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Development of a Prototype Auditory Training Computer Program for Hearing Impaired Preschoolers

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DEVELOPMENT OF A PROTOTYPE AUDITORY TRAINING COMPUTER PROGRAM FOR HEARING IMPAIRED PRESCHOOLERS

BY

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THESIS

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ABSTRACT

A computer program which pairs auditory stimuli with visual stimuli was developed for the purpose of providing auditory training for the hearing impaired. It utilizes a Texas Instruments 99 /4A computer and Extended BASIC programming language which allows considerable graphics and sound capability. The lessons make full use of the sixteen colors available and the sound is provided three ways: Texas Instruments speech synthesizer, the computer itself (musical tones and noise), and by tape recorder which is controlled by the computer.

Focus of the lessons, which are designed for children ages three to five, is awareness of sound, environmental sounds, discrimination of changes in pitch and duration of sound, recognition of rhythm, and early language learning. At this beginning level, the program is primarily teaching by pairing the stimuli repeatedly, but there are some higher level tasks requiring input from the child to identify a stimulus.

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CHAPTER ONE

INTRODUCTION

In an age of computer specialization, it seems reasonable to assume that such a marvelous device should be able to assist with one of the most difficult tasks facing educators of children: teaching communication skills to prelingually deaf children. The first two years of life are believed to provide the basis for speech communication and language comprehension in the human infant (Lenneberg,1967) and congenital hearing loss deprives developing children of sensory input at this critical time. Without speech and language skills, the prospects for success in life are immeasurably diminished for those with this handicap. Until scientists and physicians are able to provide substitute ears, the best avenue for improving the quality of life for the hearing impaired may lie in instructional methods which can circumvent the impairment and provide the tools for a successful life in spite of the handicap.

For normal children, the learning of language is a seemingly effortless process requiring no special instruction. Almost any type of interchange which occurs between a developing child and another person provides a model of language usage and form (Brown,1958). Hearing impairment deprives children of most of these modeling opportunities. People are frequently not close enough for clear hearing , or they may be facing in another direction when they speak. If light is poor, visual assistance for

decoding the auditory signal is decreased. Or the child may simply hear so little of the conversation that understanding is prevented and the only choice is to disregard the sounds in order to avoid confusion with the visual signals. Being new language learners, children have no ability to make use of linquistic cues or closure for help in understanding.

Because of this extreme difficulty in learning language skills and speech, it is not unusual for the majority of deaf children never to progress beyond the 5th grade level in reading comprehension (Moores, 1978; DiFrancesca, 1972; Trybus & Karchmer,1977). Psychological and language testing has shown the deaf to be delayed in conceptualization and other aspects of language, and also to be socially and emotionally delayed (Goetzinger,1978; Farrugia & Austin,1980). Even though the above deficits are believed to be experiential and not intellectual (Myklebust, 1960; Moores, 1970) they, neverthless, prevent the severely hearing impaired from achieving success in school and later life.

There is also evidence that educational and language delay exists (although in decreasing amount) even in children with mild hearing losses (Holm & Kunze,1969; Sak & Ruben, 1981; Downs,1985; Bess,1986). Evidently, the early deprivation of auditory input, in any degree, has a direct effect upon school achievement which can be expected to impact an individual throughout life.

It is generally agreed that the language difficulties of deafness can be ameliorated if diagnosed early enough and exposure to auditory stimulation is enhanced at a sufficiently early age (DiCarlo, 1964; Ewing,1964; Pollack, 1982; Northern & Downs, 1984). As more has become known about the expected behavioral response of young infants and with the advent of

norms for Auditory Brainstem Response (ABR) and other physiological measures of hearing loss, professionals are identifying hearing impairment in very young children, thereby enabling auditory training to begin during the critical first few years of life and, presumably, facilitating the habilitation process (Liden & Harford, 1985; Northern & Downs, 1984).

Review of the Literature

Rationale for Auditory Training

Developing children must learn to recognize and depend on sound (Pollack,1982). Just as adults have learned to "tune out" annoying background noise , prelingually deafened children, without learning to value and utilize available auditory signals consider them to be noise, and disregard them. This was dramatically demonstrated in a study by DiCarlo (1960) which showed how delayed auditory feedback affected the speech of normal children when it was heard, but did not affect the speech of the deaf. After auditory training, these children, too, were shown to be aware of their own speech and to be affected by delayed feedback of their speech.

When the hearing impairment is diagnosed early in the critical first few years, educational programs with intensive auditory training utilizing whatever residual hearing is present, combined with properly fitted and maintained hearing aids and often conducted by the parents in the home, have demonstrated improved skill with speech and language as well as cognitive functioning for young hearing impaired children (Ling, 1984a, 1984b). In such programs the need for parents to talk normally to their

hearing impaired children providing the same language input which would be given to normal children is stressed (Pollack, 1985; Simmens-Martin, 1978).

Fry (1966) presented audiograms of hearing impaired children in England, some with good speech and some with no speech. He stated that the reason some of them failed to learn to speak was "simply that they have not been exposed to enough speech". He substantiates his statement from personal clinical experiences. All of these children have considerable residual hearing by today's audiological standards (Fry's standard is not given) and Fry states that such hearing can be shown to become more sensitive after auditory training. Hodgson ((1978) presents audiograms (at 16 and 22 months) of a child whose hearing also appeared to "improve" with training. Probably these children did not actually have a change in their hearing but there is no question that they responded better after early auditory training.

Differences in language performance among the hearing impaired are believed to be due, in part, to teaching methods for the prelingually hearing impaired (Lenneberg, 1967; Ling,1976), and this is an area which can and must be improved by research. Less than 5% of hearing impaired children (Huizing, 1959) have no residual hearing at all, a fact which should provide impetus to exploit that capacity with better hearing aids and teaching methods. The natural method of language learning is through the auditory channel and if this can be utilized at all for prelingually hearing impaired youngsters, their difficulty with speech can be lessened and their future prospects considerably improved.

Auditory training received considerable attention in the literature in the 1960s and early 1970s but has not appeared as often in the recent literature. Hudgins (1953) provided early empirical evidence that children with severe to profound losses could benefit in speech perception and phrasing and in educational achievement through use of powerful hearing aids and auditory training. Oyer (1966) reported that excellent clinical evidence of the value of auditory training was available, but not enough research had been done to confirm it. Since that time the clinical evidence has continued to accumulate but the empirical evidence is still somewhat sparse. A review of DSH Abstracts from 1972-1977 (when the contents no longer listed auditory training as a separate category) revealed only 7 empirical studies out of a total of 37 articles. In the years since 1977, the information on auditory training is no longer indexed under its own heading in DSH Abstracts which necessitates more tedious analysis. A few studies have been found, however.

Reviewing one study which demonstrated a 20% increase in syllable reception ability among profoundly hearing impaired children in a unisensory (auditory only) teaching program, Stone (1983) carried out his own study and demonstrated similar results by adding intensive auditory instruction to a regular school program for the hearing impaired. The author states that "the ultimate success of such instruction lies in the teacher's conviction that each child will hear and understand spoken language" and further states that systematic training to "detect, discriminate, recognize and comprehend various spoken language patterns" is essential. He recommends "the use of recording devices such as tape

recorders and language masters" (a tape card machine which pairs auditory stimuli with pictures).

Long, Fitzgerald, Sutton and Rollins (1983) have reported a case study of a young child with a profound loss (high frequency responses at 100 dB) who was taught with intensive auditory stimulation who "functions like a normally hearing child in her use of language." She had the benefit of auditory input for 13 months before her hearing loss, however, which is a very important variable in these studies. The authors note that this approach requires intensive parental involvement and that "some parents are unable to assume the enormous commitment required."

Hearing impaired children are integrated into regular classrooms by age six or seven (60 to 90% success rate) with the Verbotonal Method of auditory training at the University of Tennessee (Asp,1985). This method utilizes tactile stimulation with specially designed vibrotactile devices, first developed in Yugoslavia, to supplement intensive auditory training. There is no data about levels of hearing loss reported.

Temporal cues (the timing between phonemes,syllables and/or words) have been shown to be important for perception and understanding of speech (Tallal,1978) and temporal training has been taught to the hearing impaired through music (Amir and Schuchman, 1985). Since the only speech cues available to the most severely hearing impaired are those of intensity, stress, duration, pitch, rate and voicing, Ling (1978) states that "so far as the suprasegmentals are concerned, there is no good substitute for the optimum use of residual hearing."

Ling also refers to the need for optimum amplification with as wide a range of speech sounds as possible during auditory training in order to help

children to store these sounds in their perceptual systems. There is debate as to the wisdom of switching the children to different types of amplification devices and there are some advocates of having the child always use his own aids so the auditory signal he receives is "consistent" (Pollack, 1982). Of course, this would be detrimental if the aids were unable to provide any high frequency information which is a characteristic frequency response of many hearing aids. Berlin (1987) describes successful modification of these aids to provide high frequency information up to about 4000 Hz. Obviously, this would be a consideration in choosing what type of amplification to use for auditory training.

Ling (1978), Siebert (1980), Buckler (1980) and Winitz (1980) advocate a hierarchy of teaching skills which follows the normal acquisition of speech sounds. These methods are all directed at very young children but Berg (1978) cites several studies which have shown the success of auditory training methods at all ages and that learning generalizes to untrained sounds and, also, to speech production. Studies at the National Technical Institute for the Deaf (NTID) also report similar results (Subtelny, Orlando & Webster,1980).

Rationale for Computerized Auditory Training

The efficacy of the computer for instruction of repetitive material, for drill and practice, and also for evaluation is well established (Hoffmeyer, 1980; Stuckless, 1983; Schwartz, 1984; Bramble, Mason & Berg, 1985). Numerous programs have been developed and are in use for teaching spelling, reading, math, and all other academic subjects . Programmed Logic for Automatic Teaching Operation (PLATO) is a long-term project developed

at the University of Illinois beginning in 1959, now a property of the Control Data Corporation, which covers a vast range of instructional levels and subjects and is in use at schools all over the country as well as available for use on home computers (Rockart & Morton, 1975). Writing to Read, a creative reading instructional program marketed by IBM Corporation, is reviewed by Jones (1985) and is thought to be capable of revolutionizing both the educational process and the publishing industry because it teaches children to read at higher levels at much younger ages.

Hoffmeyer (1980) reported on dramatic increases in learning rate (instead of the expected 0.5 year gain per year of instruction, his students had a 1.1 year gain in nine weeks) using CAI at the Florida School for the Deaf and Blind and mentioned that the students liked the method which they found "pleasurable."

