, 1980 to offer the VPSP manufacturing rights to Computers for the Physically Handicapped, Inc. In January, members of the VPSP team visited CPH and held technical discussions regarding the transfer of the relevant information, licensing agreements, and the use of consultant's time by CPH. In March, a copy of the VPSP team's proposed legal agreement was sent to CPH for signature or revision. Unfortunately, changes in the national economic climate coupled with the press of other business caused CPH to be unable to handle the VPSP project in the manner originally envisioned. Thus, while the VPSP is still needed by a large population and no device is on the market which fulfills the need, no manufacturer is currently developing it. Because of national and even international interest in the VPSP, Children's Hospital at Stanford and the VPSP Team are continuing the effort to provide for manufacture of the VPSP. The best result of this continuing effort would, of course, be finding a manufacturer for VPSP. However, even if that does not come about, the Rehabilitation Engineering Center is willing to provide the VPSP on a case-by-case basis, an alternative which is more expensive for the patient but, in some cases, well worth it.
Figure 14.
VPSP Project Timeline
Figure 15.
Dr. Williams demonstrating VPSP at Manufacturers' Conference

Figure 16.
Dr. Simpson and Mr. Lingel discussing mock-up of briefcase-size VPSP (setting on table) with Mr. Vargo of NASA Headquarters.
Benefits of VPSP Project

While the VPSP itself is not currently being produced, it has generated a great deal of sympathetic publicity for a population of people who are generally ignored. In many cases, the connection of the project with NASA was mentioned, for it is not widely known that NASA participates in projects which are not aviation or space related. A number of spinoffs which are very significant have also been unforeseen benefits of the project.

One of the observations documented during the clinical evaluation of VPSP was that spastic cerebral palsy (CP) patients had difficulty dealing with row-column scanning displays. Many of the devices available to these patients are only available with such scanning schemes. This led to a proposal to do research on scanning methods, which was funded by the Office of Special Education, Department of Education.

Children's Hospital at Stanford and PLRA are now working on a Spanish-English Voice Output Communication Aid (SEVOCA) which—while not portable, using software for a different microprocessor, and lacking many VPSP features—is an attempt to use some of the knowledge gained in developing the more capable VPSP to speed development of the bilingual SEVOCA.

The VPSP was based on 1977-era technology, and as the project has progressed, so has the technology. The VPSP team decided to propose that the newer technology be used in a smaller, cheaper, more capable version which would be easily carried by the ambulatory non-vocal, and to make it as small and light as possible. (See Figure 17). This proposal is now under consideration by NASA.

And, the original VPSP is still working and is used at Children's Hospital at Stanford as an all-purpose communication aid for patients who come for communication evaluations. If a discussion with the patient is appropriate, they can be quickly taught to use the VPSP and may easily participate in the decision about which commercially-available aid or options are most suitable for them.
Figure 17.
Future Plans

Efforts will continue to find a manufacturer for the VPSP. Meanwhile, a feasibility study is underway by NASA-Ames to determine the possibilities for a lighter, more portable VPSP which would retain the essential features of the current one.

Several non-vocal individuals in the local San Francisco Bay Area have been identified who could benefit from a custom VPSP. Study has been made of components for custom VPSP's that would be built one at a time by Children's Hospital at Stanford to run the VPSP software. A list of modifications to the VPSP software generated by trials with users has been compiled. This list was originally intended for the VPSP Manufacturer. It will now be used to guide the custom VPSP design.
APPENDIX I

VPSP USER TEST WITH SINGLE-SWITCH CONTROL

Introduction

During the initial evaluation of the VPSP reported in LeBlanc, et. al., 1980, the single-switch version of the system was not tested fully. The two subjects for whom the single-switch control was the most appropriate had extreme spasticity which caused them difficulty in using the control switch; also, there seemed to be an interaction of the cursor motion with their disability such that they often activated the switch just before or just after the desired item. Research is now underway to attempt to solve the problems of a control and display combination for these people (Children's Hospital, 1981), but the VPSP was not properly tested by the two single-switch users who were in the evaluation trials. For this reason, a subject was selected who could only operate a single switch but who had no spasticity. She was given the VPSP to use for several weeks, and observations and measurements of her performance were taken at intervals.

Subject

The subject was a 37 year old female who had been paralyzed from the neck down by ultrasonic trauma to the spinal cord in July, 1979 and who has been unable to communicate except by yes-no questions since then. At the time of this study (February to March, 1981), she was in Mission Skilled Nursing Facility, Santa Clara, California.

She is unable to talk and only able to make a few sounds. Two fingers of the left hand are able to exert 5-10 grams of force quickly and accurately, but her hand and arm must be placed in position and supported because she cannot move them. Her wheelchair could not be easily adapted to the VPSP hardware, so the VPSP was modified.

Equipment

The VPSP display was moved to the back of its chair and clamped to one of the handles. The rear of the display was supported on plastic foam blocks resting on the top of the computer box. Thus, the user could sit in her wheelchair behind and beside the VPSP and see the display at about eye-height. The control switch selected was a standard Zygo switch which could be adjusted for a very light touch. It was backed with Velcro hooks which stuck to the subject's clothing or lap robe. Several methods of positioning her hand were tried, all with limited success until she got a new wheelchair with adjustable arms, which could be set to prevent her own arm from falling off her lap.
Procedure

Since the subject could only communicate very laboriously and did not regularly use any communication aid, the comparison of the VPSP with the subject's customary system would be meaningless. After a 1/2 hour instruction period at the Rehabilitation Engineering Center interspersed with the two-hour process of finding a suitable switch and switch location, she was able to use the basic VPSP functions of selecting items from pages to compose messages for talking, cancelling errors with the VERIFY Mode, and going from one VPSP page to another.

Four days later, after the necessary physical modifications to the VPSP had been made, it was delivered to her for testing. She was able to construct messages on it immediately without any review of training. Instruction was given on the functions for storing messages for later use. She began exploring the system on her own, looking at the contents of the different pages. Later that day, after a total of 3 hours of system use, she used the system to ask questions about the operation of the message storage functions. She had assumed the user storage pages could be given messages longer than one line with the *UADD command when in fact there is a 27 character limit currently on the message length for the user pages. She was told that she could use the user text pages to store longer messages. Another question involved a misunderstanding of the append nature of the *FADD command. These misunderstandings were cleared up and, at the next visit a week later, it was observed that she had created several user pages with one-line messages and three text pages of multiple line length. One of the text pages was a message for bystanders asking that they not ask her to demonstrate the VPSP by making it speak their requests when she was busy programming what SHE wanted to say.

After this week of using the VPSP with mostly self-instruction, it was obvious that she would be able to easily master all of its functions, so it was decided to record her speed of communication in running conversation, with observations at intervals. Her usage of the User and Text pages would be noted, and of course any criticisms or suggestions she had would be noted.

The speed was recorded in words per minute, where a word is defined as 5 characters. Space was counted as a character. (See Figure 18 for the results of several testing sessions). Data for this subject is summarized and plotted in Figure 8 as subject "SS" along with the data for the
subjects previously evaluated and reported on in detail in LeBlanc, Simpson, Williams, and Lingel, 1980.

Besides improving her communication rate, this subject was able to increase her amount of communication from simple basics that could be transmitted as answers to yes-no questions to complicated discussions on what she wanted to do, her personal goals, and long involved conversations with family and friends. In the month that she had the VPSP she filled all nine text pages several times and periodically erased those she no longer needed to make room for new material. She also filled approximately 75% of the space in the user pages that each hold 14 lines of up to 27 characters each. We interpret this as strong support for the need for as much user non-volatile storage as possible in a production VPSP.
DATA FOR SUBJECT S.S.
Words, Sentences, and Spontaneous Messages

NOTE: This datapoint was collected using the alphabetically arranged spelling page. The others were with the grapho-phonotactic layout.

Figure 18.
APPENDIX II

COMPARATIVE INTELLIGIBILITY OF VPSP TEXT-TO-PHONEME SPEECH AND HANDIVOICE PRE-STORED AND PHONEME SPEECH

by

Douglas H. Williams, Carol A. Simpson, and Claudia Nordinger

The Versatile Portable Speech Prosthesis (VPSP) is a microprocessor-based, battery powered voice communication aid for non-vocal persons which has been developed at Children's Hospital at Stanford with the aid of funding from Ames Research Center, National Aeronautics and Space Administration. A stated goal of the VPSP project was to improve the intelligibility of speech generated by speech prostheses. To determine if the VPSP had met this goal, comparative word and sentence intelligibility was obtained for the VPSP and for the only commercially available speech prosthesis with unlimited message capability, the Handivoice.

Test Materials

Test materials were chosen from standard intelligibility testing materials and were selected by author (DW) because he is not familiar with the capabilities of either system for pronunciation of specific words. (Author CS developed the VPSP text-to-speech rules and was thus disqualified from selecting the testing materials.) The materials included short sentences from Campbell in 1965, a CNC list of phonemically balanced monosyllabic words by Lehiste and Peterson in 1959 and one of the Modified Rhyme Test word lists described by Fairbanks in 1958 and by House, Williams, Hecker, and Kryter in 1965.

Diverse test materials were chosen to test intelligibility in situations with various levels of linguistic context. Of the three types of materials, sentences have the most linguistic context and are thus easiest to understand.

Next in amount of context are the words in the Modified Rhyme Test. In this test each word is pronounced in a carrier phrase and the subject is supplied with a list of possible responses consisting of the correct response plus five other words that differ from the stimulus word by one phoneme. The response set is thus closed.

Because of the small, closed response set, intelligibility for the Modified Rhyme Test words is higher than for the third type of materials, the Phonemically Balanced CNC word lists. The CNC word lists each contain 50 words that as a whole contain the vowel and consonant phonemes of English in the same relative frequencies as those
measured for a corpus of the 1263 most frequently occurring monosyllabic words in written English according to Thorndike and Lorge in 1952. The CNC words are presented in isolation with an open response procedure. Context is thus greatly reduced. Subjects know only that the words they are hearing are existing words in English. Of the three types of materials, then, CNC words are most difficult and least intelligible. However, they provide the most rigorous test of phonetic and phonemic accuracy of the speech.

