

HUMAN-COMPUTER INTERFACE AND TRAINING ISSUES IN THE DESIGN OF AN EXPEDIENT COMPUTER-BASED LANGUAGE TRAINING PROGRAM

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ABSTRACT

This paper describes the development and user concept evaluation of a Computer-Based Language Training Program in Somali titled "Humanitarian Expedient Language Pronunciation Simulation" or HELPS. The HELPS Concept Demonstration Project was designed to provide expedient language training to Marines involved in humanitarian relief duties in Somalia during Operation "Restore Hope". The HELPS project was a joint cooperative effort by the Institute for Simulation and Training (IST) at the University of Central Florida, who donated the software program without cost to the Marine Corps, Apple Computer, Inc. who loaned the 10 Macintosh® PowerBook™ computers to the Marine Corps for the duration of the project, and the Marines of all ranks in I MEF who evaluated the HELPS Concept Demonstration Project in Somalia.

The analysis, design, and development steps of the HELPS project are outlined. These steps allowed the rapid prototyping and delivery of HELPS to Marines deployed in Somalia in seven weeks from concept to delivery. The results of the user evaluation in Somalia is analyzed and presented.

This paper has several objectives. The first is to describe the analysis, design, and development of the HELPS project. The second is to describe the unique human-computer interface issues involved in the design of the HELPS. The third is to present the results of the user evaluation and acceptance of an expedient language training system. The fourth is to demonstrate and summarize the implications of a capability to bridge the language barrier in computer-based language training.

ABOUT THE AUTHORS

Daniel E. Mullally Jr. is a Research Associate at IST. He has 20 years of military experience as a Marine Corps Officer followed by over 13 years of training development experience. He has served as a training consultant in industry, a scenario designer in manual and computer-based military simulations (including the 14th and 15th IITSECs Distributed Interactive Simulation Interoperability Demonstrations), and a subject matter expert in military training. His research activities include the design and development of a Forms Translator Assistant for the U.S. Customs Service using computer-assisted text and speech presentation methodology and the USMC HELPS Project.

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George A. Kishek is employed by the NCR/AT&T corporation as a Systems Engineer. He was the principal software programmer for the HELPS Project in the Computer Assisted Language Lab. He is currently working towards a Doctorate in Computer Science at The University of Central Florida.

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INTRODUCTION

HELPS Concept Development

Project HELPS (Humanitarian Expedient Language Pronunciation Simulation) was created at the Institute for Simulation and Training (IST), as a Concept Demonstration Project. This HELPS concept had originally been conceived and demonstrated as an application of several foreign language research and development projects conducted in the Computer Assisted Language Lab (CALL) at IST. These projects included "PEDRO", a computer-based "English as a Second Language" (ESOL) project, the U.S. Customs Service Forms Translator Assistant (FTA)¹ project, and "SURVIVE", an early demonstration program of the HELPS concept. Previous research into language training using computers with a voice interface revealed a high order of training transfer and effectiveness.^{2,3}

Conflicts around the world and the need to intervene created a pressing need for U.S. marines to be able to communicate in a rudimentary way with the indigenous population. Areas of needed functional communication skills include both military and humanitarian operations. The need for an efficient, cost effective and rapid means to learn new language phrases to effectively interact with others will not end with Somalia. The HELPS concept is ideally suited for rapid development of a limited vocabulary and a set of functional phrases specifically geared to provide military personnel sufficient skills to communicate with indigenous personnel. In February of 1993, General Carl E. Mundy Jr., USMC, the Commandant of the Marine Corps, stated that "Americans will collaborate increasingly in global efforts at conflict resolution, humanitarian and disaster relief, and nation-building in places just like Somalia."⁴

Currently, nearly all newly enlisted Marines are high school graduates but only 18% have achieved any proficiency in a foreign language. Foreign language instruction in U.S. public schools leaves much to be desired; the emphasis is placed on reading and grammar rather than speaking and listening.