Teaching by computer has been adopted extensively by programs for the handicapped (Watson, 1979; Hoffmeyer, 1980; Rose and Waldron, 1984). The availability of the small, personal, and relatively inexpensive microcomputer since the early 1970s, has made computer assisted instruction (CAI) affordable to multitudes of people and classrooms (Schwartz,1984). In a survey of microcomputer use for the hearing impaired, Rose & Waldron (1984) report that the most prevalent type of computer in the classrooms for the deaf is the Apple II series. They further discovered that the most needed type of software was in the areas of "language arts " and reading. No auditory training software was mentioned.

In the field of communicative disorders there is a growing organization which is promoting the development of software for use in treatment and

diagnosis : Computer Users in Speech and Hearing (see Harn, 1986). However, the development of specialized material needed for the communicatively handicapped is just beginning to expand, with relatively few manufacturers specializing in this type of computer software (Rushakoff, 1984).

Teaching speech production to the deaf utilizing computers or computer-controlled machinery to provide feedback has been extensively researched with some success (Nickerson & Stevens,1973; Boothroyd, Archambault, Adams & Storm,1975; Brooks, Fallside, Gulian & Hinds,1981), however, this equipment is very specialized and far from readily available. Interactive Language Instruction Assistance for the Deaf (ILIAD) is a computer program for teaching language which was developed from sophisticated artificial intelligence technology and has recently been adapted for use on the microcomputer (Bates & Wilson,1980).

Auditory training with microcomputers, however, has seldom been reported in the literature. Watson (1979) reviewed the computer instruction programs at the major schools for the deaf across the country and did not mention auditory training. At the 1986 Computer Conference in Orlando, Florida, sponsored by the American Speech-Language-Hearing Foundation, there was a presentation of a partially developed auditory training program being implemented on an Apple Computer in Canada (French-St. George,1986).

At the National Technical Institute for the Deaf (NTID) in Rochester, N.Y., a method was developed utilizing an Apple computer to provide the visual stimulus and a tape recorder for the sound stimulus. After some success, the method was abandoned because of difficulty with synchrony

of the computer and the tape recorder (Sims, Scott & Myers,1982). The same authors report on attempts to do auditory training using a PLATO program they had written but it was not satisfactory because of poor auditory quality and expense and because most of the PLATO material was too advanced for their students. Second generation equipment used for speechreading training at NTID utilizes a video disc in conjunction with an Apple II computer and is referred to as DAVID (Sims, 1982). Shearer (1984) comments upon the capabilities of DAVID but states that it is technically too difficult for most institutions.

There are some CAI authoring systems: PILOT, BLOCKS and LOGO which enable teachers to more easily design individualized programs of study on computers for their students but Rose & Waldron (1984) report that only 10% of the schools for the deaf have them. They found the BASIC computer language to be the one most available in these schools and this may explain one reason for no reports of auditory training programs since this language is not known to many clinicians in communicative disorders (Rushakoff, 1984). Computer systems are reported in the literature at schools for the deaf (Watson,1979) but as noted earlier at NTID, these are complicated systems and because of differences in the hardware, they might not be transferable to other schools.

One of the advantages of the computer is the possibility for children to use it without supervision, thus providing valuable practice time without the one-on-one attention of a teacher. Bloom (1983) reported on a non-computerized method of auditory training which her students can use on their own, freeing the teacher for other tasks, and found it to be very valuable. She noted several problems with the equipment, however, and

also with the time for preparation of individualized lesson plans. The need for development of material for evaluation of progress was also a criticism.

Automated auditory training which children can use alone has been suggested and utilized by Erber (1982). His device was a tape card machine which required that the teacher place the stimulus material on the cards for each child and for each lesson. He noted that such devices had "been shown to be effective in improving children's auditory perception" (no reference) but that the linearity (the sounds can only be presented in the order in which they are placed on the tape) of the recording was a disadvantage. Erber also noted that the use of electromechanical equipment was not among the skills of many teachers and they required special instruction. Doehring (1968) reported on an audio-visual device used for "auditory nonverbal perceptual training" which utilized a slide projector and a tape recorder. His study reported that 19 of 26 hearing impaired children reached learning criterion and that "even profoundly deaf children might benefit from auditory nonverbal perceptual training." It should be noted that this training was nonverbal (animal sounds) which differs from most of the other studies already reported.

Rationale for Software Program Development

A review of professional and commercial publications suggests the absence of commercially available computer software for auditory training. The educators who have written about the use of computers in teaching, stress the importance of good software (Bramble, Mason & Berg, 1985; Rockart & Morton,1975; Schwartz, 1984) and the lack of availability of

same. One of the difficulties with software development, in general, has been the need for each piece of hardware to run only software specifically written for that machine. This has prevented the distribution of already-developed material to other schools which could not afford the specific hardware required. A program which can be used on the most readily available computers in the field of communicative disorders, requiring minimal assistance from the teacher, and with provision for individual levels of expertise would, therefore, seem to have some value. Especially if it could also be shown to be a cost-effective and successful means of increasing auditory input and use of auditory skills by its users. Such a program would need to be developed with attention to the normal order of speech and language acquisition and according to accepted methods of auditory training. The availability of such a program for research could facilitate control of one of the variables which have made this research difficult to generalize, the differences in teaching methods.

Goetzinger (1978) believes that if the deaf are to be educated to their potential, their receptive language "competency" must be equal to that of their hearing peers by age 6. Some of the previously mentioned programs are meeting that goal for many of their students (Ling,1984 a,1984 b; Asp,1985) This suggests that such a program should be directed toward the preschool child in an effort to provide a better foundation of vocabulary and language by the beginning of school. Discrimination of environmental sounds is usually the first level in an auditory training hierarchy (Pollack,1982). However,there is research indicating that normal children are born with discrimination ability (see Marlowe,1982, for a review of

this research), and also research that indicates using words for training is more effective than using syllables (Abraham & Weiner,1985).

Doehring's (1968) research demonstrated that with sufficient pairing of a specific auditory signal with its visual representation on a lighted screen (a task easily accomplished by computer), hearing-impaired children were able learn to recognize that signal and apply meaning to it. Subjects always react more quickly to the speech sounds which have meaning attached (Studdert-Kennedy, 1976), and children, in particular, respond best to the sounds of speech (Northern & Downs,1985). Since we know that the deaf cannot hear all acoustic signals, it seems logical to give them redundant signals in auditory training and let them choose their own best method of decoding. This is the approach which has demonstrated success with numerous children (Pollack,1985; Stone, 1983; Ling, 1984, Long et. al. 1983)

According to Pollack's suggestions for auditory training, the child should be hearing words which pertain to things around him/her every day and be hearing language at a level he or she can be expected to use (Pollack, 1985) . Research has provided a sound theoretical basis for the type of material which should be presented at various stages in order to follow the normal language development of children (Chomsky,1969; Brown, 1973; Kusko,1985). Studies of lexical development of normal children (Carroll & White, 1973; Gruendel,1977) provide the types of stimulus words which are expected to be within the range of a three-year-old child. Obviously, this will be variable for a hearing impaired child, although most studies of their speech acquisition has shown that they are following the same order, but are delayed (Goetzinger,1978).

A computer program which teaches the use of action verbs compared the effectiveness of three teaching techniques: the visual image on the computer screen; pictures; or live action . The computer image compared very favorably with the live action and was significantly more effective than pictures (Harn,1986). Ruder, Hermann and Schiefelbusch (1977) have demonstrated that verbal imitation is not necessary for a child to learn to comprehend new words. Winitz (1973) has reported on the value of teaching receptive language in this manner before attempting speech with second language learners.

As the level of skill increases, words can be placed on the screen with the visual object, facilitating the association of sound patterns with graphic patterns for reading. Lenneberg strongly supported early exposure of deaf children to graphic language material (1967). Simple sentences and commands would also be appropriate for this level of program as the child acquires the vocabulary, if they could be represented graphically on the screen. Simple choices could be offered to slightly older children (age 4 and 5) as they become familiar with the computer, thus enabling an evaluation of their level of skill. The program could be written to automatically branch to a higher level upon attainment of a minimum score on an evaluation quiz. Erber (1982) stresses the importance of appropriate reward and feedback methods in order to motivate the child to continue.

Inexpensive and commonly available speech synthesizers which can be coupled to the microcomputers do not provide very clear articulation, nor do they provide natural rythym and pitch variations, therefore this would not seem to be a very good model for hearing impaired children. Studies of the effect of synthesized speech on the auditory system of deaf children

would be needed to determine if it could be used. Such research has not been forthcoming to date.

The purpose of this research is to investigate development of a prototype computer program for auditory training for hearing impaired children, ages 3 to 5. This program should be designed to be useable on commonly available microcomputers with limited memory and should be inexpensive, thus making it useful for the maximum number of school systems and individuals.

CHAPTER TWO

METHODS

Instrumentation and Materials

Software was written in "Extended BASIC" (programming language which allows for sophisticated "video game" graphics and sound) and fed to a Texas Instruments computer, model 99/4A, equipped with 48K of RAM and a single disk drive. Each lesson is recorded on a 5.25 inch floppy disk and programmed to load automatically when the computer is turned on. Visual images are displayed on a Panasonic color computer monitor while the auditory signal is provided in one of three ways: a Texas Instruments tape recorder equipped with cable to allow synchronization with the computer, a Texas Instruments speech synthesizer, and the computer itself, which can generate musical frequencies within the range of 110-44,733 Hz.

Procedures

Based on the work of Norman Erber, Nussbaum and Deyo (1981) developed an Auditory Skill Development Guide for Kendall Demonstration Elementary School at Gallaudet University and recommended the following hierarchy for auditory training:

Detection, or the ability to be aware of the presence or absence of sound.

Discrimination, or the ability to perceive similarities and differences

among two or more auditory stimuli.

Recognition, or the ability to identify a direct representation of an auditory stimulus.

Comprehension, or the ability to respond appropriately based on an auditory stimulus.

These programs are directed at all levels of hearing impairment in a preschool population beginning at age three. For the severe to profoundly impaired, the assumption is made that the users have little or no awareness of sound. Also, since any level of hearing impairment can result in defective sensory input in the early years, the first two categories above, detection and discrimination, were chosen for most of the sample lessons. The method of presentation of each lesson is based on a response paradigm needed in behavioral audiological testing, where the client makes a response after detection of an auditory signal. The response desired is a computer key press which always results in the presentation of a visual "reward" on the computer screen. There is no right or wrong answer at the beginning levels, since the idea is to have the child notice the sound and be rewarded for his behavior.