Subjects and Procedure

Subjects were linguistically naive college students and had no prior experience listening to digitized or synthesized speech except perhaps the Texas Instruments Speak and Spell (digitized human speech). The test materials were recorded on high fidelity audio recording equipment on reel-to-reel tape at 7 1/2 ips. The stimuli for the VPSP were generated by using exact spelling, i.e. with no phonetic spellings for exception words. The stimuli for the Handivoice were generated by a speech therapist who has extensive experience with the Handivoice and with teaching phonetic "sound-spelling" and "sound-blending" to Handivoice users.

10 subjects heard VPSP speech only. The other ten heard Handivoice speech only. They were tested in pairs or alone. Each subject heard the taped stimuli via a high-fidelity headset. Assignment to type of speech was random. Subjects knew only that they were listening to synthesized speech, not which system they were hearing. The experimenter who administered the testing also did not know which system was being tested, only that "system A" or "system B" was on the tape in use.

Results

Means and standard deviations of intelligibility for the two types of speech for each of the three types of test material is given in Tables 1-3. Intelligibility is basically the percentage of words correct out of the total number of words presented. Depending on the test materials, the computation of this percentage varies slightly.

The sentence intelligibility shown is the percent of words correct out of the total number of words in the sentence. Sentence intelligibility is sometimes based on the percent correct of five selected key words in the sentence. We chose to use all words in the sentence because the Campbell sentences have only four words each. Sentence intelligibility for the VPSP was 71% compared to 26% for the Handivoice. This difference was statistically significant (t=12.39, df=18, p << 0.001 (two-tailed)).

Modified Rhyme Word Intelligibility is defined as the
percentage of words correctly identified from the list of 50 words, after correction for guessing. A correction factor adjusts the score for the guessing that is possible in a multiple choice situation. The formula for the correction factor is:

\[
\text{corr fac} = \frac{\text{number of words wrong}}{5}
\]

This correction factor is subtracted from the actual number of words correct to obtain an adjusted number of words correct. The corrected percent correct or intelligibility is then:

\[
\text{corrected % correct} = \frac{\text{adjusted no. correct}}{50} \times 100
\]

\[
= \text{adjusted no. correct} \times 2
\]

As with sentences the VPSP with 68% was more intelligible than the Handivoice with 43%; and this difference was also statistically significant \((t=7.66, \ df=18, \ p < 0.001\) (two-tailed).

CNC word intelligibility is the percent words correct in the list of 50 words. Because of the open response set there is no need for a correction factor for guessing. Again, the VPSP with 44% intelligibility was better than the Handivoice with 10% and the difference was significant \((t=13.81, \ df=18, \ p << 0.001\) (two-tailed).

---

**Table 1. Sentence Intelligibility**

<table>
<thead>
<tr>
<th></th>
<th>VPSP</th>
<th>Handivoice</th>
<th>(t)</th>
<th>df=18, (p &lt; 0.001) (two-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>71.22</td>
<td>25.70</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SD</td>
<td>8.44</td>
<td>8.49</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>10</td>
<td>10</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**Table 2. Modified Rhyme Word Intelligibility**  
(closed response set/multiple choice)

<table>
<thead>
<tr>
<th></th>
<th>VPSP</th>
<th>Handivoice</th>
<th>(t)</th>
<th>df=18, (p &lt; 0.001) (two-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>68.32</td>
<td>43.36</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SD</td>
<td>8.82</td>
<td>5.33</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>10</td>
<td>10</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 3. CNC Word Intelligibility (open response set)

<table>
<thead>
<tr>
<th></th>
<th>VPSP</th>
<th>Handivoice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>44.22</td>
<td>10.40</td>
</tr>
<tr>
<td>SD</td>
<td>12.22</td>
<td>5.40</td>
</tr>
<tr>
<td>N</td>
<td>10</td>
<td>10</td>
</tr>
</tbody>
</table>

$t=13.81$, df=18

$p << 0.001$ (two-tailed)

Discussion

Any discussion of the large differences in intelligibility between the VPSP and the Handivoice must take into account the very different ways in which the user generates speech with the two systems. The user programs the Handivoice in one of two ways. If the desired word, phrase, or morpheme (word part) is pre-stored in the fixed vocabulary, the user may select it. Other words are sound spelled by the user using a set of phonetic segments that are a mixture of English phonemes, and segments of English phonemes. If the sound spelling is accurate, the pronunciation will be phonemically correct and may be phonetically more or less correct, depending on the skill of the user. In this study, a skilled user did the Handivoice programming to give it its best advantage phonemically and phonetically. The term phonetics refers to the physical or acoustic aspects of the speech while the term phonemic refers to the cognitive linguistic concept of the phoneme. Phonemes are technically the smallest segments of speech that can change the meaning of a speech message. In lay terminology they are speech sounds—the consonants and vowels. A given phoneme is pronounced differently in different phonetic contexts. Physical variations in the pronunciation of phonemes are said to be phonetic variations. (See Simpson 1980 for discussion of this distinction and its importance for the programming of phonetic segment synthesizers like the Handivoice.) To achieve good phonetic pronunciation for novel words, the Handivoice user must program the phonetic variant of a given phoneme for the phonetic context in which that phoneme occurs. The pre-stored words were coded by the manufacturer with attention to phonetic accuracy and with built in intonation.

The VPSP, on the other hand, has no pre-coded words. All words are generated from scratch by the text-to-phoneme rules. The text-to-phoneme rules and the phoneme-to-phonetic segment rules automatically produce the correct pronunciation for the words in the text. The user can select pre-spelled words, but these words go through the text to phoneme conversion in the same manner as the rest of the text. The user may choose to improve on the
pronunciation of exception words by spelling them phonemically or "sound-spelling" them. However, in order to put the VPSP at its greatest disadvantage, only correct spellings of the stimuli were used. Another major difference exists between the speech of the Handivoice and the VPSP. The user-created words on the Handivoice have fixed intonation for each phoneme. The VPSP text-to-phoneme rules, on the other hand, adjust intonation on the individual phonemes as a function of their phonetic and morphological environment. This intonation gives the listener additional important perceptual cues in understanding the VPSP speech. Finally, the phonetic segment set in the Handivoice is more limited than that of the ML-1 Votrax used in the VPSP. This would make the VPSP speech phonetically easier to understand if the text-to-phoneme rules indeed take advantage of the ML-1 phonetic segment set.

Clearly, the VPSP project has attained the goal of improved intelligibility for speech prostheses. Also, the normal spelling entry of text for speaking requires less training for the linguistically naive user who is familiar with English spelling. But, the relative contribution, positive or negative, of the different features of the speech of the two systems cannot be determined from these data. A much more extensive intelligibility study would be required to make such an assessment. A practical but time-costly next step would be to implement the VPSP rules, minus intonation but including stress and phoneme-to-phonetic segment rules, on the Handivoice to determine the contribution of the VPSP text-to-phoneme rules themselves to intelligibility. Finally, it must be noted that the data presented are relative intelligibility data and cannot be used to derive the intelligibility of the VPSP and the Handivoice in actual conversation. All of the test materials used are more difficult than conversational speech which has the advantage of occurring in a pragmatic or real world context.
March 10, 1980

Maurice LeBlanc
Rehabilitation Engineering Center
Children's Hospital-Stanford
520 Willow Road
Palo Alto, CA 94304

Dear Maury,

On January 14 and February 17, 1980, I had the opportunity to work closely with Dr. Carol Simpson and consequently view the Versatile Portable Speech Prosthesis (VPSP). I have also viewed the video tape of its use and observed it at the Southern California Communication Group 4th Annual Communication Aids Fair. Perhaps the most useful time spent evaluating this instrument was 2 hours in the home of a consumer/user. Interviewing this young woman was the highlight of my experiences with the VPSP.

The unit appealed to me as a valuable communication system for the non-oral individual for several reasons:

- The speech output was remarkably intelligible (testing done on 2/17/80).
- The page storing capabilities allow the device to be highly personalized and convenient.
- The English spelling to speech transition through a keyboard greatly speeds up the message transmission process (trials completed 2/17/80).
- The small CRT screen enables the sender to monitor his/her message and the receiver to verify the speech he hears. I see great applicability for this dual mode in training sessions and for children.
- Corrections are made easily from the keyboard.
- The unit also has a single switch operation, which although slow makes it adaptable for the person more severely physically limited.
- The volume of the unit is surprisingly good in large or noisy groups (observation during Fair with approximately 50 people in the room.)
- The present wheelchair mounting allows it to be operated off the battery for portability.
Areas/aspects of the VPSP that may need continued work are judged by this consultant to be:

- Continued work with size reduction to enable it to be used by an ambulator.
- Refinement of text to speech rules to cover more English spellings.
- Re-arrangement of level and shift buttons for speech and convenience.
- Consider tactile or auditory feedback mechanism on keyboard to reduce typing errors and double entries.
- Continue to explore other power and memory storage alternatives.

These are my impressions of the VPSP to date. I am very pleased to have spent the time working with the unit in several settings and to have taken part in the speed and intelligibility testing. Combined with the clinical trial data and other reports, this evaluation may serve to help others recognize the potential of the VPSP. It is an approach in voice output communication aids that many non-oral consumers can utilize.

Sincerely,

Judy Montgomery
Non-Oral Communication Center
9675 Warner Avenue
Fountain Valley, CA 92708

JM:ks
April 15, 1980

Maurice LeBlanc
Director, Rehabilitation Engineering Center
Children's Hospital at Stanford
520 Willow Road
Palo Alto, CA 94304

Dear Maury,

During the past year, I have had the opportunity to observe the development of the Versatile Portable Speech Prosthesis (VPSP), to meet some of its consumer "test pilots", and to confer periodically with Carol Simpson and Doug Williams.