The traditional model for learning to speak a foreign language is for the instructor to verbalize words and phrases and have the class respond as a group. The instructor tries to hear incorrect pronunciations and provide individual feedback. The high ratio of students to teacher leads to slow, inefficient learning. Many language classes use laboratories in which students listen to tapes and repeat the phrase into microphones. The instructor can monitor student responses one at a time and provide feedback. Assuming a student to instructor ratio of 20/1, students receive individual feedback only on an average of 5% of the time. In addition, it is awkward for the student to hear a recording of his response for comparison with the correct one. Computer-Assisted Language Learning (CALL) is a relatively recent technology which shows promise in improving the traditional model.

The underlying concept of the HELPS project was to demonstrate the technology of using a computer to:

- present foreign language (Somali) and English text on screen,
- recall recorded native speech,
- record the user's attempt to mimic the native speaker,
- allow the subjective comparison by the user of his/her recorded voice against that of the recorded native speaker, and,
- provide repeated interactive cycles of the listen/record/compare process as a means to quickly learn new foreign language words and phrases.

The HELPS technology approach, the Human-Computer Interface issues, the

hardware selected, the software design approach selected, and the personnel assets available were critical decisions faced in the initial stages of the HELPS concept development Project.

This technology demonstration was designed to fill an immediate need to train Marines engaged in Humanitarian operations in Somalia during Operation "RESTORE HOPE" in the rudiments of speaking Somali. The timely delivery of an adequate language training device was of overwhelming importance and dictated several design and development innovations in the creation of the HELPS Project.

Hardware Availability - Hardware for the HELPS Concept Demonstration Project was limited to those readily available, off-the-shelf computers which had the ability to record and playback speech files. The computer selected for the Concept Demonstration had to have a capability to use headphones to diminish noise pollution, create a distraction for others nearby, or draw attention if used in a combat situation. The computer selected had to have the ability to be used in transit in ships, aircraft, or vehicles as required. The computer had to be capable of portable operations for extended periods of up to one hour. The computer had to have the ability to use a variety of field or expeditionary power sources. The delivery platform had to be rugged, lightweight and easily serviced. The computer, to be fully capable of meeting the expected range of field use, would require the capability to provide sound output to an external amplifier, bullhorn or loudspeaker. The computer used in HELPS would require a high order of user-friendliness for the first-time user who would possess a minimum of computer training or keyboard familiarity.

The PowerBooks™ used in the development of the HELPS system were loaned to the Marine Corps for a period of six months specifically for use in this HELPS Concept Demonstration Project.

Software Selection - The software selected for the HELPS Concept Demonstration Project was required to be readily available, inexpensive, and user friendly. The speech files and text supported by the software had to be rapidly accessed, and provide for a "FIND" function by searching for any portion of the word or phrase sought. The software had to be

compatible with the delivery of sound files on the hardware selected for the HELPS Concept Demonstration Project. The software used in the HELPS Concept Demonstration Project was provided without charge to the United States Marine Corps forces engaged in humanitarian relief operations in Operation "RESTORE HOPE."

Personnel Assets Available - Personnel, with the variety of specialized skills and talents needed, had to be readily available from within the University of Central Florida or in the immediate Orlando, Florida area in order to provide HELPS as rapidly as possible to the Marines in Somalia. The availability of computer software, voice recording, English language specialists, military task analysts and Somali language translators had to be quickly determined in advance of the development of the HELPS project. Fortunately all of the requisite personnel were available from the University community. A skilled Somali translator, Abdi-Rizak I. Salah was found through the International Student registry. Abdi proved to have a vast knowledge of the language, culture, and conditions that prevailed within his homeland, and an ability to select and tailor the words and phrases chosen for the HELPS Concept Demonstration Project. The USMC provided initial and follow-on HELPS Concept Demonstration Project evaluation personnel assigned to the I MEF Headquarters in Camp Pendleton, California and in Somalia.