The desire to make the program suitable for such young children, with minimal supervision, further suggested design of the software in a manner which would "teach" the task to the child. The success of this idea has yet to be evaluated, but some preliminary trials with hearing children have suggested positive results. If not successful, it would be necessary for the parent or teacher to demonstrate the correct response.

Erber (1982) suggests the design of these lessons by listing the steps in teaching "perception" to a child:

> 1) Showing the child a repertoire of responses (or discovering those already known by the child);
> 2) associating a stimulus with each response;
> 3) presenting one of these stimuli with a request to respond;
> 4) having the child choose from among the alternatives;
> 5) rewarding correct responses and pointing out (or ignoring) incorrect responses.
>
> If the child frequently responds correctly, you can assume that the desired perceptual learning has taken place. If incorrect responses are common, your conclusion is that the child is having difficulty learning, or that you have incorrectly presented the perceptual task. During instruction, you may vary stimulus and response complexity according to the child's success or difficulty with the perceptual activity. (p. 27)

Risberg's study (cited in Erber,1982) has shown that the frequency discrimination ability of hearing impaired children is often poorer than that of normal hearing children. The difference limen for frequency of severely and profoundly impaired children ranges from 5-40 % requiring up to a 40% difference in frequency for them to distinguish between two neighboring tones, while normal children can distinguish two tones with a 1-2% difference in frequency. This same research also indicates that a child's tone discrimination ability relates closely to his ability to recognize familiar words auditorily. Two different lessons based on this research have been developed.

Smith (1972) used a pattern discrimination task where the subjects are taught to associate a color block with a tone (short block for short tone, long block for long tones, block high on the screen for high pitch, large block for loud sounds, etc.) when evaluating the speech skills of her young hearing impaired subjects. Geers and Moog (1987) suggest that the same test is a useful addition to the set of criteria they recommend for predicting if the profoundly impaired children in their school (Central Institute for the Deaf) will be auditory/oral or manual. These reports suggested use of this task for auditory training and a program was designed to teach this skill.

The ability to perceive intensity cues has been measured even in profoundly hearing impaired children whose pitch discrimination ability is extremely poor. It has been suggested that they only make these discriminations vibrotactilely (Erber,1982). While this has limited application to speech discrimination, it makes sense that if the ability can be trained to a higher degree it can be utilized to assist in speechreading and in detection of suprasegmentals in speech (Ling,1978). Therefore an attempt has been made to create a lesson which can be used by these children to increase their intensity detection ability. This may be the only lesson which can be utilized by some children, but it should have usefulness for the severely impaired and all those with lesser impairments to call attention to the fact that rhythm in speech is important.

The common use of a menu-driven program in computer software would not be appropriate for this age child since they cannot read or be expected to choose letters or numbers on the keyboard. Therefore, this is avoided by placing each program separately on a disk with programming designed to automatically load and run the program. This requires only that the adult

place the disk in the drive and turn the computer on. With two keystrokes, the program is running. In order to run another program, the computer is turned off, the disk is changed and the computer is turned on again. The same two keystrokes will run the program for the child. Input from the child will require only a touch of any key to keep things happening in rapid succession. Error trapping routines have been included to ensure that the program will not stop running if a wrong key is touched.

The only exception to the above procedure is in the language lesson where the stimulus is speech. Since the speech produced by a commonly available synthesizer was judged subjectively to be of insufficiently good quality for auditory training, a tape recorder is used for this lesson. This requires that the teacher put the proper tape into the recorder and follow the on-screen directions for rewinding and synchronizing the tape with the computer program. After this, the computer controls the tape and the child still controls the computer by responding to the auditory signal with a key touch.

A decision was made to develop lessons in three areas: language; suprasegmentals of pitch, duration, and prosody; and discrimination of speech from other environmental sounds. Some of the tasks in the lessons will allow evaluation of the learning which is taking place, if any. These five lessons are believed to be a good representation of the type of teaching which can appropriately be done by computer for auditory training. The results of further investigation will probably suggest modifications and other avenues for development.

CHAPTER THREE

RESULTS

Auditory Training Lessons

Presence or Absence of Sound

Prelingually hearing impaired children may not attach any meaning to sounds even if they hear them (Pollack,1985). This lesson attempts to teach them that a sound can signal something good. The screen is blank and the word "Listen" is spoken by the speech synthesizer. Then the computer plays a tune and waits for the child to respond at this point by touching a key, since the auditory signal has been given. The first time through, the teacher should determine if the child is hearing the sound and adjust the volume accordingly. It may also be necessary for the child to be shown that he or she may touch a key, although all children who tried this program seemed to do this without prompting. Immediately after the key touch (any key) a humorous picture is drawn on the screen for a short time and then it goes blank again. The process is repeated with longer delays before the sound each time. Touching a key produces no response until the sound is heard and then a key touch will always produce the drawing of a person with very large ears. After 5 times through this routine, the child is given a visual reward accompanied by a verbal one (Good for you!) by the speech synthesizer and then invited to try some more.

There are now other sounds and pictures produced by the computer, which waits each time for the child to touch a key after the sound is heard, before producing the picture. The sounds are: car horn, clock, smoke alarm, water running, door bell, telephone ring and a person's voice. The sounds are repeated while the picture is on the screen to facilitate learning. The choice of these sounds was dictated by the ability of the programmer to make the computer imitate that particular environmental sound. Environmental sounds are usually the first step in any auditory training hierarchy (Erber, 1981) because they are everyday sounds and must be distinguished from speech which has special meaning to humans.

Language Lesson

Building on the previous section, this section pairs a stimulus picture with the word or words to match it. Essentially still a detection task for the child, requiring only a response (key touch) after the auditory signal, this program also provides some language input. A paired auditory and visual stimulus are produced each time the child touches a key with things happening very quickly to avoid boredom. Language taught includes nouns, verbs, and colors. The nouns and verbs were chosen because they were commonly occuring in the environment of children and are also the early building blocks of language in the initial stages (Brown, 1973). The nouns are also things which can move enabling the demonstration of the concept of the action verbs. The ability of a child to learn this concept by computer was demonstrated by Harn (1986). The colors were selected because they would make things more interesting and the particular colors were those available in the programming language. Nouns used are: car, truck, airplane,

sailboat, train, man. Colors used are: yellow, blue, green, red. Verbs used are: go, walk, jump, run, fly.

Pattern Discrimination

Placing two colored blocks on the screen at two levels, the computer then plays two musical tones, a high note (900 Hz.) and a low note (150 Hz.). The intensity is always controllable by use of the volume control on the monitor. A small "frog" on the screen jumps into the appropriate square to indicate if the tone is "high" or "low." This is repeated several times in random sequence as a means of teaching the concept. Steps involved in this lesson are the first two, detection and discrimination. If the child is not able to hear a difference between the tones or is unable to hear the tones, he or she will not learn the concept and will be unable to perform the next level.

Moving to a higher cognitive level, the computer produces two tones at a time and the frog jumps twice. This is extended to three tones and the frog jumps to the squares in the sequence of the tones: high, low, low; high, low, high; low, low, high; etc.

In the third level, the child is given an opportunity to listen to the tones and move the frog to the proper square, resulting in a visual and auditory reward. This task is a a recognition task, requiring a response to "label" the sound. This is a much higher cognitive task than the previous ones and the lesson is programmed to loop back to the beginning for reinstruction, after one or two wrong answers. There is no "punishment" for a wrong answer, just a chance to try again.

The next section teaches duration by pairing a long tone (250 Hz) with a long, colored bar and a short tone (same frequency) with a short, colored bar. The pattern is varied and then the child is given a chance to move the frog to the correct bar (long or short) upon the presentation of a tone.

Musicsteps

This section attempts to teach pitch direction changes using blocks of color on the screen, building stairsteps. The amount of pitch change is deliberately made large to create the beginning level of this type of lesson. (Sanders, 1982). Higher levels would present closer pitch discriminations and conceivably the hierarchy may not be usable by all hearing impaired children. However, the point at which a child could no longer play the game successfully would provide useful information about the child's discrimination ability for those working with the child, enabling them to tailor their expectations and lessons accordingly. Geers and Moog (1986), suggest that a child who is unable to make these distinctions should be given instruction in manual communication.

This program offers a recognition level auditory training task, requiring the child to label the sound. The child can use two cues to match the block pictures with the tones heard: the number of tones, and the direction of the pitch (up or down). After some learning time, the child is asked to choose from several block pictures the one which matches what he or she has heard. Again, there is no punishment for wrong answers, just a chance to try again and perhaps a trip back through the initial teaching section. No child will be allowed to become frustrated, because the lessons do not repeat endlessly. They cycle to a higher or lower level automatically based on the child's

responses. Correct responses lead to higher levels; incorrect responses lead to reinstruction at the present level or a switch to a different exercise.

Rhythm Section

This section asks the child to clap his hands when the color red appears on the screen. The message is conveyed by a pair of hands on opposite sides of the screen which come together with an audible "clap" when the correct color is on the screen. Without any sound cues this is a difficult task so the computer pairs the colors with a rhythmic tone pattern. The child is given some time to figure out what he or she is supposed to do and then the tone pattern is presented alone without the color cue, but with the hands on the screen. Finally, the tone pattern is presented alone with no visual cues.

CHAPTER FOUR

DISCUSSION

Development of a new teaching technique is a time-consuming and tedious process which is undertaken with high hopes for producing positive change in the learners. In the field of aural rehabilitation, particularly with prelingually deafened children, there is a tremendous need for better results. Before this can happen, the current techniques must be examined and improved. This computer prototype has undergone considerable change during the development process and is now ready for a pilot test. Each section has different goals and addresses different levels and skills and this should provide information, when evaluated, about which skills are best learned by computer and what must be changed to conform to the needs of the children.

Research evidence of the effectiveness of a program such as this should provide the impetus for further development which could ultimately lead to its expansion for much higher levels and age groups. It may be equally effective for training the use of tactile devices for the profoundly impaired as well as for the intensive auditory work needed to retrain cochlear implant recipients. Words could be the stimuli at higher linguistic and age levels which would make the programming much simpler and the extensive memory requirements of the graphics would not be needed. The stimulus

could also more easily be changed to provide new words as the previous ones are learned.