The VPSP represents an exciting advance in the field of communication aids, and I strongly advocate its continued development into a commercial product.

Here are some of the features of the VPSP which make it important and which distinguish it from currently available aids:

1. The user can personalize his/her vocabulary.
2. Text and vocabulary can be stored in a very convenient manner, and similarly be accessed with ease.
3. The VPSP is modularly designed to accept single switch, joystick, and full-keyboard entry.
4. The orthographic-to-phonetic conversion feature provides access to speech for anyone who can spell.
5. Messages can be edited easily, so the user can visually confirm an utterance's integrity before releasing it to speech.

In a truly portable form, the VPSP can serve non-speaking individuals who are literate, linguistically intact, sighted, and who experience varying levels of motoric ability. The quality of "portability" is relative. By reducing the dimensions, power requirements, and susceptibility to mechanical trauma of the current design, the VPSP can be configured into both wheelchair-portable and person-portable models using present technology. I know that Carol and Doug have studied their options with respect to these considerations and can be of great benefit to any manufacturer in the incorporation of human factors research into the transition from prototype to commercial product.

The VPSP, as an intelligent speech prosthesis with dynamic visual display, high-quality spoken output, and modular input options, is a long-awaited contribution to the arsenal of communication aids.

Sincerely,

John Bryson Eulenberg

JOHN BRYSON EULENBERG
DEAR CAROL AND DOUG,

I'VE STILL COMING DOWN FROM YESTERDAY. BOY, THAT WAS THE MOST EXCITING THING I'VE DONE IN A LONG TIME. I PARTICULARLY ENJOYED THE VERBAL JOUST WITH COMPUTALKER. IN CASE YOU COULDN'T TELL, I ENJOY ENGAGING IN THAT KIND OF QUICK REPARTÉ. AND THE TALKING WHEELCHAIR (YOU SIMPLY MUST THINK OF A BETTER NAME FOR THAT GADGET!) ENABLED ME TO DO IT WITH A FLUIDITY AND FORCE I NEVER THOUGHT POSSIBLE BEFORE.

AS PROMISED, HERE IS A BRIEF CRITIQUE OF THE V.P.S.P. FIRST OFF, YOU NEED A BETTER SCREEN CLEAR. I DIDN'T LIKE BEING STUCK WITH A SHORT SENTENCE ON THE CRT AND HAVING TO MAKE FOUR MOVES IN ORDER TO CLEAR IT. IT SLOWED DOWN MY STYLE, MAN, AND YOU KNOW HOW IMPORTANT STYLE IS TO A BLOKE, DON'T YOU?

POINT NUMBER TWO: WHY ARE THE CURSOR CONTROLS UNDER THE CONTROL OF THE CONTROL KEY? (NO, I'M NOT TRYING TO POSE THIS QUESTION IN THE MANNER OF GERTRUDE STEIN.) IS IT TO PROTECT THE INTEGRITY OF THE CURSOR POSITION FROM THE UNWANTED INTRUSIONS OF FLAYERS? ("FLAYERS": A TERM USED BY M.B.W. TO DEFINE THAT GROUP OF CEREBRAL PALSIED INDIVIDUALS WITH POOR MOTORIC CONTROL OF THEIR UPPER EXTREMITIES.) IF SO, WHY NOT PUT THE F KEY UNDER THE CONTROL COMMAND? OR THE U KEY? OR EVEN THE C AND K KEYS? I WANT TO RUN THAT CURSOR 'ROUND THAT LI'L OL' SCREEN ANYTIME LI'L OL' ME FEELS LIKE IT. LIKE I DO ON MY SOL. I DON'T WANNA MESS WITH NO CONTROL KEY!

POINT THREE: IT WOULD BE NICE TO HAVE A WAY OF SAYING BITS AND PIECES OF A LONG TEXT. FOR EXAMPLE, IF I'M GIVING A SPEECH WITH THE V.P.S.P., AND HAVE PROGRAMED IN SEVERAL JOKES ALONG THE WAY, I WOULD LIKE SOME METHOD OF STOPPING IN MID-TEXT IN ORDER TO GIVE MY AUDIENCE AMPLE TIME TO VENT THEIR MIRTHFUL FEELINGS UPON A GREATFUL SPEAKER.

POINT FOUR: BEFORE OFFERING THE V.P.S.P. TO ANY POTENTIAL MANUFACTURER, YOU MUST DO SOME TESTING ON SOME EXTREMELY MOBILE DISABLED PEOPLE. IF YOU DO NOT DO THIS, IT COULD LEAD TO SOME UNPLEASANT CONSEQUENCES FOR THE PROJECT. WHEN I LIVED IN BERKELEY, I USED TO USE MY CHAIR AS A CAR. ON THE AVERAGE I'D BE ON THE STREETS AT TEN IN THE MORNING AND COME TOOLING HOME AT TWO THE NEXT MORNING. I CAN JUST SEE A PERSON STUCK ON TELEGRAPH AVENUE AT TWO IN THE MORNING WITH NO POWER FOR THEIR CHAIR, NO WAY OF COMMUNICATING AND SOME WEIRDO COMING TOWARDS THEM WITH A GLAZED LOOK IN HIS EYE. WOW MAN! SOUNDS LIKE A PLOT FOR A TV MOVIE. BUT SERIOUSLY
FOLKS, A LOQUACIOUS, MOBILE CRIP WOULD SUCK THOSE BATTERIES OF POWER IN NO TIME.

I FOUND OUT I WILL BE SPEAKING TWICE AT THE COMMUNICATION FAIR— IN THE MORNING AND AFTERNOON. IF YOU WOULD LIKE, I COULD SPEND PART OF MY FREE TIME HELPING TO DEMONSTRATE THE V.P.S.P.

I WOULD ALSO LIKE TO HELP DEMONSTRATE THE THING TO POTENTIAL MANUFACTURERS, IF MY BUDGET AT ALL ALLOWS IT. I KNOW THIS IS A PRETTY GUTSY THING TO SAY AFTER SEEING YOU ONLY ONCE, BUT I'M THE MOST POWERFUL DEMONSTRATION YOU COULD HAVE.

THANK YOU AGAIN FOR A MOST BEAUTIFUL DAY. HOPE TO TALK WITH YOU SOON.

SINCERELY,

MICHAEL B. WILLIAMS
APPENDIX III

A. MEDIA COVERAGE OF THE VPSP—PARTIAL LIST
(Numerous other articles have appeared in sources not listed here, picked up from wire services.)


Biomedical Electronics, The session on personal computers as an aid to the handicapped at National Computer Conference (report described VPSP), July 10, 1979, p. 2.


Snyder, Bill. Stanford University Medical Center News Bureau Press Release on the VPSP, nailed Tuesday, March 4, 1980 (w/ photo available).


Two-minute segment by Lloyd LaCuesta on 10:00 Channel 2 KTVU-TV News, Oakland, March 10, 1980.


30-minute live radio interview of Carol Simpson and Douglas Williams with VPSP speaking on syndicated show, "Coast to Coast", by the Woodruff Organization, San Francisco, March 18, 1980.

Wheelchair speaks for those who can't, Campus Report: A Publication for Stanford University Faculty & Staff, Volume XII, Number 25, March 19, 1980, page 10 (w/ picture).

Omni Magazine: Bob Brody, freelance writer, called from New York for telephone interview (and to listen to VPSP via phone) for article for Omni Magazine, April 2, 1980.


First Talking Wheelchair, De Anza College Student Newspaper, Cupertino, CA, May 1980.


ABC National Television Show "20/20" spent the entire week of February 11–15, 1980 shooting footage for a story on the problems and solutions to problems for the non-oral. One and a half days were devoted to filming the VPSP in use by Sally Melanephy in her home and to interviews at Children's Hospital at Stanford and PLRA. A twenty-minute segment was broadcast February 1981.

Williams, D. H. A Versatile, Portable, Speech Prosthesis, in Proceedings of the Johns Hopkins First National Search for Applications of Personal Computing to Aid the Handicapped, IEEE Computer Society, P. O. Box 80452, Worldway Postal Center, Los Angeles, California, 90080, October 1981.

Catherine Caffrey, NASA's Life-Enhancing Spinoffs, Fusion, September 1981.

American Medical News, March 26, 1980.


KGWR Radio, Sacramento, California, Jerry Grisham, News Anchorman, September 15, 1980.


B. Interviews and/or information given to the following journalists are listed here if we do not know when or where their story was published.

Science Digest: gave telephone interview to Diana Ingham who called from Chicago for details on the VPSP, April 14, 1980.

Gregg Vanderheiden, Trace Center, 922 EHB, 1500 Johnson Drive, University of Wisconsin, Madison, Wisc. 53706.

Science 80: VPSP demo given to Edward Edelson, Science Editor for article on use of electronics in treating deafness, aiding blind persons, and in other prostheses,
January 8, 1980.
Stephen Brugler, Vice President, Telesensory Systems Inc. 3408 Hillview Ave, Palo Alto, Ca. 94304.


Canadian Broadcasting Company (CBC): telephone interview on VPSP given by Maurice LeBlanc to Leslie Kruger and Barbara Frum, February 21, 1979.

New Scientist: CBC says they learned of the VPSP from an article in the New Scientist, dated prior to February 21, 1980.


Echo On: Newsletter for H.C. Electronics Handivoice Users, Alan Schwartz, Editor, was given demo of VPSP and interview for article in Echo On, February 25, 1980.


A. Sylvestre Centre de Reeducation et de Readaptation Fonctionnelles De Kerpape 56270 Ploemuer B.P. 241 56321 Lorient Cedex, FRANCE

Ms. Carolyn Stone, German Television, PO Box 40827 Palisades Station, Washington, D.C. 20016.

Science Report: Sent requested VPSP info sheet to Mr. Norin Kagen, with offer to supply 16mm copy of VPSP video tape for their science newsreel, July 23, 1979.