Objectives of the Concept Demonstration

The objectives of the HELPS Concept Demonstration Project were to: (1) take advantage of recent advances in computer technology which support language training; (2) design a functional instruction course specifically geared to teaching "survival" Somali speaking skills for particular military missions in as short a time as possible; and (3) produce and test this courseware for proof-of-concept within six weeks (or sooner) after program start.

The HELPS Concept Demonstration Project in Somali objectives were structured for FMF units preparing for deployment, embarked on ships for extended operations offshore, or currently ashore in Somalia during Operation "RESTORE HOPE". The HELPS Computers would be placed within units for any of these situations, and made available to individuals on a scheduled, 24 hour basis. The placement of

computer-based expedient language trainers within their units would provide a learning center dimension for Marines and sailors to develop a language skill critical to any meaningful interaction with the Somali speaking people during humanitarian operations.

Rapid Prototyping and Development -

The HELPS Concept Demonstration Project was designed to rapidly prototype and develop a system in response TO a perceived need to quickly provide a system for evaluation under the initial conditions of the intervention. The seven week period of development forced some shortcuts in design and content completeness in favor of early delivery. That rapid prototyping and development experience is documented in this report to assist others in future projects of this type.

Six Month Evaluation Duration - The HELPS Concept Demonstration Project was designed to evaluate the performance of the system during a six month period. The underlying rationale of the demonstration was to provide a user evaluation under field conditions of a computer-based language training system. The evaluation was not meant to examine in depth the content or effectiveness of the phrases selected for inclusion of the system, but rather it was meant to determine the level of user interest in continued development of a future system. Without some statement of user acceptance the continued development of a system could not be advised.

Technology Push - The HELPS Concept Demonstration Project was designed to provide a window of opportunity to the ultimate users of the proposed system (Marines in Somalia engaged in Operation "RESTORE HOPE") of the modern state-of-the-art computer technology available to provide them with a Computer Aided Language Learning capability.

ANALYSIS

User Requirements Analysis

Analysis and design of the user requirements proceeded from previous experience with "SURVIVE" and "PEDRO" computer-based Spanish language programs developed at IST. The selection of the hardware, software, and personnel assets, and the time available structured the analysis and

design process. The initial step in the HELPS analysis was to select the appropriate language content to teach. The language requirement is more for speaking than for reading. The expedient language training should be computer-based, self-paced and designed to be delivered efficiently aboard ship, other work places, or in the field.

If the purpose of HELPS was to provide expedient language training as a means to communicate with Somali natives, then the words and phrases selected for inclusion in HELPS needed to be complete communications. Communications is a process which is transactional in nature. Communications to be complete needs feedback to the speaker from the listener.

Consideration was given to the selection of the native Somali speaker. The issues of dialect and regional inflections were overcome by selecting a native Somali speaker born and raised in Mogadishu, the capital of Somali. Mogadishu is considered the cultural center of Somalia and due to the influence of radio broadcasting from Mogadishu is viewed as the predominant accent heard and understood throughout Somalia.

Written material was provided to support the computer-based language instruction in the form of a vest-pocket sized booklet appropriate for self-study. (See Figure 1). The courseware was designed to be so easy to use as to encourage intensive practice. The phrases were carefully scripted in a format designed to provide on separate lines a numbered English, a normal Somali, and a phonetically structured Somali Phrase. This phonetic Somali phrasing took the convention of a hyphenated presentation with the accented syllable being capitalized to show the emphasis. The presentation and numbering conventions were standardized for both the computer screens and the vest-pocket sized phrase book.

The configuration of the computer-based delivery device was designed to provide the user with a friendly, intuitive interface offering a book-like presentation of separate pages for each phrase. The turning of the page was facilitated by using the directional arrows at the bottom of each screen which allowed the user to "page" backwards and forwards to other individual phrase screens.