A hearing impaired child must contend with classroom acoustics, signal-to-noise ratio and lighting as critical factors determining the quality of auditory/visual signals available to him or her. Even the most successful hearing aid fitting often leaves a child with a mild to moderate hearing loss which places he or she at a considerable disadvantage in the typical classroom. Many classrooms in which these children must learn do not achieve the minimum standards for reverberation and good signal-to-noise ratio which have been shown to be essential for the hearing impaired listener (Bess, Sinclair, & Riggs, 1985).

Under the current law requiring mainstreaming for handicapped children, many teachers with hearing impaired children in their classrooms lack the necessary training to to recognize the special needs of these students (Webster & Ellwood,1985). Failure to consider distance to the speaker, interference of background noise, effect of lighting and need to face the child at all times put the hearing impaired learner at even greater disadvantage. The use of a program similar to this might provide the opportunity to give intensive auditory training to all mainstreamed children, without additional training and time for the teacher. It could also be used for those who are not at the same level as others in the class, enabling them to catch up on their own. In addition, new vocabulary words will need to be trained auditorily each week which may or may not be done with parental help and could be done by computer. It is not enough to spell the word, one must be able to recognize the *sound* .

Auditory training is but one aspect of a comprehensive approach to education of the hearing impaired which must include the use of properly fitted and maintained hearing aids and an advantageous signal-to-noise ratio at all times. It has been shown to facilitate speech reading even for the more severely impaired and to increase the ability of most to utilize the auditory signal. Appearing on the market at a startling rate, are new computer lessons for language learning and the teaching of all subjects, which should be advantageous to the visually-oriented needs of the hearing impaired child. However, some bridge must be found to provide access to the language skills which enable use of these more-advanced programs. The additional time needed by the hearing impaired to learn speech and language are a large deterrent to their progress in school. If this approach could be shown to provide that extra practice in an enjoyable and time-efficient manner, it could be the bridge that is needed.

Before any field testing can take place, technical decisions must be made to control the signal-to-noise ratio and presentation of the signal to the child. Ideally, this would be done by some type of earphone so that the program could be used without disturbing others who might be nearby. An auditory trainer might be used to deliver the sound to the child or perhaps a direct coupling to the child's aids could be effected. Part of the evaluation process would need to address these decisionsas well as the method of presentation of the stimulus words and adequacy of the tape recorder or computer sound for auditory training.

Digital disk technology and digital voice synthesis are currently being intensively researched in the engineering and computer fields and would be ideal for this type of application. The possiblility of using this technology

is exciting and would increase the flexibility and quality of the sound tremendously but is beyond the scope of the present paper.

One limitation of this program is the machine specificity. The Texas Instruments computers are no longer manufactured and are in limited supply. The computer of choice for software in this field is the Apple II followed by the IBM (Schwartz,1984). An attempt has been made to translate this program for use on the Apple II series of computers with exceedingly disappointing results. The quality of the graphics was not comparable to the Texas Instruments computer and sound limitations were also a factor. Some of the problems may be overcome with a different programming language but the possibility that the problems were hardware limitations necessitated the tabling of that approach for the time being. In the meantime, it would not be difficult to set up a feasibility or pilot study using the Texas Instruments computer. While this is not the computer in use in school systems, it is inexpensive and there are many users across the country as well as local support groups which could facilitate the acquisition of sufficient devices for study.

Personal talks with teachers of the deaf have indicated a desire for this type of software and provided incentive to the present researcher. If the prototype is shown to be useful, the hoped-for improvement in the educational opportunities for the hearing impaired may a be a step closer to reality.

APPENDIX

PATTERN DISCRIMINATION

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1 REM   THIS PROGRAM IS UNPUBLISHED, FULLY PROTECTED BY U.S.COPYRIGHT LAWS,AND C
ONSIDERED A TRADE SECRET BELONGING TO THE COPYRIGHT HOLDER
2 REM  (C) COPYRIGHT. 1987. LESLIE DOSTER, BRIAN DOSTER
10 CALL CLEAR
20 CALL CHAR(136."0E1F1F3931313119DFDFEFFF7F7F7FF770FBFC9C8C8C8C98FBFBF7FEFEFEFE
EF")
30 CALL CHAR(133,"FFFFFFFFFFFFFFFF")
40 FOR R=2 TO 6 :: CALL HCHAR(R,12,133,6):: NEXT R
50 FOR R=17 TO 22 :: CALL HCHAR(R,12,133,6):: NEXT R :: CALL MAGNIFY(4):: CALL S
PRITE(#1,136,7,70,180,0,0)
55 CALL SAY("HELLO"):: FOR D=1 TO 100 :: NEXT D
60 FOR D=1 TO 200 :: NEXT D
70 A=1 :: B=1 :: CALL SOUND(800,900,1):: FOR D=1 TO 300 :: NEXT D :: CALL SPRITE
(#1,136,7,12,94,0,0):: FOR D=1 TO 300 :: NEXT D
80 CALL SPRITE(#1,136,6,70,180,0,0):: FOR D=1 TO 200 :: NEXT D :: CALL SOUND(800
,140,1):: FOR D=1 TO 300 :: NEXT D
90 CALL SPRITE(#1,136,6,140,94,0,0):: FOR D=1 TO 300 :: NEXT D :: CALL SPRITE(#1
,136,16,70,180,0,0):: FOR D=1 TO 200 :: NEXT D
100 CALL SOUND(800,900,1):: FOR D=1 TO 300 :: NEXT D :: CALL SPRITE(#1,136,16,12
,94,0,0):: FOR D=1 TO 300 :: NEXT D
110 CALL SPRITE(#1,136,3,70,180,0,0):: FOR D=1 TO 200 :: NEXT D
120 CALL SOUND(800,140,1):: FOR D=1 TO 300 :: NEXT D :: CALL SPRITE(#1,136,3,140
,94,0,0):: FOR D=1 TO 300 :: NEXT D
130 CALL SPRITE(#1,136,14,70,180,0,0):: FOR D=1 TO 200 :: NEXT D :: CALL SOUND(8
00,900,1)
140 FOR D=1 TO 300 :: NEXT D :: CALL SPRITE(#1,136,14,12,94,0,0):: FOR D=1 TO 30
0 :: NEXT D :: CALL SPRITE(#1,136,4,70,180,0,0)
150 FOR D=1 TO 200 :: NEXT D
160 CALL SOUND(800,900,1):: FOR D=1 TO 300 :: NEXT D :: CALL SPRITE(#1,136,4,12,
94,0,0):: FOR D=1 TO 300 :: NEXT D
170 CALL SPRITE(#1,136,16,70,180,0,0):: FOR D=1 TO 200 :: NEXT D
180 CALL SOUND(800,140,0):: FOR D=1 TO 200 :: NEXT D :: CALL SOUND(800,900,0)::
FOR D=1 TO 400 :: NEXT D :: CALL SPRITE(#1,136,16,140,94,0,0)
190 FOR D=1 TO 200 :: NEXT D :: CALL SPRITE(#1,136,16,12,94,0,0):: FOR D=1 TO 30
0 :: NEXT D
200 CALL SPRITE(#1,136,5,70,180,0,0):: FOR D=1 TO 200 :: NEXT D
210 CALL SOUND(800,900,0):: FOR D=1 TO 150 :: NEXT D :: CALL SOUND(800,140,0)::
FOR D=1 TO 300 :: NEXT D
220 CALL SPRITE(#1,136,5,12,94,0,0)
230 FOR D=1 TO 100 :: NEXT D :: CALL SPRITE(#1,136,5,140,94,0,0)
240 FOR D=1 TO 300 :: NEXT D :: CALL SPRITE(#1,136,12,70,180,0,0):: FOR D=1 TO 2
00 :: NEXT D
250 CALL SOUND(800,900,0):: FOR D=1 TO 200 :: NEXT D :: CALL SOUND(800,900,0)::
FOR D=1 TO 300 :: NEXT D :: CALL SPRITE(#1,136,12,12,94,0,0)
260 FOR D=1 TO 100 :: NEXT D :: CALL SPRITE(#1,136,1,12,94,0,0):: FOR D=1 TO 150
 :: NEXT D :: CALL SPRITE(#1,136,12,12,94,0,0)
270 FOR D=1 TO 300 :: NEXT D :: CALL SPRITE(#1,136,16,70,180,0,0):: FOR D=1 TO 2
00 :: NEXT D
271 CALL SOUND(800,140,0):: FOR D=1 TO 150 :: NEXT D :: CALL SOUND(800,900,0)::
FOR D=1 TO 150 :: NEXT D :: CALL SOUND(800,140,0)
272 FOR D=1 TO 400 :: NEXT D :: CALL SPRITE(#1,136,16,140,94,0,0):: FOR D=1 TO 1
50 :: NEXT D :: CALL SPRITE(#1,136,16,12,94,0,0)
273 FOR D=1 TO 150 :: NEXT D :: CALL SPRITE(#1,136,16,140,94,0,0):: FOR D=1 TO 2
00 :: NEXT D
280 CALL CHAR(140,"0E1F1F3931313119DFDBEBFC7F7F7FF770F8FCFCFC748CF8FBDB173FFEFEF
EEF"):: CALL MAGNIFY(4)
290 CALL SPRITE(#1,140,16,140,94,0,0):: FOR D=1 TO 300 :: NEXT D
300 FOR C=4 TO 16 STEP 2 :: CALL COLOR(#1,C):: FOR D=1 TO 50 :: NEXT D :: NEXT C
310 CALL SPRITE(#1,136,4,70,140,0,0):: CALL SAY("YOUR TURN. YOU MAKE ME MOVE")
320 CALL SOUND(800,900,0)
330 CALL JOYST(1,X,Y):: CALL MOTION(#1,-Y,X):: CALL COINC(#1,12,94,10,C):: IF C=
0 THEN 330 :: IF C=-1 THEN GOSUB 790
359 GOTO 369 :: CALL SOUND(800,900,0)
```