German Television sent a team who spent several hours taping the VPSP and interviewing Dr. Simpson (and VPSP) in German. Aired in Europe, Spring, 1981.

Ms. Marscha Krone writing article on appl. of mp to handicapped 2e Willemstraat 32 8725 JK Groningen HOLLAND, May 13, 1981.

Miss Yin-kwan Leung 2255 Northrop Ave. #35 Sacramento, CA Requested information for entry into TECTRA—the Federal Laboratory Consortium online databank of successful
technology transfer cases.

David Ball, Editor, Remedial Therapist, The Newborne Group, Recorder House 91 Stoke Newington Church Street, London, N16 OAU Requested VPSP demo and article for magazine (in preparation).

Handisoft, 30 rue Pasteur Vert-Sent-Denis F7240 CESSON (France) Dr. Paul Eschstruth was given information and a VPSP demo as he is working on a similar device for French patients.

Spastic Society 669 Waverley Rd., Glen Waverley, Victoria, Australia.

Prof. Hiroyasu Funakubo, D. Eng, University of Tokyo, Faculty of Engineering 3, 7 - Chome, Hongo Bunkyo - Ku, Tokyo, Japan.

Mr. Norman Kagen, Science Report, 210 North 52nd. St., New York City, N.Y. 10019.

Mr. Kevin O'Connor, Editorial Specialist American Speech-Language Hearing Association, 10801 Rockville Pike, Rockville, Maryland 20852.

Donna Haupt, Life Magazine, 1271 Avenue of the Americas, New York, NY 10016.


German Television, Wiesbaden, Germany, Rudolf Schwarz, June 4, 1980.

German Television, Scientific Program, Erich Vogt, February 19, 1981.


Pediatric News, Rockville, Maryland, Jon Simmons, April 8, 1981.

Science International, Ontario, Canada, M. Murchand.

Spastic Society, Victoria, Australia, Andrea Goldsmith, June 27, 1980.


C. More than 200 requests for information from individuals have been answered since the start of the project, and they continue to come to Children's Hospital at Stanford Rehabilitation Engineering Center. In many cases these are people who are, or know of, someone who could use a VPSP if it were available for a reasonable cost.

D. Formal presentations or shows where VPSP was presented:

National Computer Conference, New York City, June 4-7, 1979. VPSP was demonstrated several times by Dr. Simpson and Charles Lingel (after an airline trip across the country).

Human Factors Society, Bay Area Chapter. VPSP was the topic of the Oct. 22, 1979 meeting at The Center for Design, 227 Forest Ave., Palo Alto, Ca.

Bay Area Non-Oral Communication Group. VPSP demonstrated by a user and Drs. Simpson and Williams, Dec. 4, 1979.

California State University, Long Beach. Disabled Day 1980, February 6, 1980. VPSP videotape was shown continuously.

Southern California Communication Conference Rancho de los Amigos, Downey, Cal., March 1, 1980. VPSP was demonstrated continuously all day, and a special design seminar was given on it.

Bay Area Non-Oral Communication Faire, April 19, 1980. VPSP was demonstrated by Sally Melanephy, a non-vocal member of the VPSP team, and used by several non-vocal persons.

De Anza College, Cupertino, Ca. Access to Communication in the 80's Workshop, May 16, 1980. Dr. Simpson, Sally Melanephy, and VPSP were featured speakers.

Conference on Daily Living for the Speechless. Dr. Guy Hamilton invited Drs. Simpson and Williams to demonstrate the VPSP and talk about its design at this conference, London, England, June 1981. Several successful demonstrations were done for practitioners and government officials over the course of a week.

E. Awards Received by VPSP

National Computer Conference, May 19-22, 1980, Anaheim, California. A videotape of VPSP was shown. VPSP was awarded seventh place in the personal computer competition. A computer and case of disks were awarded as prizes.

VPSP was a regional winner in the Johns Hopkins First National Search for Personal Computing Aids for the Handicapped.

NASA Headquarters Citation for Accomplishment during Ames Research Center Performance Review, January 18, 1981.
APPENDIX V
A. VPSP USER'S MANUALS FOR THREE VERSIONS

Users's Manual for the Single Switch VPSP

Introduction

The Versatile Portable Speech Prosthesis (VPSP) or "Talking Wheelchair" is designed as a speech prosthesis for individuals with severe motor impairment but who have good cognitive linguistic skills and/or abilities.

One version of the VPSP is designed for user control by a single switch. It presents possible selections to the user on a small television screen. It moves a small rectangular block (called a "cursor") from one item to the next. When the cursor gets to the item the user wants, the user presses the selection switch. Using this one switch, the user can put items in a Talkspace for later talking, display any of 78 different screenfuls of selections (called "menu pages") and command the system to perform any of 16 different functions.

The system itself incorporates several levels of linguistic sophistication and corresponding capability. At the simplest level, the user can select from among several pre-spelled phrases and command the system to talk the selected phrase. At the most sophisticated level, the user can generate any desired message, edit it, talk it, and/or store it for future use. Depending on the linguistic abilities and acquired skills of the user, one or more of these levels may be used. A user need use only as much of the VPSP capability as he/or she is able. The different levels, in order of increasing sophistication, are listed below.

1. SPEAK A PRE-SPELLED PHRASE.
2. FILL IN A BLANK IN A PRE-SPELLED PHRASE WITH A CONTENT WORD AND SPEAK THE PHRASE.
3. COMPOSE A NEW PHRASE FROM PRE-SPELLED WORDS AND SPEAK IT.
4. COMPOSE A NEW PHRASE FROM SOME PRE-SPELLED WORDS AND SOME WORDS SPELLED BY THE USER. Note: Phonetic misspellings are usually pronounced correctly by the VPSP.
5. STORE A COMPOSED MESSAGE FOR LATER USE AND LATER RETRIEVE IT FOR TALKING. Note: The VPSP "remembers" the user's stored messages even if turned off.
6. GIVE A NAME TO A SET OF ONE OR MORE STORED MESSAGES TO AID MEMORY IN RETRIEVAL.
7. EDIT, THAT IS CHANGE, DELETE, OR ADD TO STORED MESSAGES AND/OR CHANGE THE NAMES UNDER WHICH THEY ARE STORED.
At all levels, the VPSP is designed to let the user erase mistakes or correct them before they are implemented. Also, should the user change her or his mind, it is easy to stop one operation and begin another.

Besides the capability for custom vocabulary and message generation, the VPSP lets the user "personalize" it in other ways. The user can set the speed at which the VPSP functions to match what is most comfortable. Also, the user can choose between two modes of system operation. With "Verify Mode" turned ON, the VPSP hesitates for a short period after the user has made a selection to see if the user really intended that selection. After the waiting period, it carries out the selection. Should the user want to correct an erroneous selection during this interval, he or she presses the selection switch a second time during the waiting interval, and the VPSP then ignores the original, erroneous selection. With "Verify Mode" turned OFF, the VPSP carries out the user's selection immediately and the user must use the *ERase, *DElete, or *CLear commands to correct errors (see section on Commands below).

How to use the VPSP

VPSP Rules
1) Use the pushbutton switch to turn the VPSP on and off.
2) Use the paddle switch, or whatever "selection switch" you are using, to stop the cursor (the little square light that moves across the screen) at the item on the screen that you want.
3) YOU CANNOT HURT THE VPSP USING THESE TWO SWITCHES.

VPSP Special Symbols

The VPSP has some special symbols. You will see them as you follow this tutorial step by step.

1. "[" is called the "cursor". It moves around the screen at the speed you have selected on the "STARTUP" page. (The "STARTUP" page comes on automatically when you turn the VPSP on.)

2. The ">" at the tops and bottoms of the columns means "go on to the next column". If you select it with your switch, it will cause the cursor to get out of the column it is scanning and start scanning the next column. There is an example of ">" on the STARTUP Page.

3. A "[" in front of a word or string of letters means that that word or string of letters is the name of a page in the VPSP that you can go to, simply by selecting that item. You will see examples of "[" on the
Table of Contents page and almost all of the other VPSP pages. For example, [END is the name of a page that has word endings on it, i.e. -ing, -ed, -tion, -ally.

4. A "**" in front of a two-letter abbreviation means that the abbreviation is a command that the VPSP will perform if the user selects it. For example *RE is not the word "re"; it is the command to the VPSP that tells it to RReturn to the previous page, whatever that page was.

5. If there are none of these special symbols in front of the words, letters, or phrases you see on the VPSP screen, then that means these words, letters, or phrases are available to use to build your speech messages, by spelling them out in a special area of the screen called the "Talkspace".

VPSP Tutorial

Turn the VPSP on with the pushbutton switch. You will see the STARTUP page appear on the screen after a short wait—about as long as it takes for your TV set to come on. Now, use the STARTUP page to select the speed that you want the cursor to move at. When the cursor gets to the speed that you want to try (one of the numbers in the first column), press the selection switch. Once you select a speed, the cursor starts over at the top of the column. The number you selected appears below the "D" in "SPEED". The cursor will move at the speed selected. If you don't like that speed, you may select another.

If you are satisfied with the speed, select either of the ">'s" in the "speed" column. ">" always means "start scanning columns" or "next column". The cursor will therefore move to the "VERIFY" column and move between "on" and "off". If you select "on" for "verify on", it will make the cursor blink for a while when you make your following selections. While it is blinking, it is doing nothing else; it is just waiting for you to see if you really meant to choose that item. If you really meant that item, then you just wait till the cursor stops blinking, and the VPSP will do whatever you selected. If, however, you made a mistake and didn't really want the thing you selected, then you can hit the selection switch again while the cursor is blinking. This will make the VPSP ignore your mistake and make the cursor start scanning on the next item. Using "Verify On" makes the VPSP take a little longer to respond to your commands, but, if you make a lot of accidental selections, it can save you time in the long run.