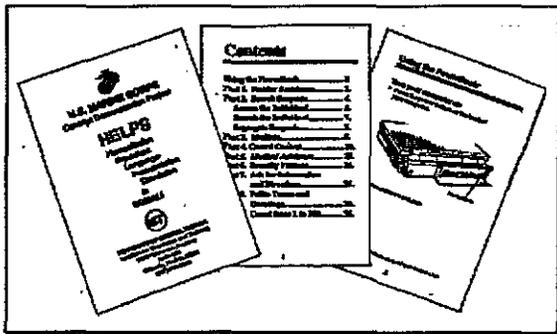


Figure 1. HELPS Instruction Booklet

Phrases were selected to meet the conditions expected of a military unit engaged in both military and humanitarian operations. Some of the phrases were chosen from Marine Corps training manuals to allow the Marine Corps training manuals to allow the Marines to select from categories of Search, Secure and Segregate individuals.⁵ Courseware was designed to be supplemented by audio-tapes.

Criteria for Word and Phrase Selection

Previous experience in testing IST developed language training projects lead the analysts to select those statements which are imperative in their nature and require only compliance to determine if communication is complete. Such statements as "STOP" or "COME HERE" are considered completed communications if the listener or listeners respond as requested.

The second type of communications selected for inclusion in the HELPS Project is the phrase carefully designed to elicit a non-verbal response. Phrases like "SHOW ME WHERE IT HURTS" or "HOW MANY ARE WITH YOU?" are examples of these phrases. The listener completes the communication by pointing or by responding with a show of fingers to these questions.

Human Computer Interface Issues

The limitations imposed by the computer-based language training approach were examined in detail to determine the natural process of listening, repeating, mimicking, correcting, and listening again and again as required to capture the example of correct pronunciation provided by the traditional language tutor. The HELPS user can accomplish all of these steps in language learning except to receive the acceptance or

rejection of his/her pronunciation attempt. That immediate feedback, oral or non-verbal, provided by the traditional language tutor is replaced in HELPS with the subjective personal evaluation of the user's recorded performance by the user himself/herself.

This departure from the traditional language tutoring process in the unique Human Computer Interface design of HELPS offers some interesting observations. First, the user can hear his/her own recorded voice compared against that of the native speaker. This ability to hear their own electronically reproduced voice effectively places the user "outside themselves". The user is offered an accurate representation of their own voice and the expert native speaker's voice to compare without any implied sense of embarrassment at their inexpert repetition. Without the fear of failing to perform to standard, the user can repeat the listening, recording, and comparing cycles offered in HELPS as many times as they feels it is necessary.

This is the reason the word **SIMULATION** was chosen for inclusion in the HELPS title. The computer acts as a simulated tutor. The user can demand and receive the continued, uninterrupted, and private performance of the tutor (HELPS) to meet his/her personal training objectives.

DESIGN

The HELPS project grew from previous research in Spanish and Arabic computer-based language training courseware developed at the Institute for Simulation and Training at the University of Central Florida. HELPS was designed to be based on the Apple Macintosh® PowerBook™ to allow the user to record his/her own voice and compare it with the recorded speech files of a native speaker. The student is tutored by a native speaker (whose voice resides on the computer) taking advantage of both auditory and visual feedback.

Intuitive "Point and Click" and on-screen instructions coupled with a pocket-sized phrase book provide the user with a rapid entry into the HELPS system. The use of icons depicting the intended functionality were incorporated throughout the screen design. These icons were explained in detail in the HELPS phrase book introduction.

The PowerBook™ was set up to open automatically to the HELPS program. This allowed the user to see the first opening screen immediately upon start-up. (See Figure 2)