```
360 CALL JOYST(1,X,Y):: CALL MOTION(#1,-Y,X):: CALL COINC(#1,12,94,10,C):: IF C=
0 THEN 360 :: IF C=-1 THEN GOSUB 790
369 CALL SOUND(800,140,0)
370 CALL JOYST(1,X,Y):: CALL MOTION(#1,-Y,X):: CALL COINC(#1,140,94,10,C):: IF C
=0 THEN 370 :: IF C=-1 THEN GOSUB 790
379 GOTO 384 :: CALL SOUND(800,140,0)
380 CALL JOYST(1,X,Y):: CALL MOTION(#1,-Y,X):: CALL COINC(#1,140,94,10,C):: IF C
=0 THEN 380 :: IF C=-1 THEN GOSUB 790
384 CALL CLEAR :: CALL MOTION(#1,0,-50)
385 CALL SOUND(800,131,2,165,2,196,2):: CALL SOUND(800,262,2,330,2,392,2):: CALL
 SOUND(800,523,2,659,2,784,2)
386 CALL SPRITE(#1,140,12,90,94,0,0):: FOR D=1 TO 200 :: NEXT D :: CALL MOTION(#
1,-50,0)
387 CALL SOUND(800,784,2,659,2,523,2):: CALL SOUND(800,392,2,330,2,262,2):: CALL
 SOUND(800,196,2,165,2,131,2)
388 CALL SPRITE(#1,140,12,90,94,0,0):: FOR D=1 TO 200 :: NEXT D :: CALL SAY("BYE
 BYE")
389 CALL MAGNIFY(2):: CALL SPRITE(#3,132,2,90,94,0,0):: CALL SPRITE(#4,134,2,111
,94,0,0):: CALL DELSPRITE(#1)
390 CALL CHAR(132,"0000000000000018"):: CALL CHAR(134,"1800000000000000"):: CALL
 CHAR(132,"0000000000001824")
391 CALL CHAR(134,"2418000000000000"):: CALL CHAR(132,"00000000003C4281"):: CALL
 CHAR(134,"81423C000000000")
392 CALL CHAR(132,"0000000000186681"):: CALL CHAR(133,"8166180000000000"):: CALL
 CHARSET
400 CALL CHAR(104,"FFFFFFFFFFFFFFFF")
410 CALL DELSPRITE(ALL):: CALL CLEAR :: CALL CHAR(133,"FFFFFFFFFFFFFFFF"):: CALL
 CHAR(120,"FFFFFFFFFFFFFFFF")
411 FOR T=14 TO 8 STEP -2 :: CALL SCREEN(T):: FOR D=1 TO 400 :: NEXT D :: NEXT T
420 CALL SOUND(50,250,1):: FOR R=22 TO 20 STEP -1 :: CALL COLOR(12,7,1):: CALL H
CHAR(R,8,120,7):: NEXT R :: FOR D=1 TO 200 :: NEXT D
430 CALL SOUND(950,250,1):: FOR R=22 TO 2 STEP -1 :: CALL COLOR(13,3,1):: CALL H
CHAR(R,18,133,7):: NEXT R :: FOR D=1 TO 200 :: NEXT D
440 CALL CLEAR
450 CALL SOUND(50,250,1):: FOR R=22 TO 20 STEP -1 :: CALL COLOR(10,11,1):: CALL
HCHAR(R,8,104,7):: NEXT R :: FOR D=1 TO 200 :: NEXT D
460 CALL SOUND(900,250,1):: CALL COLOR(13,7,1):: FOR R=22 TO 2 STEP -1 :: CALL H
CHAR(R,18,133,7):: NEXT R :: FOR D=1 TO 200 :: NEXT D
470 CALL CLEAR
480 CALL SOUND(50,250,1):: FOR R=22 TO 20 STEP -1 :: CALL COLOR(10,16,1):: CALL
HCHAR(R,2,104,7):: NEXT R :: FOR D=1 TO 200 :: NEXT D
490 CALL SOUND(950,250,1):: FOR R=22 TO 2 STEP -1 :: CALL COLOR(12,5,1):: CALL H
CHAR(R,12,120,7):: NEXT R :: FOR D=1 TO 200 :: NEXT D
500 CALL SOUND(50,250,1):: FOR R=22 TO 20 STEP -1 :: CALL COLOR(13,3,1):: CALL H
CHAR(R,24,133,7):: NEXT R :: FOR D=1 TO 200 :: NEXT D
510 CALL CLEAR
520 CALL SOUND(950,250,1):: FOR R=22 TO 2 STEP -1 :: CALL COLOR(13,14,1):: CALL
HCHAR(R,2,133,7):: NEXT R :: FOR D=1 TO 200 :: NEXT D
530 CALL SOUND(950,250,1):: FOR R=22 TO 2 STEP -1 :: CALL COLOR(12,5,1):: CALL H
CHAR(R,12,120,7):: NEXT R :: FOR D=1 TO 200 :: NEXT D
540 CALL SOUND(150,250,1):: FOR R=22 TO 20 STEP -1 :: CALL COLOR(10,16,1):: CALL
 HCHAR(R,24,104,7):: NEXT R :: FOR D=1 TO 200 :: NEXT D
549 CALL CLEAR
550 CALL CHAR(140,"0E1F1F3931313119DFDBE8FC7F7F7FF770F8FCFCFC748CF8FBDB173FFEFEF
EEF")
560 CALL CHAR(136,"0E1F1F3931313119DFDFEFFF7F7F7FF770F8FC9C8C8C8C98FBFBF7FEFEFEF
EEF"):: CALL MAGNIFY(4)
570 CALL SPRITE(#1,136,11,70,160,0,0):: CALL SAY("HELLO"):: FOR D=1 TO 200 :: NE
XT D
575 FOR R=22 TO 2 STEP -1 :: CALL HCHAR(R,2,133,7):: NEXT R
580 FOR Y=22 TO 20 STEP -1 :: CALL HCHAR(Y,12,120,7):: NEXT Y :: FOR D=1 TO 200
:: NEXT D :: CALL SOUND(950,250,1)
590 FOR D=1 TO 300 :: NEXT D :: CALL SPRITE(#1,136,12,70,20,0,0):: FOR D=1 TO 30
0 :: NEXT D
600 CALL SPRITE(#1,136,10,70,160,0,0):: FOR D=1 TO 300 :: NEXT D :: CALL SOUND(2
50,250,0)
610 FOR D=1 TO 300 :: NEXT D :: CALL SPRITE(#1,136,10,140,99,0,0):: FOR D=1 TO 3
00 :: NEXT D
```

```
630 CALL SPRITE(#1,136,4,70,160,0,0):: FOR D=1 TO 300 :: NEXT D :: CALL SOUND(25
0,250,0):: FOR D=1 TO 300 :: NEXT D
640 CALL SPRITE(#1,136,4,140,99,0,0):: FOR D=1 TO 300 :: NEXT D
650 CALL SPRITE(#1,136,2,70,160,0,0):: FOR D=1 TO 300 :: NEXT D :: CALL SOUND(95
0,250,0):: FOR D=1 TO 300 :: NEXT D
651 CALL SPRITE(#1,136,2,70,20,0,0):: FOR D=1 TO 300 :: NEXT D :: CALL SPRITE(#1
,136,16,70,160,0,0):: FOR D=1 TO 100 :: NEXT D
652 CALL SAY("YOUR TURN. YOU MAKE ME MOVE")
653 CALL SOUND(950,250,0)
654 CALL JOYST(1,X,Y):: CALL MOTION(#1,-Y,X):: CALL COINC(#1,70,20,20,C):: IF C=
0 THEN 654 :: IF C=-1 THEN GOSUB 790
655 FOR D=1 TO 200 :: NEXT D :: CALL SOUND(250,250,0):: FOR D=1 TO 200 :: NEXT D
656 CALL JOYST(1,X,Y):: CALL MOTION(#1,-Y,X):: CALL COINC(#1,140,95,20,C):: IF C
=0 THEN 656 :: IF C=-1 THEN GOSUB 790
660 FOR D=1 TO 300 :: NEXT D :: CALL SOUND(950,250,0)
665 CALL JOYST(1,X,Y):: CALL MOTION(#1,-Y,X):: CALL COINC(#1,70,20,20,C):: IF C=
0 THEN 665 :: IF C=-1 THEN GOSUB 790
700 CALL CLEAR :: CALL MOTION(#1,0,-50)
701 CALL SOUND(800,131,2,165,2,196,2):: CALL SOUND(800,262,2,330,2,392,2):: CALL
 SOUND(800,523,2,659,2,784,2)
702 CALL SPRITE(#1,140,12,90,94,0,0):: FOR D=1 TO 200 :: NEXT D :: CALL MOTION(#
1,-50,0)
703 CALL SOUND(800,784,2,659,2,523,2):: CALL SOUND(800,392,2,330,2,262,2):: CALL
 SOUND(800,196,2,165,2,131,2)
704 CALL SPRITE(#1,140,12,90,94,0,0):: FOR D=1 TO 200 :: NEXT D :: CALL SAY("BYE
 BYE")
705 GOTO 812
790 FOR D=1 TO 200 :: NEXT D :: CALL SPRITE(#1,140,12,70,140,0,0):: FOR D=1 TO 2
00 :: NEXT D
800 FOR C=4 TO 16 STEP 2 :: CALL COLOR(#1,C):: FOR D=1 TO 50 :: NEXT D :: NEXT C
 :: CALL SPRITE(#1,136,12,70,140,0,0)
810 FOR D=1 TO 200 :: NEXT D :: RETURN
812 CALL CLEAR
```

LANGUAGE LESSON