If you find you are pretty accurate with the selection switch and hit it only for items you want, then you will want to
choose "Off" for "Verify Off". That will make the VPSP immediately do your bidding - no blinking cursor; as soon as you select something, the VPSP will act. If you make a mistake, or just change your mind, there are still ways to undo your selection. These include the commands \*ERase, \*DElete, and \*CLear, which will be explained later on. So, once you have chosen either "ON" or "OFF", the VPSP will automatically go to the Table of Contents page. From there you will be able to go to any other page in the VPSP.

The Table of Contents

On the Table of Contents page, you will see the names of lots of other pages. You can tell they are names of pages because they all start with "[", meaning "page name". TIME means a page called "TIME" with time words on it. SPEL means a page called "SPEL" with letters on it for spelling new words. You will see the name of the Table of Contents page at the top: [TOC, standing for Table of Contents. Every page has its own name on it, at the top.

Now, when the cursor gets to [USEFUL PHRASES, hit the selection switch. The VPSP will go to the [USEFUL Phrases page. Actually, the VPSP only uses the first four letters in a page name. Take a look at this page.

There is a blank area above the line on the page. This is the "Talkspace", and it is always there, even when you change pages. This is where you will put the message you want to talk.

Notice the column on the right. Everything in it starts with a "*". "*" means "a command to the VPSP to do the action named by the two letters after the "*". Some commands are:

*CO "go to the Table of CContents page"

*SP "go to the SPelling page and tack a space onto whatever is in the Talkspace so as to start a new word".

*ER "ERase the last entry that was put into the Talkspace" Then, if *ER is used again without making any new selections, it means, "ERase the last letter in the Talkspace" and can be used over and over again to erase one letter at a time.

*ST "go back to the STARTUP page" - so you can change the speed or switch "Verify" on or off.

The ">" means "move the cursor along the tops of the columns on this page. To see how it works, notice that the cursor is moving along the tops of the columns when you first come
to this page, or any other page. Pick a column you want, and hit the selection switch when the cursor gets to the top of that column. Now the cursor moves down the column. When it gets to the bottom, it starts over again at the top. Experiment with ">" by selecting it to see what the cursor does.

Now, select the first column of words and phrases from the [USEful Phrases page. Now the cursor will move down that column. When it gets down to "Listen to me", hit the switch. Now, "Listen to me" will go into the Talkspace, and the cursor will go back to moving across the tops of the columns.

Now, select the third column, the one with the commands. When the cursor moves down by "*TA" for, Talk the Talkspace, press the switch. Did it say, "Listen to me!"? You can repeat your message by using *TA again. Or, you can clear out that message and put something else in your Talkspace. To clear the Talkspace, select *CL for Clear. Maybe you want to say something that is not already spelled on the VPSP pages. Select the *SP command, and the VPSP will go to the Spelling page. Here you have all the letters of the alphabet, arranged in columns according to the general order that you use them to spell words in English. There are also punctuation marks such as ".", "?", and also a "space", shown by a tiny dot in the center. And, the last column on the page has all the commands, just like the other pages. There's an extra command on the [SPEL page called *DU for DUPLICATE the last entry. This is handy for words that have double letters in them. Say you select "T". Then you can select *DU, and the VPSP will add another "T" to the Talkspace. Try spelling something. When you want to talk it, select the *TA.

If you make a wrong selection or change your mind, use the *ER to erase the last entry. To delete a whole word at a time, use *DE to delete the last word in the Talkspace. To clear out the Talkspace, use *CL. Actually, you could use nothing but the [SPEL page and say anything you want. But, it takes time to spell things out letter by letter. So, the VPSP has a lot of pages with words and phrases already spelled out for you. You can then select them for the Talkspace as a single item.

As you feel the inclination, explore the VPSP pages. You do this by selecting the name of the page you want to go to. Remember that you can tell if something is a page name by whether it starts with "[". You might want to start by looking at these pages:

[ASK "Ask a question" This page has words that you use for asking questions, such as "what", "who", "when"; and "are", "is", "can", "do".

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[MAKE "Make a new phrase" This page has words for making up a new phrase, such as "I", "you", "he", "she"; "am", "are", "will", "won't".

[CONN "Connector words" This page has the little connector words that you put between the main words in your messages, such as "the", "a", "to", "of", "that", "because", "unless".

[TIME "Time words" This page has time words such as "now", "then", "before", "after", "today", "week".

[NUMB "Numbers" This page has the numbers 1, 2, 3, 4, 5, 6, 7, 8, 9, 0, and special endings such as -rd, -st, -th.

[DICT "Dictionary" This is the "Main Dictionary Page". It has the names of all 25 pages in the Dictionary. The Dictionary pages contain 925 of the most frequently used words in English. When you go to the [DICT page, you will see on it page names such as [ABSO, [DEVE, [ELEM, etc. Each of these pages is named for the first word on it, in alphabetical order. So, the page named [DEVE starts with the word "develop" and has words all the way through the word "electric". Next comes the page [ELEM]. Spend some time exploring the Dictionary pages to see what's in them. Notice that you can "thumb through" the dictionary because each page in it has on it the name of the previous page and the name of the next page. Anytime you want to return to the Main Dictionary Page, select the *RE command for "Return to Previous Pages". The VPSP "knows" that you don't mean to go back to one of the individual dictionary pages but rather that you want to return to the Main Dictionary Page, called [DICT.

There are other pages in the VPSP that you can discover on your own. Also, in the back of this manual is a list of all the VPSP pages. Altogether, the VPSP has 78 pages, including 29 pages that you can put your own messages on to store them until you need them. These pages, called "USER PAGES", since you are the "User", will be remembered by the VPSP even when you turn it off and back on again.

Summary of the Basic VPSP Commands

Here is a handy list of the VPSP commands you have learned. Each of these 9 commands always appears on any VPSP page that has words or letters or phrases on it that you can put into the Talkspace. These commands with their meanings are also on your VPSP pages called [DIRE, which you can get by going to the Table of Contents with *CO and then going to page 2 of the Table of Contents by selecting [PG 2. On [PG 2 you will see [DIRE, which stands for "Directions to use the Talker". (Talker is another name for the VPSP.) Select it and you will see this display:

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[DIRECTIONS TO USE TALKER]

MOVE CURSOR TO NEXT COLLOM >
GO TO TABLE OF CONTENTS *CO
GO TO SPELLING PAGE *SP
RETURN TO PAGE YOU WERE ON *RE
ERASE LAST ENTRY/LETTER *ER
TALK THE TALKSPACE *TA
GO TO USER COMMAND PAGE *UC
DELETE LAST WORD *DE

CLEAR TALKSPACE *CL
GO TO START-UP PAGE *ST
DUPLICATE LAST ENTRY *DU

The first nine commands in the display above appear on every VPSP page, including your own pages, which have letters, words, or phrases that you can select and put into your Talkspace. The last command, *DU, appears only on the [SPEL page and on the [SOUN (for Soundspelling) page since that is the only place you are likely to use it. It is handy for making double letters for spelling words like "letter".

Special VPSP User Commands

Besides the *DU command, there are seven other special commands. These seven commands are the ones you use to create your own VPSP pages. With them you can put what you have in the Talkspace onto your own pages. You can rename your pages to names that have special meaning for you. You can erase what you have on your pages and put something else there instead. You can even put the names of pages on your pages so you can get to them more quickly. As you use your VPSP, you will find that you can change it in many different ways to suit your needs and that as your needs change, you can change the VPSP to keep up with you.

Storing Your Own Messages on your Own VPSP Pages

Suppose you have a short sentence in the Talkspace that you have spent some time composing. Now you would like to save it so you don't have to compose it all over again the next time you want to talk it. If your sentence is no longer than 27 letters, including the spaces, then you can store the whole thing on one line of one of your "user pages" (You are the user, remember?)

To add what you have in the Talkspace to one of your "user pages", select the *UC command (for User Commands).
The VPSP will go to the [UCOM page. In the first column of the [UCOM page, select *UADD (for U Add to your page). You will see "*UADD" appear on the screen. Then select the page to which you want to add your Talkspace message. For now, how about selecting the page called [MY 3. The VPSP will go to page [MY 3. You will see there are two columns on page [MY 3, or any other "user page" you may have selected. The first column has a lot of blank space in it, and the second column has all the familiar 9 commands that you've seen on the other VPSP pages. Select the first column so that the cursor starts moving down that column of blank lines. When the cursor gets to the line where you want to put your message from the Talkspace, press your switch. You will see a copy of your message appear on that line of the page. Then the VPSP will automatically go back to the [UCOM page. This all happens sort of quickly. You might want to go back to the page where you put your message and see that it is really there. It will be. Just select that page again and the VPSP will take you there. Now you can use your selection switch to get your message from that page and put it into the Talkspace. You can treat your own message just like any other item on the VPSP pages that can be put into the Talkspace.

Remember that you can only put one line at a time from your Talkspace onto these "user" pages. You can put up to 14 1-line messages on a single "user" page, but you have to do them one at a time. If you want to put together longer messages to store, then you must use the [TCOM page. You will notice that you can get to the [TCOM page from the [UCOM page.

Suppose you have a message in the Talkspace that is three lines long and you want to store it. Use *UC to get to the [UCOM page, and from there select [TCOM (for "Text Commands"). The VPSP will take you to the [TCOM page, and the cursor will start moving down the first column automatically. When it gets to the *FADD command, press your switch. You will see *FADD appear on the screen and the cursor will start moving down the second column. These are the names of nine different pages upon which you can write up to 100 words each. Choose one, say the TXT2 page. The VPSP will automatically add the message you have in the Talkspace onto this page. If there was already something on the page, the VPSP will add the Talkspace message onto the end of what was already there. This way build up a long speech by composing a sentence at a time and adding it to the same page.

After the VPSP has added your message to the page, it will go back to the [TCOM page. If you want to talk what is on any of the "text" pages, use the *FTALK command from the [TCOM page and then choose the "text" page that you want to talk.
Changing the Names of Your Own VPSP Pages

Suppose you have put several messages on one of your user pages. Perhaps this page is called \[MY 9\], or some other number. The name \[MY 9\] doesn't tell you very much about what you have put on it. You can make up your own name for that page and change its name from \[MY 9\] to your new name for it.