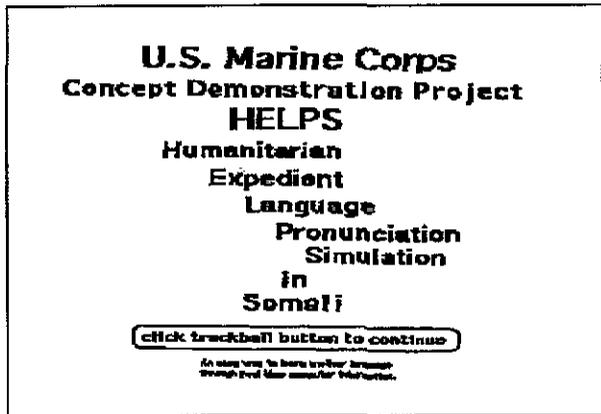


Figure 2. HELPS Opening Screen

Subsequent screens are reached by "Point and Click" techniques. To keep with the familiar "Book" metaphor the first operative screen contains the "Table of Contents" offering any of 10 lines active to the trackball and trackball buttons "pointing and clicking" technique. (See Figure 3)

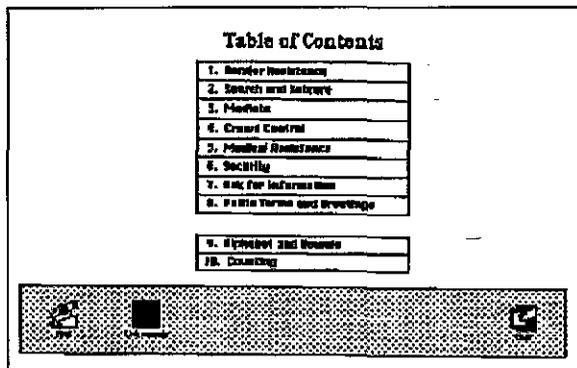


Figure 3. HELPS "Table of Contents" Screen

To quickly reach an appropriate phrase or word a "Find" function was provided which can instantly present the choices for selection. After selecting a subject from the "Table of Contents", the user is presented with a lined screen displaying a choice in English of up to fifteen words or phrases. By pointing and clicking on any one of these lines the user is presented with the selected word or phrase screen. The expedient language instruction is presented on a segmented screen with the Somali word or

phrase shown boxed first in a "normal" Roman alphabet and secondly, boxed in a hyphenated format showing the accented syllables in all upper case letters. The English word or phrase is shown in a box below the Somali translations. Both the "normal" speech and the "phonetic" speech boxes have active sound files. Clicking on either of the Somali boxes, the user is presented with the recorded phrase spoken by a native speaker. (See Figure 4)

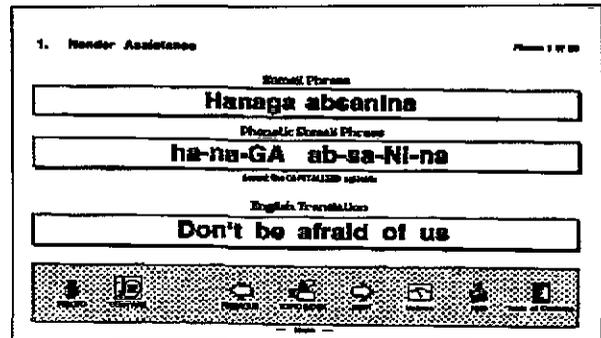


Figure 4. HELPS Sample Phrase Screen

A unique feature of the HELPS software is its ability to link up to fifteen selected words or phrases. The user can create and save these LINKED screens to replay upon demand. He/she can modify the previously linked screens by deleting or adding new phrases (See Figure 5). The phrases are separated by a built-in pause simulating the pause of a speaker at the end of each sentence or word. The resultant phrases can be delivered directly from the PowerBook™ or delivered to an external speaker.

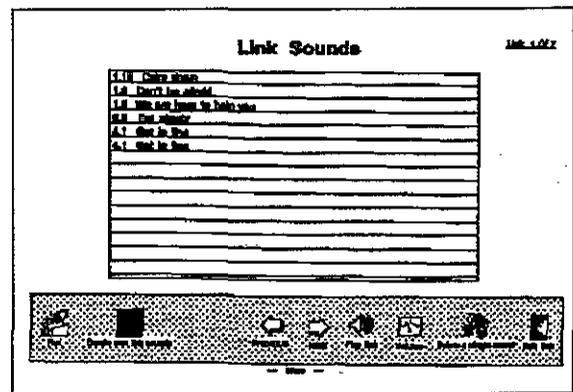


Figure 5. HELPS "Link" Screen

In addition to each of 253 words and phrases, the 21 consonants are shown in combination with each of the 5 possible vowel

and 5 double vowel and the 32 examples of numbers contained in the counting section are presented. The HELPS system allows for the repeated self-paced attempts to master difficult phrasing and pronunciation until the user is satisfied with the results.