```
1 REM THIS PROGRAM IS UNPUBLISHED.FULLY PROTECTED BY U.S.COPYRIGHT LAWS AND CONS
IDERED A TRADE SECRET BELONGING TO THE COPYRIGHT HOLDER
3 CALL INIT
4 CALL LOAD(9460.4,204,29,22.4,91,4,204,30,22,4,91)
5 CALL LOAD(16368,79,70,70,32,32,32,36,250,79,78,32,32,32,32,36,244)
6 CALL LOAD(8194,37,0,63,240)
10 CALL CLEAR
6014 REM BEGINNING OF LANGUAGE LESSON (C) COPYRIGHT, 1987, LESLIE DOSTER, BRIAN
 DOSTER
6015 CALL CLEAR :: DISPLAY AT(14,8):"REWIND TAPE": :"PRESS ENTER" :: FOR T=1 TO
100 :: NEXT T
6016 CALL LINK("ON"):: CALL KEY(0,S,V):: IF V=0 THEN 6016 :: IF S=13 THEN 6017
6017 CALL LINK("OFF"):: CALL CLEAR
6018 DISPLAY AT(14,1):"PRESS RECORDER PLAY BUTTON" :: DISPLAY AT(16,8):"TOUCH EN
TER" :: DISPLAY AT(18,5):"ONE MOMENT.PLEASE"
6019 CALL KEY(0.S.V):: IF V=0 THEN 6019 :: IF S=13 THEN 6020
6020 CALL LINK("ON"):: FOR B=1 TO 1400 :: NEXT B :: CALL LINK("OFF"):: CALL CLEA
R :: CALL SCREEN(3)
6021 FOR DELAY=1 TO 200 :: NEXT DELAY
7000 CALL CLEAR :: CALL CHAR(108."000000000000010202021F3F7FE7241800000000000000E0
100838FCFEFEF3120C"):: CALL MAGNIFY(4)
7005 CALL LINK("ON"):: CALL SPRITE(#1,108,2,80,110,0,0):: FOR D=1 TO 400 :: NEXT
 D :: CALL LINK("OFF")
7006 CALL KEY(0,S,V):: IF V=0 THEN 7006 :: IF 29>S>96 THEN 7010
7010 CALL CLEAR :: CALL SCREEN(8):: CALL LINK("ON"):: CALL SPRITE(#1,108,11.80,1
10,0,0):: FOR DELAY=1 TO 400 :: NEXT DELAY
7011 CALL LINK("OFF"):: CALL KEY(0,S.V):: IF V=0 THEN 7011 :: IF 29>S>96 THEN 70
12
7012 CALL LINK("ON"):: CALL SPRITE(#1.108,11,80.110,0,-20):: FOR DELAY=1 TO 500
:: NEXT DELAY :: CALL LINK("OFF")
7013 CALL KEY(0.S,V):: IF V=0 THEN 7013 :: IF 29>S>96 THEN 7050
7050 CALL CLEAR :: CALL CHAR(96."00010307070F0F1F3F7FFF00FF7F3F1F4040505058585C5
C5E5E5F40FFFEFCF8"):: CALL MAGNIFY(4)
7052 CALL LINK("ON"):: CALL SPRITE(#1.96.2.80,110,0.0):: FOR DELAY=1 TO 400 :: N
EXT DELAY :: CALL LINK("OFF")
7053 CALL KEY(0.S,V):: IF V=0 THEN 7053 :: IF 29>S>96 THEN 7055
7055 CALL CLEAR :: CALL SCREEN(8):: CALL LINK("ON"):: CALL SPRITE(#1.96.5,80.110
,0,0):: FOR DELAY=1 TO 400 :: NEXT DELAY :: CALL LINK("OFF")
7056 CALL KEY(0,S.V):: IF V=0 THEN 7056 :: IF 29>S>96 THEN 7057
7057 CALL LINK("ON"):: CALL SPRITE(#1,96.5,80,110,0,20):: FOR H=1 TO 500 :: NEXT
 H :: CALL LINK("OFF")
7058 CALL KEY(0,S,V):: IF V=0 THEN 7058 :: IF 29>S>96 THEN 7080
7080 CALL CLEAR :: CALL CHAR(100."0000000000001E1317177F7F7FFF6C6C00000000FFFFFF
FFFFFFFFFFFFFF0C0C"):: CALL MAGNIFY(4)
7081 CALL LINK("ON"):: CALL SPRITE(#1,100,2,80,110,0,0):: FOR D=1 TO 400 :: NEXT
 D :: CALL LINK("OFF")
7082 CALL KEY(0,S,V):: IF V=0 THEN 7082 :: IF 29>S>96 THEN 7085
7085 CALL LINK("ON"):: CALL SPRITE(#1,100,3,80,110,0.0):: FOR DELAY=1 TO 400 ::
NEXT DELAY :: CALL LINK("OFF")
7086 CALL KEY(0,S,V):: IF V=0 THEN 7086 :: IF 29>S>96 THEN 7087
7087 CALL LINK("ON"):: CALL SPRITE(#1,100,3,80,110.0,-20):: FOR DELAY=1 TO 500 :
: NEXT DELAY :: CALL LINK("OFF")
7088 CALL KEY(0,S,V):: IF V=0 THEN 7088 :: IF 29>S>96 THEN 7090
7090 CALL CLEAR :: CALL CHAR(124,"0000003070707FFFFF7F70703000000070747CF4F0F8FE
FDFDFEF8F0F47C7470"):: CALL MAGNIFY(4)
7091 CALL LINK("ON"):: CALL SPRITE(#1,124,2,80,110,0,0):: FOR DELAY=1 TO 400 ::
NEXT DELAY :: CALL LINK("OFF")
7092 CALL KEY(0.S.V):: IF V=0 THEN 7092 :: IF 29>S>96 THEN 7093
7095 CALL LINK("ON"):: CALL SPRITE(#1.124,10,80,110,0.0):: FOR DELAY=1 TO 400 ::
 NEXT DELAY :: CALL LINK("OFF")
7096 CALL KEY(0.S,V):: IF V=0 THEN 7096 :: IF 29>S>96 THEN 7098
7098 CALL LINK("ON"):: CALL MOTION(#1,-20,20):: FOR DELAY=1 TO 200 :: NEXT DELAY
 :: CALL LINK("OFF")
```

```
7099 CALL MOTION(#1,0,20)
7100 CALL KEY(0,S,V):: IF V=0 THEN 7100 :: IF 29>S>96 THEN 7101
7101 CALL CLEAR :: CALL MAGNIFY(4):: CALL DELSPRITE(ALL)
7110 CALL CHAR(124,"0103030103070B1363030302020202068OCOC080C0E0D0C8C6C0C0404040
4060")
7111 CALL LINK("ON"):: CALL SPRITE(#1,124,16,80,110,0,0):: FOR DELAY=1 TO 300 ::
 NEXT DELAY :: CALL LINK("OFF")
7112 CALL KEY(0,S,V):: IF V=0 THEN 7112 :: IF 29>S>96 THEN 7113
7119 CALL CHAR(120,"0001036311080703030303OE080402060080C0C688D0E0C0C0C0C0701020
4060")
7125 CALL CHAR(108,"00000000000001020202 1F3F7FE72418000000000000E0100888FCFEFEF3
120C"):: CALL SPRITE(#3,108,10,90,220,0,-34)
7130 FOR T=1 TO 8 :: CALL SPRITE(#1,120,16,90,110,0,0):: FOR D=1 TO 110 :: NEXT
D :: CALL DELSPRITE(#1)
7140 CALL SPRITE(#2,124,16,60,110,0,0):: FOR D=1 TO 120 :: NEXT D :: CALL DELSPR
ITE(#2):: NEXT T
7200 CALL DELSPRITE(ALL)
7201 CALL KEY(0,S,V):: IF V=0 THEN 7201 :: IF 29>S>96 THEN 7210
7210 CALL CHAR(132,"000101000101010305090000010107 06C0E0E0C0E0A0202030E8C0E0B098
180C")
7219 CALL CHAR(136,"0103030103030303030301010101010180C0C080C040404040C0C0808080
8080")
7220 CALL CHAR(140,"010303010303020206 0A0103060C080880C0C080C040C04060508080808 0
80C0")
7222 CALL LINK("ON"):: CALL SPRITE(#1,140,2,90,110,0,0):: FOR DELAY=1 TO 300 ::
NEXT DELAY :: CALL LINK("OFF")
7223 CALL KEY(0,S,V):: IF V=0 THEN 7223 :: IF 29>S>96 THEN 7224
7224 CALL LINK("ON"):: CALL SPRITE(#1,140,5,90,110,0,0):: FOR DELAY=1 TO 400 ::
NEXT DELAY :: CALL LINK("OFF")
7225 CALL KEY(0,S,V):: IF V=0 THEN 7225 :: IF 29>S>96 THEN 7240
7240 FOR C=110 TO 250
7250 CALL SPRITE(#1,140,5,90,C,0,0):: CALL DELSPRITE(#2):: FOR D=1 TO 15 :: NEXT
 D
7260 CALL SPRITE(#2,136,5,90,C+2,0,0):: CALL DELSPRITE(#1):: FOR D=1 TO 7 :: NEX
T D
7270 CALL SPRITE(#3,132,5,90,C+4,0,0):: CALL DELSPRITE(#2):: FOR D=1 TO 15 :: NE
XT D
7280 CALL SPRITE(#2,136,5,90,C+6,0,0):: CALL DELSPRITE(#3):: FOR D=1 TO 20 :: NE
XT D :: C=C+8 :: NEXT C
7281 CALL CHAR(132,"000C1E1E0E07070719030606040404 0C00000000000000080C0C06030301E02
0000")
7282 CALL CHAR(136,"000C1E1E0E070707190100000000000010000000000000080C0C0C0C0C0C0
C0C0")
7283 CALL CHAR(128,"040E1F0C041F0E0E0E1F1F3F3F3F5B9B40E0F0401F1E121252FEFEFEFFFC
3C18")
7300 CALL KEY(0,S,V):: IF V=0 THEN 7300 :: IF 29>S>96 THEN 7310
7310 CALL LINK("ON"):: CALL SPRITE(#6,128,11,80,256,0,0):: FOR DELAY=1 TO 500 ::
 NEXT DELAY :: CALL LINK("OFF")
7311 FOR C=230 TO 10 STEP -1
7312 CALL SPRITE(#1,132,5,80,C,0,0):: CALL DELSPRITE(#2):: FOR D=1 TO 2 :: NEXT
D
7313 CALL SPRITE(#2,136,5,80,C-2,0,0):: CALL DELSPRITE(#1):: FOR D=1 TO 2 :: NEX
T D
7314 CALL MOTION(#6,0,-10):: CALL DELSPRITE(#2):: FOR D=1 TO 8 :: NEXT D :: C=C-
10 :: NEXT C
7320 CALL DELSPRITE(#1,#2,#3)
7321 CALL LINK("ON"):: CALL SPRITE(#6,128,11,80,110,0,0):: FOR DELAY=1 TO 500 ::
 NEXT DELAY :: CALL LINK("OFF")
7322 CALL KEY(0,S,V):: IF V=0 THEN 7322 :: IF 29>S>96 THEN 7323
7323 CALL LINK("ON"):: CALL SPRITE(#6,128,2,80,110,0,0):: FOR DELAY=1 TO 500 ::
NEXT DELAY :: CALL LINK("OFF")
7324 CALL KEY(0,S,V):: IF V=0 THEN 7324 :: IF 29>S>96 THEN 7325
7325 CALL LINK("ON"):: CALL MOTION(#6,0,-20):: FOR DELAY=1 TO 500 :: NEXT DELAY
:: CALL LINK("OFF")
```

PRESENCE OR ABSENCE