You build your new page name in the Talkspace. Start by clearing out the Talkspace with the *CL command. Then go to the SPEL page using either the *SP command or by selecting the \[SPEL\] page.

There are a couple of rules to follow when you make up new page names. Remember that the "[" means to the VPSP that the letters after the "[" are a page name. You should always start page names with "[" so the VPSP will know they are page names. Now, select a "[" from the column of punctuation marks. You will see "[" as the first letter in the Talkspace.

The other rule about names of pages is that they have to be four letters long. So, think of a four letter name for your page – one that hasn't been used for any other page. Maybe you decide to call it \[NEWS\]. Spell it out in the Talkspace.

Now go back to your "user" commands with *UC. When you get the \[UCOM\] page, select the *UNAME command. Then select the page that you want to rename. We'll use \[MY 9\] as an example. So, you select \[MY 9\], and you will see on the screen that the VPSP goes to page \[MY 9\] and changes its name to \[NEWS\], then comes back to the \[UCOM\] page and changes the \[MY 9\] page there to \[NEWS\], too.

You can change the name of any "user" page you want as many times as you want just by putting the new name in the Talkspace and then using the *UNAME command. If you forget the "[" at the beginning, the VPSP will just not change the name at the point where you try to use *UNAME. Also, if you try to use the same name more than once, the VPSP will remind you of this by printing "Filename in use", which is its way of saying you are already using this name for another page.

If you want to change the name of one of your text pages, do just as you did for changing a "user" page, except you go to the \[TCOM\] page and use the *FNAME command.

Erasing Messages You Don't Want Anymore

Some of the messages you store away may be for a particular person or event. Later you'd like to use the
space for a different message. If you want to change one of the 1-line messages in a "user" page, just compose your new message in the Talkspace and use *UADD as you always would. When you get to the page with the message you want to replace, just select the line of that message and your new message will be written on top of the old one and will make the old one go away.

If you don't have a new message to put there but still want to get rid of an old message, you can play a trick on the VPSP to get rid of the old message. Use *CL to clear the Talkspace. Now it is full of nothing. Actually it is full of blanks (different from spaces) which you can't see. Now you use *UC as always and go to the page with the message to be erased. Select that message, and the VPSP will write the blanks from the Talkspace on top of the message and the old message will go away.

Getting rid of messages in the text pages is a little different. You must use the *FCLEAR command (on the [TCOM page). Use *UC to get to the [UCOM page and then select [TCOM to get to the [TCC page. Then select *FCLEAR from the first column. Next select the page you want to clear out. The whole page is going to be cleared, not just one line. When you select the page, the VPSP will show it to you and ask you if you really want to clear it. On the screen it will show you a "Y" and an "N". If you decide you don't really want to clear that page select the "N". If you really want to clear it, then select the "Y" and the VPSP will clear the page for you.

That's all the special VPSP commands. There is a list of them below that you can refer to if you forget how they work.

Summary of VPSP User Commands

Here is a list of all the special User Commands that you get to with the command *UC. The ones for the 1-line messages on the [UCOM page all start with the letter "U", and the ones for the longer, "text" pages all start with the letter "F".

[UCOM page commands:

*UNAME
NAME THE PAGE YOU SELECT WITH THE NEW PAGE NAME THAT YOU HAVE PUT IN THE TALKSPACE. Start page names with "[", which you can find on the [SPEL page. Names have to be exactly 4 letters long.

*UADD
ADD WHAT YOU HAVE IN THE TALKSPACE TO THE USER PAGE THAT YOU SELECT. Remember, you cannot add messages that are longer than 27 letters (including spaces). You won't hurt the VPSP if you try to add something longer than 27 letters; the VPSP will just cut off the part of the message that won't
fit. The message will still be intact in the Talkspace.

*F... commands for the "text" pages.

[TCOM page commands:
*FVIEW VIEW (LOOK AT) THE PAGE THAT YOU SELECT.
*FTALK TALK THE PAGE THAT YOU SELECT.
*FADD ADD THE TALKSPACE TO THE PAGE YOU SELECT.
*FNAME NAME THE PAGE YOU SELECT WITH THE NEW NAME THAT YOU HAVE PUT IN THE TALKSPACE.
*FCLEAR CLEAR OUT THE PAGE YOU SELECT, I.E., ERASE THE WHOLE PAGE.

When you get to the page, the VPSP will ask if you really want to clear the page. The cursor will move between "Y" and "N". If you really want to clear it, select "Y". If you did not mean to clear the page, select "N".

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B. User's Manual for the Joystick (or 5-Switch) VPSP

Introduction

The Versatile Portable Speech Prosthesis (VPSP) or "Talking Wheelchair" is designed as a speech prosthesis for individuals with severe motor impairment but who have good cognitive linguistic skills and/or abilities.

One version of the VPSP is designed for user control by a joystick plus a selection switch (or 5 switches). It presents possible selections to the user on a small television screen. The user moves a small rectangular block (called a "cursor") from one item to the next by means of a joystick or 4 separate switches. The joystick (or 4 directional switches) provide for moving the cursor up, down, right, or left on the screen. When the cursor gets to the item the user wants, the user presses the selection switch. Using these switches, the user can put items in a Talkspace for later talking, display any of 78 different screenfuls of selections (called "menu pages") and command the system to perform any of 16 different functions.

The system itself incorporates several levels of linguistic sophistication and corresponding capability. At the simplest level, the user can select from among several pre-spelled phrases and command the system to talk the selected phrase. At the most sophisticated level, the user can generate any desired message, edit it, talk it, and/or store it for future use. Depending on the linguistic abilities and acquired skills of the user, one or more of these levels may be used. A user need use only as much of the VPSP capability as he/she is able. The different levels, in order of increasing sophistication, are listed below.

1. SPEAK A PRE-SPELLED PHRASE
2. FILL IN A BLANK IN A PRE-SPELLED PHRASE WITH A CONTENT WORD AND SPEAK THE PHRASE.
3. COMPOSE A NEW PHRASE FROM PRE-SPELLED WORDS AND SPEAK IT.
4. COMPOSE A NEW PHRASE FROM SOME PRE-SPELLED WORDS AND SOME WORDS SPELLED BY THE USER. Note: Phonetic misspellings are usually pronounced correctly by the VPSP.
5. STORE A COMPOSED MESSAGE FOR LATER USE AND LATER RETRIEVE IT FOR TALKING. Note: The VPSP "remembers" the user's stored messages even if turned off.
6. GIVE A NAME TO A SET OF ONE OR MORE STORED MESSAGES TO AID MEMORY IN RETRIEVAL.
7. EDIT, THAT IS CHANGE, DELETE, OR ADD TO STORED MESSAGES AND/OR CHANGE THE NAMES UNDER WHICH THEY ARE STORED.
At all levels, the VPSP is designed to let the user erase mistakes or correct them before they are implemented. Also, should the user change her or his mind, it is easy to stop one operation and begin another.

Besides the capability for custom vocabulary and message generation, the VPSP lets the user "personalize" it in other ways. The user can set the speed at which the VPSP functions to match what is most comfortable.

How to use the VPSP

VPSP Rules:
1) Use the pushbutton switch to turn the VPSP on and off.
2) Use the joystick (or the 4 directional switches) to put it in front of the item on the screen that you want.
3) Use the paddle switch, or whatever "selection switch" you are using, to choose the item next to the "cursor" that you want.
3) YOU CANNOT HURT THE VPSP USING THESE SIX SWITCHES.

VPSP Special Symbols

The VPSP has some special symbols. You will see them as you follow this tutorial step by step.

1. "_" is called the "cursor". You move it across the screen with your joystick or your four directional switches at the speed you have selected on the "STARTUP" page. (The "STARTUP" page comes automatically when you turn the VPSP on.)

2. The ">" on the STARTUP Page means "go on to the next thing". Once you are satisfied with the speed you've chosen on the STARTUP Page, you use the ">" to tell the VPSP to "go on". On the other pages of the VPSP, it just indicates the tops and sometimes bottoms of the columns, but otherwise it does nothing if you select it.

3. A "[" in front of a word or string of letters means that that word or string of letters is the name of a page in the VPSP that you can go to, simply by selecting that item. You will see examples of "[" on the Table of Contents page and almost all of the other VPSP pages. For example, [END is the name of a page that has word endings on it, i.e. -ing, -ed, -tion, -ally.

4. A "*" in front of a two-letter abbreviation means that the abbreviation is a command that the VPSP will perform if the user selects it. For example *RE is not the word "re"; it is the command to the VPSP that tells it to RETURN to the previous page, whatever that page was.
5. If there are none of these special symbols in front of the words, letters, or phrases you see on the VPSP screen, then that means these words, letters, or phrases are available to use to build your speech messages, by spelling them out in a special area of the screen called the "Talkspace".

**VPSP Tutorial**

Turn the VPSP on with the pushbutton switch. You will see the STARTUP page appear on the screen after a short wait—about as long as it takes for your TV set to come on. Now, use the STARTUP page to select the speed that you want the cursor to move at when you are holding down your directional switches (or holding your joystick in the same direction). Use the joystick (or the "up" and "down" switches) to put the cursor in front of the speed that you want to try (one of the numbers in the first column). Press the selection switch. Once you select a speed, the number you selected appears below the "D" in "SPEED". Now, if you hold your joystick "up" or "down", the cursor will move at the speed selected. If you don't like that speed, you may select another.

If you are satisfied with the speed, select either of the ">"s" in the "speed" column. ">" means "go on". So, once you have chosen ">", the VPSP will automatically go to the Table of Contents page. From there you will be able to go to any other page in the VPSP.