DEVELOPMENT

Initial Prototype Test

The initial prototype tests were conducted at the Institute for Simulation and Training at the University of Central Florida using sequentially, the HELPS Concept Demonstration Project developmental personnel, other students from within the University, Marines from the Naval Training Systems Center, and Marine reservists from the 4th Truck Company in Orlando, Florida. These tests provided insight and feedback to the design deficiencies of the initial prototype.

Problems Encountered

The initial prototype development item was modified and transported to Camp Pendelton, CA. Evaluation and modification of the HELPS System continued concurrently during the demonstrations and initial training for USMC Project personnel. Several problems were encountered with the design and development of the speech files during this period. These problems were analyzed and modifications to the system were made as required. Software modifications were made to allow the user a period of time to record their voice timed against either the normal or slow paced Somali presentations.

Initial Prototype Distribution

The initial prototype system, modified as the result of user comments in the initial prototype tests at the Institute for Simulation and Training, was returned to the Marine Corps on 25 January 1993 at Camp Pendelton, California. Six of the systems were transported into Somalia by the Marine Corps Project Officer, and two systems were retained for training use by the Marine Expeditionary Unit (MEU) at Camp Pendelton, scheduled to replace the MEU in Somalia. One System was retained by the Institute for Simulation and Training and one system was retained at I MEF Headquarters at Camp Pendelton.

USER EVALUATION RESULTS

Summary of HELPS use in Somalia

Preliminary analysis of results resulted in the following conclusions. Testing provided a successful proof-of-concept. Every subject tested had an overall positive response to the HELPS. The user evaluation responses to the HELPS project are being collected and evaluated at the time of this writing. A copy of the Evaluation Questionnaire Form used to elicit responses from HELPS users in Somalia is attached to this paper. Several initial revisions to the human computer interface were made as a result of responses to this evaluation form. Suggestions for improvements included repeated requests for additional words and phrases. All of those responding agreed on the requirement of having the HELPS system available for training in advance of operations.

The HELPS is clearly a viable concept which has been shown to achieve its design objectives. Preliminary findings in field tests indicate a high degree of user acceptance. The intuitive design features of the HELPS interface lead to a rapid learning curve in achieving operator understanding. The HELPS system can defuse a portion of the anxiety caused by entering a new language environment by providing personalized, interactive instruction with the rate of delivery determined by the user.

IMPLICATIONS OF CONCEPT DEMONSTRATION

Technology Transfer

The HELPS approach, based on continued promising research and development at IST, provides for the individual tutoring of a student learning to pronounce words, phrases and sentences in any foreign language. Training time is predicted to take 5-10 hours of time at the computer (plus additional self-study using audio-tapes and a booklet) to learn 50 functional phrases.

Other HELPS modules using the same approach and authoring system can be developed for learning any foreign language. Programs could provide for a variety of help functions including the closest English approximation to the selected sound. A "see and hear" component of the help function, which could also be implemented, would depict: (1) a

"talking head" animation pronouncing the sound in question and providing advice on how to produce the sound; and/or (2) wave forms of the subject's and native speaker's production of the sound presented for easy comparison. IST is also evaluating the feasibility of incorporating voice recognition to provide feedback on correctness of pronunciation.

Future language programs will take advantage of emerging micro-miniaturization to develop language training programs on "Palm-Sized" computers. The introduction of this technology offers the ability to create a truly individual language training and communications device. Talking technical manuals are easily conceivable.

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