```
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20 RANDOMIZE
30 CALL INIT
40 CALL LOAD(9460.4,204.29,22,4,91,4,204,30,22,4,91)
50 CALL LOAD(16368,79,70,70,32,32,32,36,250,79,78,32,32,32,32,36,244)
60 CALL LOAD(8194.37,0,63,240)
70 CALL CLEAR
80 CALL COLOR(12,2,1):: CALL COLOR(13,2,1):: CALL COLOR(14,2,1)
90 FOR N=1 TO 4 :: CALL CLEAR :: CALL SCREEN(11):: FOR T=1 TO M :: NEXT T :: CAL
L SOUND(100.440,1):: CALL SOUND(100,494,1)
100 CALL SOUND(100,523,5):: CALL SOUND(100,587,1):: CALL SOUND(20.523,5):: CALL
SOUND(500,523,1)
105 CALL SAY("CAN YOU HEAR THAT")
110 CALL KEY(0,S,V):: IF V=0 THEN 110 :: IF 19<S<96 THEN GOSUB 940
120 M=M+200 :: NEXT N
140 CALL CLEAR :: DISPLAY AT(14.8):"GOOD FOR YOU!!!"
150 CALL SAY("GOOD FOR YOU")
160 CALL CLEAR :: CALL SAY("TRY SOME MORE")
170 CALL CLEAR :: CALL SCREEN(5):: CALL CHAR(108."00000000000000010202021F3F7FE724
1800000000000E0100888FCFEFEF3120C"):: CALL MAGNIFY(4)
180 FOR T=1 TO 500 :: NEXT T
190 CALL SOUND(400.-3.1,240,1):: CALL SOUND(100.-3,30):: CALL SOUND(300,-3,1,240
,1):: CALL SOUND(100,-3.30)
200 CALL SOUND(200,-3,1,240,1)
210 CALL KEY(0,S.V):: IF V=0 THEN 210 :: IF 19<S<96 THEN 230
220 REM BEGINNING OF CAR
230 CALL CLEAR :: CALL SPRITE(#1.108.11.80,110.0.-15):: FOR T=1 TO 300 :: NEXT T
240 CALL SOUND(400.-3,1,240.1):: CALL SOUND(100,-3,30):: CALL SOUND(300,-3,1,240
,1):: CALL SOUND(100.-3,30)
250 CALL SOUND(200,-3.1,240.1):: FOR T=1 TO 200 :: NEXT T :: CALL DELSPRITE(ALL)
260 CALL CHAR(128."0000003F408088F810123062C0C2C0FF000000FC0201111F08A80CA603A30
3FF")
270 FOR D=1 TO 2 :: FOR FF=1 TO 12 :: CALL SOUND(.5.440,3,1047,5.1760,1):: NEXT
FF :: FOR B=1 TO 200 :: NEXT B :: NEXT D
280 CALL KEY(0,S.V):: IF V=0 THEN 280 :: IF 19<S<96 THEN 300
290 REM BEGINNING OF TELEPHONE
300 CALL SCREEN(10):: CALL SPRITE(#1.128.2.90.105.0,0):: FOR D=1 TO 200 :: NEXT
D
310 FOR D=1 TO 2 :: FOR FF=1 TO 12 :: CALL SOUND(.5.440,3,1047.5.1760.1):: NEXT
FF :: FOR B=1 TO 100 :: NEXT B :: NEXT D
320 CALL DELSPRITE(ALL)
330 REM BEGINNING OF WATER
340 CALL CLEAR :: CALL CHAR(58."000000000000000000000000000000001020007000000FF0000
FF00FF0909FF0000")
350 CALL CHAR(62,"F807F80000FF00000000000000000000408101010202040000000003040808
10")
360 CALL CHAR(66."000000FF0000000000000000FF00000000000000000000000001404080808OF00F
10")
370 CALL CHAR(70."101008080878800800000000000000000000000000000000001020202040408
08")
380 CALL CHAR(74."1020204245458888884844442422A292000000000000000000000000000000
00")
390 CALL CHAR(78."0911110142848488081012222989909051514908242412110000008080804O
20")
400 CALL CHAR(82."000000000000000000004448506050484400404040404040407C00446C54544444
44")
410 CALL SOUND(2000,-5,5)
420 CALL KEY(0.S,V):: IF V=0 THEN 420 :: IF 19<S<96 THEN 430
430 CALL SCREEN(4):: H=58 :: FOR X=1 TO 5 :: FOR Y=1 TO 5 :: CALL HCHAR(X+10.Y+1
3.H):: H=H+1 :: NEXT Y :: NEXT X
440 CALL SOUND(2000.-5.5):: FOR D=1 TO 200 :: NEXT D :: CALL CLEAR
450 REM BEGINNING OF SMOKE
460 CALL CLEAR :: CALL CHAR(58,"0000000000000000100000000037C8010000000000FF001010
000000000080780422")
470 CALL CHAR(62."000000000000000000002040810204340600804000304F404031000FC03000000
03")
```

```
480 CALL CHAR(66."4180000080BF800000804020100808185048444241404030000040810208 07C
03")
490 CALL CHAR(70."FC001010101000FF0080402112047880284888080808081020202020100804
03")
500 CALL CHAR(74."00000000000000000000000000000000000000000000003101010102040 80
00")
510 CALL CHAR(78,"000000000000000C038070000000000000000FF00000000000C70800000000 0
00")
520 CALL CHAR(82."0000000000000000000003844403804443800 7C1010101010100044444444444
38")
530 CALL SOUND(1500,1003,1)
540 CALL KEY(0,S,V):: IF V=0 THEN 540 :: IF 19<S<96 THEN 550
550 H=58 :: FOR X=1 TO 5 :: FOR Y=1 TO 5 :: CALL HCHAR(X+10,Y+13,H):: H=H+1 :: N
EXT Y :: NEXT X
560 CALL SOUND(1500,1003,1):: FOR T=1 TO 200 :: NEXT T
570 REM BEGINNING OF DOOR
580 CALL CHAR(114,"0000000000000000003F20272424242400FF00E72424242400FC04E424242
424")
590 CALL CHAR(118."00000000000000000000000000000000024242424242427202424242424 24E
700")
600 CALL CHAR(122."242424242424E4040000000000000000000000000000000000202020202027 2
424")
610 CALL CHAR(126."0000000000E7242424747424 04E4242400000000000000000000000000000000
000")
620 CALL CHAR(130."24242424242424242424242424242424242424242424242424000000000000 0
000")
630 CALL CHAR(134,"0000000000000000242424272 03F0000242424E700FF0000242424E404FC0
000")
640 CALL CHAR(138."0000000000000000000000003C40380478000000 7C10101010000000444444 4
438"):: CALL CLEAR
650 CALL COLOR(12.2.1):: CALL COLOR(13.2.1):: CALL COLOR(14.2,1):: CALL SOUND(30
0.523.1)
660 CALL SOUND(400.392.5)
670 CALL KEY(0.S.V):: IF V=0 THEN 670 :: IF 19<S<96 THEN 680
680 CALL SCREEN(10):: H=114 :: FOR X=1 TO 5 :: FOR Y=1 TO 5 :: CALL HCHAR(X+10.Y
+13.H):: H=H+1 :: NEXT Y :: NEXT X
690 CALL SOUND(300.523.1):: CALL SOUND(400,392,5):: FOR T=1 TO 200 :: NEXT T
700 REM BEGINNING OF CLOCK
710 CALL CHAR(86."4093A42810101010E0100808102061A641BEA255147F800807889008 0402C3
32")
720 CALL CHAR(90."02C9251408080888110A0401010202023842810000402000080000081C2A08
08")
730 CALL CHAR(94."0E2140000001020088 50A04040202020040404050404020200000081000000
00")
740 CALL CHAR(98."08089CFC9C00000000000000000000000101010D01010202002010100000000
00")
750 CALL CHAR(102."20400080804122180000000000000000802010000004122 0C204040808000 0
000")
760 CALL CHAR(106."0000000001010000061960 8102FC000008C0BF000000000030CC4320100F0
000")
770 CALL CHAR(110."000000804 0C000000000000000000000000000000000000000000000000000
000"):: CALL CLEAR
780 FOR L=1 TO 5
790 CALL SOUND(20.140.0):: CALL SOUND(200.110.30):: CALL SOUND(20.115.0):: CALL
SOUND(200.110.30)
300 NEXT L
301 CALL KEY(0.S.V):: IF V=0 THEN 810 :: IF 19<S<96 THEN 820
802 CALL SCREEN(13):: H=86 :: FOR X=1 TO 5 :: FOR Y=1 TO 5 :: CALL HCHAR(X+10.Y+
13.H):: H=H+1 :: NEXT Y :: NEXT X
805 FOR L=1 TO 5
306 CALL SOUND(20.140.0):: CALL SOUND(200.110.30):: CALL SOUND(20.115.0):: CALL
SOUND(200.110.30)
307 NEXT L
910 CALL CLEAR :: CALL DELSPRITE(ALL):: CALL SCREEN(5)
811 FOR D=1 TO 3 :: FOR N=600 TO 800 STEP 10 :: CALL SOUND(-200,N.8):: NEXT N ::
 FOR N=800 TO 600 STEP -10
812 CALL SOUND(-200,N.8):: NEXT N
813 NEXT D
```