**The Table of Contents**

On the Table of Contents page, you will see the names of lots of other pages. You can tell they are names of pages because they all start with "[", meaning "page name". [TIME means a page called "TIME" with time words on it. [SPEL means a page called "SPEL" with letters on it for spelling new words. You will see the name of the Table of Contents page at the top: [TOC, standing for Table of Contents. Every page has its own name on it, at the top.

Put the cursor in front of [USEFUL PHRASES and hit the selection switch. The VPSP will go to the [USEFUL Phrases page. Actually, the VPSP only uses the first four letters in a page name. Take a look at this page.

There is a blank area above the line on the page. This is the "Talkspace", and it is always there, even when you change pages. This is where you will put the message you want to talk.

Notice the column on the right. Everything in it starts with a "*". "*" means "a command to the VPSP to do the action named by the two letters after the "*".

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Some commands are:

*CO  "go to the Table of Contents page"

*SP  "go to the Spelling page and tack a space onto whatever is in the Talkspace so as to start a new word"

*ER  "ERase the last entry that was put into the Talkspace." Then, if *ER is used again without making any new Talkspace, it can be used over and again to erase one letter at a time.

*ST  "go back to the STARTUP page" - so you can change the speed.

The '>' just indicates the tops of the columns on this page. If you select it, nothing happens and the VPSP just waits for you to do something else. Pick a column you want with the joystick by moving it right or left and watching the cursor move right or left, too. Experiment with moving the cursor from one column to another. Then try moving the cursor up and down in a column by moving your joystick up and down (or by pressing your "up" and "down" switches). Notice that if you are going "up" and the cursor gets to the top of the column, it "wraps around" the back of the screen and starts coming up from the bottom. The same sort of "wrap around" happens for all four directions: right, left, up and down.

Now, put the cursor in the first column of words and phrases from the [USEful Phrases page. Now move it to "Listen to me" and hit the selection switch. Now, "Listen to me" will go into the Talkspace.

Now, move the cursor to the third column, the one with the commands. Then move the cursor to *TA for Talk the Talkspace, press the selection switch. Did it say, "Listen to me!"?

You can repeat your message by selecting *TA again. Or, you can clear out that message and put something else in your Talkspace. To clear the Talkspace, select *CL for Clear.

Maybe you want to say something that is not already spelled on the VPSP pages. Select the *SP command, and the VPSP will go to the Spelling page. Here you have all the letters of the alphabet, arranged in columns according to the general order that you use them to spell words in English. There are also punctuation marks such as ".", ",", and also a "space", shown by a tiny dot in the center. And, the last column on the page has all the commands, just like the other pages. Try spelling something. When you want to talk it, select the *TA.
If you make a wrong selection or change your mind, use the *ER to erase the last entry. To delete a whole word at a time, use *DE to delete the last word in the Talkspace. To clear out the Talkspace, use *CL. Actually, you could use nothing but the [SPEL page and say anything you want. But, it takes time to spell things out letter by letter. So, the VPSP has a lot of pages with words and phrases already spelled out for you. You can then select them for the Talkspace as a single item.

As you feel the inclination, explore the VPSP pages. You do this by selecting the name of the page you want to go to. Remember that you can tell if something is a page name by whether it starts with "[". You might want to start by looking at these pages:

[ASK "Ask a question" This page has words that you use for asking questions, such as "what", "who", "when"; and "are", "is", "can", "do".

[MAKE "Make a new phrase" This page has words for making up a new phrase, such as "I", "you", "he", "she"; "am", "are", "will", "won't".

[CONK "Connector words" This page has the little connector words that you put between the main words in your messages, such as "the", "a", "to", "of", "that", "because", "unless".

[TIME "Time words" This page has time words such as "now", "then", "before", "after", "today", "week".

[NUMB "Numbers" This page has the numbers 1, 2, 3, 4, 5, 6, 7, 8, 9, 0, and special endings such as -rd, -st, -th.

[DICT "Dictionary" This is the "Main Dictionary Page". It has the names of all 25 pages in the Dictionary. The Dictionary pages contain 925 of the most frequently used words in English. When you go to the [DICT page, you will see on it page names such as [ABSO, [DEVE, [ELEM, etc. Each of these pages is named for the first word on it, in alphabetical order. So, the page named "[DEVE" starts with the word "develop" and has words all the way through the word "electric". Next comes the page "[ELEM". Spend some time exploring the Dictionary pages to see what's in them. Notice that you can "thumb through" the dictionary because each page in it has on it the name of the previous page and the name of the next page. Anytime you want to return to the Main Dictionary Page, select the *RE command for "Return to Previous Page". The VPSP "knows" that you don't mean to go back to one of the individual dictionary pages but rather that you want to return to the Main Dictionary Page, called [DICT.
There are other pages in the VPSP that you can discover on your own. Also, in the back of this manual is a list of all the VPSP pages. Altogether, the VPSP has 78 pages, including 29 pages that you can put your own messages on to store them until you need them. These pages, called "USER PAGES", since you are the "User", will be remembered by the VPSP even when you turn it off and back on again.

Summary of the Basic VPSP Commands

Here is a handy list of the VPSP commands you have learned. Each of these nine commands always appears on any VPSP page that has words or letters or phrases on it that you can put into the Talkspace. These commands with their meanings are also on your VPSP pages called [DIRE, which you can get by going to the Table of Contents with *CO and then going to page two of the Table of Contents by selecting [PG 2. On [PG 2 you will see [DIRE, which stands for "Directions to use the Talker". (Talker is another name for the VPSP.) Select it and you will see this display:

DIRECTIONS TO USE TALKER

MOVE CURSOR TO NEXT COLLUM >
GO TO TABLE OF CONTENTS *CO
GO TO SPELLING PAGE *SP
RETURN TO PAGE YOU WERE ON *RE
ERASE LAST ENTRY/LETTER *ER
TALK THE TALKSPACE *TA
GO TO USER COMMAND PAGE *UC
DELETE LAST WORD *DE
CLEAR TALKSPACE *CL
GO TO START-UP PAGE *ST

The first nine commands in the display above appear on every VPSP page, including your own pages, which have letters, words, or phrases that you can select and put into your Talkspace.

Special VPSP User Commands

Besides the basic VPSP commands, there are seven other special commands. These seven commands are the ones you use to create your own VPSP pages. With them you can put what you have in the Talkspace onto your own pages. You can rename your pages to names that have special meaning for you. You can erase what you have on your pages and put something else there instead. You can even put the names of pages on your pages so you can get to them more quickly. As you use your VPSP, you will find that you can change it in many different ways to suit your needs and that as your
Suppose you have a short sentence in the Talkspace that you have spent some time composing. Now you would like to save it so you don't have to compose it all over again the next time you want to talk it. If your sentence is no longer than 27 letters, including the spaces, then you can store the whole thing on one line of one of your "user pages" (You are the user, remember?)

To add what you have in the Talkspace to one of your "user pages", select the *UC command (for User Commands). The VPSP will go to the [UCOM page. In the first column of the [UCOM page, select *UADD (for U Add to your page). You will see "*UADD" appear on the screen. Then select the page to which you want to add your Talkspace message. For now, how about selecting the page called [MY 3. The VPSP will go to page [MY 3. You will see there are two columns on page [MY 3, or any other "user page" you may have selected. The first column has a lot of blank space in it, and the second column has all the familiar nine commands that you've seen on the other VPSP pages. Put the cursor in the first column and then move it down the column of blank lines. When you get the cursor to the line where you want to put your message from the Talkspace, press your selection switch. You will see a copy of your message appear on that line of the page. Then the VPSP will automatically go back to the [UCOM page. This all happens sort of quickly. You might want to go back to the page where you put your message and see that it is really there. It will be. Just select that page again and the VPSP will take you there. Now you can select your message from that page and put it into the Talkspace. You can treat your own message just like any other item on the VPSP pages that can be put into the Talkspace.

Remember that you can only put one line at a time from your Talkspace onto these "user" pages. You can put up to 14 1-line messages on a single "user" page, but you have to do them one at a time. If you want to put together longer messages to store, then you must use the [TCOM page. You will notice that you can get to the [TCOM page from the [UCOM page.

Suppose you have a message in the Talkspace that is three lines long and you want to store it. Use *UC to get to the [UCOM page, and from there select [TCOM (for "Text Commands"). The VPSP will take you to the [TCOM page. Put the cursor on the *FADD command and press your selection switch. You will see *FADD appear on the screen. Now put the cursor in the second column. There are the names of nine different pages upon which you can write up to 100 words each. Select one, say the TXT2 page. The VPSP will
automatically add the message you have in the Talkspace onto this page. If there was already something on the page, the VPSP will add the Talkspace message onto the end of what was already there. This way you could build up a long speech by composing a sentence at a time and adding it to the same page.

After the VPSP has added your message to the page, it will go back to the [TCOM page. If you want to talk what is on any of the "text" pages, use the *PTALK command from the [TCOM page and then choose the "text" page that you want to talk.

Changing the Names of Your Own VPSP Pages

Suppose you have put several messages on one of your user pages. Perhaps this page is called [MY 9, or some other number. The name [MY 9 doesn't tell you very much about what you have put on it. You can make up your own name for that page and change its name from [MY 9 to your new name for it.

You build your new page name in the Talkspace. Start by clearing out the Talkspace with the *CL command. Then go to the [SPEL page using either the *SP command or by selecting the [SPELpage.

There are a couple of rules to follow when you make up new page names. Remember that the "[" means to the VPSP that the letters after the "[" are a page name. You should always start page names with "[" so the VPSP will know they are page names. Now, select a "[" from the column of punctuation marks. You will see "[" as the first letter in the Talkspace.

The other rule about names of pages is that they have to be four letters long. So, think of a four letter name for your page - one that hasn't been used for any other page. Maybe you decide to call it [NEWS. Spell it out in the Talkspace.

Now go back to your "user" commands with *UC. When you get the [UCOM page, select the *UNAME command. Then select the page that you want to rename. We'll use [MY 9 as an example. So, you select [MY 9, and you will see on the screen that the VPSP goes to page [MY 9 and changes its name to [NEWS, then comes back to the [UCOM page and changes the [MY 9 page there to [NEWS, too.

You can change the name of any "user" page you want as many times as you want just by putting the new name in the Talkspace and then using the *UNAME command. If you forget the "[" at the beginning, the VPSP will just not change the name at the point where you try to use *UNAME. Also, if you try to use the same name more than once, the
VPSP will remind you of this by printing "Filename in use", which is its way of saying you are already using this name for another page.

If you want to change the name of one of your text pages, do just as you did for changing a "user" page, except you go to the [TCOM page and use the *FNAME command.

Erasing Messages You Don't Want Anymore

Some of the messages you store away may be for a particular person or event. Later you'd like to use the space for a different message. If you want to change one of the 1-line messages in a "user" page, just compose your new message in the Talkspace and use *UADD as you always would. When you get to the page with the message you want to replace, just select the line of that message and your new message will be written on top of the old one and will make the old one go away.

If you don't have a new message to put there but still want to get rid of an old message, you can play a trick on the VPSP to get rid of the old message. Use *CL to clear the Talkspace. Now it is full of nothing. Actually it is full of blanks (different from spaces) which you can't see. Now you use *UC as always and go to the page with the message to be erased. Select that message, and the VPSP will write the blanks from the Talkspace on top of the message and the old message will go away.

Getting rid of messages in the text pages is a little different. You must use the *FCLEAR command (on the [TCOM page). Use *UC to get to [UCOM page and then select [TCOM to get to the [TCOM page. Then select *FCLEAR from the first column. Next select the page you want to clear out. The whole page is going to be cleared, not just one line. When you select the page, the VPSP will show it to you and ask you if you really want to clear it. On the screen it will show you a "Y" and an "N". If you decide you don't really want to clear that page select the "N". If you really want to clear it, then select the "Y" and the VPSP will clear the page for you.

That's all the special VPSP commands. There is a list of them below that you can refer to if you forget how they work.

Summary of VPSP User Commands

Here is a list of all the special User Commands that you get to with the command *UC. The ones for the 1-line messages on the [UCOM page all start with the letter "U", and the ones for the longer, text" pages all start with the letter "F".
**[UCOM] page commands:**

* **UNAME**
  NAME THE PAGE YOU SELECT WITH THE NEW PAGE NAME THAT YOU HAVE PUT IN THE TALKSPACE. Start page names with "[", which you can find on the [SPEL] page. Names have to be exactly four letters long.

* **UADD**
  ADD WHAT YOU HAVE IN THE TALKSPACE TO THE USER PAGE THAT YOU SELECT. Remember you cannot add messages that are longer than 27 letters (including spaces). You won't hurt the VPSP if you try to add something longer than 27 letters; the VPSP will just cut off the part of the message that won't fit. The message will still be intact in the Talkspace.

**[TCOM] page commands:**

* **FVIEW**
  VIEW (LOOK AT) THE PAGE THAT YOU SELECT. To get back to [TCOM, press your selection switch.

* **FTALK**
  TALK THE PAGE THAT YOU SELECT.

* **FADD**
  ADD THE TALKSPACE TO THE PAGE YOU SELECT.

* **FNAME**
  NAME THE PAGE YOU SELECT WITH THE NEW NAME THAT YOU HAVE PUT IN THE TALKSPACE.

* **FCLEAR**
  CLEAR OUT THE PAGE YOU SELECT, I.E. ERASE THE WHOLE PAGE. When you get to the page, the VPSP will ask if you really want to clear the page by showing you a "Y" and an "N". If you really want to clear it, select "Y". If you did not mean to clear the page, select "N".
C. User's Manual for the Keyboard VPSP

There are two rules to remember when using the VPSP:
1) You cannot hurt the VPSP by anything you type.
2) Whenever the VPSP gives you a message at the top of the screen, you can either do as it says or, if you don't want to do that, you can type any other key and return to exactly where you were. Sometimes it tells you of a mistake you made. These "mistakes" don't hurt the VPSP. They just tell you that it didn't "understand" what you typed. Just hit another key to make the message go away and get back to what you were doing.

When the VPSP first comes on, you will see the Directory of all the pages that currently exist, listed in alphabetical order. To get to any page so you can talk it, edit it, clear it, or kill it, just type the 4-letter name of the page and then press the <Go> key. (In these directions, whenever you see enclosed within < >'s, it means that is the name of the key, not that you should type the < >'s.)

Try going to the page named "KEYS".
Type <K> <E> <Y> <S>
Now press <Go>

Now the screen displays the page named "KEYS". This is one of the special pages in the VPSP because it tells you what the different control keys for the VPSP are and what they do. This page cannot be changed accidentally; so you can always come here to refresh your memory on which keys do what. Now, to get back to the Directory, you use what we call "Control D". "D" stands for Directory. "Control" refers to the fact that you have to have the VPSP keyboard in "control mode", sort of like "shift" on a typewriter so as to get a "control" "D" rather than a regular "D". We abbreviate "control" "D" like this: <"D>. Here are two ways to get <"D>; use whichever you prefer:

Way Number 1

Hold down the key labeled <CTRL>.
(notice the yellow light on the keyboard in upper left corner).
While holding <CTRL> down, press the <D> key.
You will see the Directory come back on the screen.
Release the <CTRL> key. (notice the yellow light go out).
Now you are back in regular typing mode.

Way Number 2

Press the red button labeled <Control Cursor> in the upper left corner. (notice the yellow light beside
This shows you that you are in "control mode". You will stay in "control mode" until you press the red button again.
Now press the <D> key.
You will see the Directory come back on the screen.
Now press the red button labeled <Control Cursor> again. (notice the yellow light go out)
Now you are back in regular typing mode.

There are two other special pages that give you directions to use the VPSP. They are called "DIR1" and "DIR2". Try going to them by typing their 4-letter name and then <Go>.
First go to "DIR1" and read it.

Now you can go directly from "DIR1" to "DIR2" by typing <D> <I> <R> <2> and then <Go>. You don't HAVE to return to the directory before going to another page.

Well, by now you probably want to say something. Think of a four-letter name that abbreviates the idea you want to say. As an example, I'll use "ISAY". "ISAY" (or whatever name you choose) is going to be the name of a new page that you will create.

Type <I> <S> <A> <Y>
Type <Go>
Read the message that appears at the top of the screen. Follow its instructions.
Next you should see a blank page named "ISAY", or whatever name you chose.
Now type in anything you want to say. Whenever you want to say it, press <Talk>.

Whatever you have typed on a page will be automatically stored there as soon as you go to another page or go back to the Directory. The VPSP will "remember" it even if you turn the system off and back on again.

Of course sometimes you will want to clear out a page and type something else. To do this you use "control C", for Clear, and then use one of the arrow keys at the top of the keyboard. We will use "->" to stand for the right arrow key and "<-" to stand for the left arrow key. Say you have just typed something in and talked it. And now you want to clear it out.

Notice where the white square or "cursor" is on the screen.
It is the glowing square that moves right each time you type a letter.
Type <^C>, as follows:
Either hold down <CTRL> while you press <C>
Or, press <Control Cursor>, then <C>, then <Control Cursor>. Either way, you will get a message at the top of the screen. Read it.

If you press the left arrow key, i.e. "<-", you will see everything to the left of the cursor cleared.

If you press the right arrow key, i.e. "->", you will see everything to the right of the cursor cleared.

Suppose you want to clear out only the first part of your message. Use the arrow keys, "Up", "Down", "Right", "Left", to put the cursor just after the last letter of the part that you want to clear out. Type <C> and then press the Left Arrow. Everything in front of (to the left of) the cursor will disappear, but everything starting with the letter the cursor is on top of will remain.

If, on the other hand, you had wanted to clear out the last part of your message but keep the first part, you could put the cursor on the first letter of the part you want to clear out. Then typing <C> and then pressing the Right Arrow will clear out everything starting with the letter the cursor is sitting on and going all the way to the end. But the beginning would be saved.

Experiment with this to see how it works.

Suppose you just want to rub out or erase a few letters. Use the arrow keys to put the cursor just after the letter you want to rub out, and press <RUBOUT>. You can rub out one letter at a time this way, like the "backspace" on a typewriter.

Suppose you want to insert some letters or words in the middle of your message. Put the cursor just after the letter where you want to start adding on. Now type whatever you want to insert and watch it appear in the middle of your message. The message that was there "opens up" to let your new letters be inserted. Experiment with this.

Now, suppose you are finished with the "ISAY" page, and you don't want it cluttering up the directory. You want to "KILL" that page. In order to kill a page you are on, you just type <K> <I>. Remember, this destroys the page whether there is anything on it or not, so be sure you don't want to keep anything on it before "KILLING" it. Try killing the ISAY page you just made.

Of course, if you wanted to keep this page and go off to another one, you would just go to that other page and the VPSP would automatically save the page you were on.
Every time you create a new page, the VPSP puts the name of that page in the Directory. Then, when you type <^D> to display the Directory, you will see the new page listed there, too, and in alphabetical order. Also, when you kill a page, the VPSP takes that page name out of the directory. So, when you look at the directory, the name of the page you killed will no longer be there. The Directory can hold up to 78 pages.

You can rename a page, if you want. Say you have a page called "MATH" and you decide you would rather call it "ALGB", or Algebra. Start by going to the page you want to change the name of:

Type <M> <A> <T> <H> and then <GO>

Now that you're on the page, type in the new name for it, in this case, "ALGB":

Then, Type <PAGE> (The "Page" key is on the top row of the keyboard on the far left)

You will see a message appear at the top of the screen. Do as it says, and you will have changed the name of your page from "MATH" to "ALGB", or whatever names you used. If you look in the Directory, you will see the new name in alphabetical order and will see that the old name is no longer there.

That is everything you need to know about controlling the VPSP. You can create pages, change them, talk them, rename them, and kill them depending on your communication needs. The VPSP will remember everything you do to your pages and save them just as you left them until you change them.
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