```
815 CALL KEY(0.S.V):: IF V=0 THEN 815 :: IF 19<S<96 THEN 834
834 CALL CHAR(108."000000001E1213121FFFFEFFFF303000000000000204080FF00AAAA00FFFF00C
000"):: FOR T=1 TO 200 :: NEXT T
835 CALL CHAR(112."000000000000FF00AAAA00FFFF0000000000000204080FF00AAAA00FFFF303
000")
836 CALL SPRITE(#1.108.9,90.200,0,0):: CALL SPRITE(#2.112,9,90,226,0,0):: CALL S
CREEN(2):: CALL MAGNIFY(4)
837 CALL MOTION(#1,0,-20):: CALL MOTION(#2,0,-20):: FOR D=1 TO 200 :: NEXT D
838 FOR D=1 TO 3 :: FOR N=600 TO 800 STEP 10 :: CALL SOUND(-200,N.8):: NEXT N ::
 FOR N=800 TO 600 STEP -10
839 CALL SOUND(-200,N.8):: NEXT N :: NEXT D
340 CALL DELSPRITE(ALL):: CALL SCREEN(11)
850 CALL CLEAR :: CALL SAY("HELLO.WHO IS THIS")
860 CALL KEY(0.S,V):: IF V=0 THEN 860 :: IF 19<S<96 THEN 865
865 CALL CHARSET :: GOSUB 940
880 CALL CLEAR
890 CALL SCREEN(9)
900 CALL VCHAR(1.1.63.768)
910 FOR T=1 TO 300
920 NEXT T
930 CALL CLEAR
935 END
940 REM CHARACTER
950 CALL DELSPRITE(ALL):: CALL CHAR(37."0000000F3FFFFFFF"):: CALL VCHAR(6.19.37)
:: CALL CHAR(38."0000FFFFFFFFFFFF"):: CALL VCHAR(6.20.38)
960 CALL CHAR(131."000000F0FCFFFFFF"):: CALL VCHAR(6.21.131):: CALL CHAR(128."03
0F1F3F7F7FFFFF")
970 CALL VCHAR(7.18.128)
980 CALL CHAR(129."C0F0F8FCFEFEFFFF"):: CALL CHAR(47."FEFFE0E0C0C0C080"):: CALL
VCHAR(8.18.47):: CALL CHAR(45."0F07030701000100")
990 CALL VCHAR(7.21.45):: CALL VCHAR(7.22.129):: CALL CHAR(132."E113140F0F0F0F0F
"):: CALL VCHAR(8.17.132):: CALL CHAR(88."87C8E8F0F0F0F0F0")
1000 CALL VCHAR(8.23.88):: CALL CHAR(60."F8F0C0C0E0"):: CALL VCHAR(7.19.60):: CA
LL CHAR(62."1F070301"):: CALL VCHAR(8.22.62)
1010 CALL CHAR(133."0708102040404040"):: CALL VCHAR(8.16.133):: CALL CHAR(134."E
010080402020202"):: CALL VCHAR(8.24.134)
1020 CALL CHAR(135."4020201010080808"):: CALL VCHAR(9.16.135):: CALL CHAR(136."0
204040808101010"):: CALL VCHAR(9.24.136)
1030 CALL CHAR(137."0808080808080808"):: CALL VCHAR(9.17.137.2):: CALL CHAR(138.
"08040201"):: CALL VCHAR(11.16.138)
1040 CALL CHAR(139."080818E404020201"):: CALL VCHAR(11.17.139):: CALL CHAR(140."
804020100C03"):: CALL VCHAR(12.18.140)
1050 CALL CHAR(141."0808080404040808"):: CALL VCHAR(10,16.141):: CALL CHAR(142."
000000000080601F"):: CALL VCHAR(12,19.142)
1060 CALL CHAR(143,"00000000000000FF"):: CALL VCHAR(12,20,143):: CALL CHAR(95,"0
000000000106F8"):: CALL VCHAR(12,21,95)
1070 CALL CHAR(36,"0102040830C"):: CALL VCHAR(12,22,36):: CALL CHAR(64,"10101827
20404080"):: CALL VCHAR(11,23,64)
1080 CALL CHAR(61,"10204080"):: CALL VCHAR(11,24,61):: CALL CHAR(92,"10101020202
01010"):: CALL VCHAR(10,24,92)
1090 CALL CHAR(91,"8040300F"):: CALL VCHAR(9.18,91):: CALL VCHAR(9,21,91):: CALL
 CHAR(93,"01020CF"):: CALL VCHAR(9,19,93)
1100 CALL VCHAR(9,22,93):: CALL CHAR(42,"10080601"):: CALL VCHAR(11,19,42):: CAL
L CHAR(81,"000000C33C"):: CALL VCHAR(11,20,81)
1110 CALL CHAR(90,"081030C0"):: CALL VCHAR(11,21,90):: FOR DELAY=1 TO 200 :: NEX
T DELAY
1120 CALL SAY("HELLO"):: FOR D=1 TO 200 :: NEXT D :: CALL CLEAR :: CALL CHARSET
:: RETURN
```

MUSICSTEPS

```
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2320 CALL CLEAR :: CALL SCREEN(8):: CALL COLOR(12,2,1)
2390 CALL COLOR(13,2,1):: CALL CHAR(130,"FFFFFFFFFFFFFFFF"):: C=2 :: R=22 :: CAL
L CHAR(112,"FFFFFFFFFFFFFFFF")
2395 DATA 110,131,165,220,262,330,440,523,660,784,880,1047
2396 CALL CHAR(126,"3F3F0F1F3B73E0C0"):: CALL VCHAR(5,7,126)
2398 RESTORE 2395
2399 CALL COLOR(13,9,1):: CALL SAY("UP"):: FOR D=1 TO 250 :: NEXT D
2400 FOR D=1 TO 4 :: READ NT :: CALL SOUND(800,NT,5):: FOR R=R TO R-4 STEP -1 ::
 CALL HCHAR(R,C,130,4):: NEXT R :: C=C+4 :: NEXT D
2401 R=22 :: C=10
2410 FOR FF=1 TO 250 :: NEXT FF :: CALL COLOR(13,5,1)
2420 FOR D=1 TO 4 :: READ NT :: CALL SOUND(800,NT,5):: FOR R=R TO R-4 STEP -1 ::
 CALL HCHAR(R,C,130,4):: NEXT R :: C=C+4 :: NEXT D
2421 FOR F=1 TO 250 :: NEXT F :: CALL COLOR(13,12,1):: R=22 :: C=18
2430 FOR D=1 TO 4 :: READ NT :: CALL SOUND(800,NT,5):: FOR R=R TO R-4 STEP -1 ::
 CALL HCHAR(R,C,130,4):: NEXT R :: C=C+4 :: NEXT D
2435 FOR D=1 TO 250 :: NEXT D
2540 CALL CHAR(127,"C0E0733B1F0F3F3F"):: CALL VCHAR(5,7,127):: CALL COLOR(13,3,1
):: CALL SAY("DOWN")
2547 DATA 1760,1397,1175,988,880,698,523,440,349,262,220,175,131,110
2549 FOR Y=1 TO 250 :: NEXT Y :: CALL COLOR(11,14,1):: R=3 :: C=2
2550 FOR D=1 TO 4 :: READ NT :: CALL SOUND(800,NT,5):: FOR R=R TO R+4 :: CALL HC
HAR(R,C,112,4):: NEXT R :: C=C+4 :: NEXT D
2650 FOR Y=1 TO 250 :: NEXT Y :: CALL COLOR(11,16,1):: R=3 :: C=10
2655 FOR D=1 TO 4 :: READ NT :: CALL SOUND(800,NT,5):: FOR R=R TO R+4 :: CALL HC
HAR(R,C,112,4):: NEXT R :: C=C+4 :: NEXT D
2656 FOR Y=1 TO 250 :: NEXT Y :: CALL COLOR(11,2,1):: R=3 :: C=18
2660 FOR D=1 TO 4 :: READ NT :: CALL SOUND(800,NT,5):: FOR R=R TO R+4 :: CALL HC
HAR(R,C,112,4):: NEXT R :: C=C+4 :: NEXT D
2661 FOR Y=1 TO 250 :: NEXT Y :: CALL COLOR(13,9,1):: FOR D=1 TO 250 :: NEXT D
2670 CALL CLEAR
2689 REM SUBROUTINE FOR STEPS
2690 CALL CLEAR
2700 R=1 :: C=4 :: FOR D=1 TO 5 :: FOR R=R TO R+1 :: CALL HCHAR(R,C,130,2):: NEX
T R :: C=C+2 :: NEXT D
2701 R=10 :: C=18 :: FOR D=1 TO 5 :: FOR R=R TO R-1 STEP -1 :: CALL HCHAR(R,C,13
0,2):: NEXT R :: C=C+2 :: NEXT D
2702 R=11 :: C=5 :: FOR D=1 TO 2 :: FOR R=R TO R+1 :: CALL HCHAR(R,C,130,2):: NE
XT R :: C=C+2 :: NEXT D
2703 R=14 :: C=22 :: FOR D=1 TO 2 :: FOR R=R TO R-1 STEP -1 :: CALL HCHAR(R,C,13
0,2):: NEXT R :: C=C+2 :: NEXT D
2704 R=17 :: C=4 :: FOR D=1 TO 4 :: FOR R=R TO R+1 :: CALL HCHAR(R,C,130,2):: NE
XT R :: C=C+2 :: NEXT D
2706 R=24 :: C=22 :: FOR D=1 TO 4 :: FOR R=R TO R-1 STEP -1 :: CALL HCHAR(R,C,13
0,2):: NEXT R :: C=C+2 :: NEXT D
2779 CALL VCHAR(4,20,126):: CALL VCHAR(8,6,65)
2780 CALL VCHAR(11,8,127):: CALL VCHAR(14,6,67):: CALL VCHAR(14,24,68):: CALL VC
HAR(11,22,126)
2782 CALL VCHAR(20,10,127):: CALL VCHAR(24,6,69):: CALL VCHAR(24,26,70):: CALL V
CHAR(20,22,126)
2790 CALL VCHAR(8,23,66):: CALL VCHAR(3,10,127):: FOR D=1 TO 200 :: NEXT D
```

```
2950 DATA 110,147,175,220,294,349,440,523,659,880,1175,1397,1760
2960 RESTORE 2950 :: DIM TN(16):: FOR Z=1 TO 16 :: READ TN(Z):: NEXT Z
2968 DATA 5,1,2,1,5,1,2,1,4,1
2969 RESTORE 2968 :: FOR ZZ=1 TO 5 :: READ AA,F
2970 X=INT(RND*2)+1 :: IF X=1 THEN I=16 :: U=INT(RND*(16-(AA*F)))+1 :: F=F*1 ELS
E I=1 :: U=INT((RND*(16-(AA*F)))+1)+(AA*F):: F=F*-1
2980 C=U-F :: FOR Z=1 TO AA :: C=C+F :: CALL SOUND(800,TN(C),5):: NEXT Z
3010 IF AA=4 THEN I=12
3011 IF AA=4 AND F<1 THEN I=5
3012 IF AA=2 THEN I=3
3013 IF AA=2 AND F<1 THEN I=14
3015 CALL KEY(1,S,V):: IF V=0 THEN 3011 :: IF S=I THEN 3020 ELSE 3017
3017 T=T+1 :: CALL SAY("NOT RIGHT TRY AGAIN"):: GOTO 2980
3020 K=K+1 :: CALL SAY("GOOD FOR YOU")
3025 NEXT ZZ :: RESTORE 2395
4000 CALL CLEAR :: DISPLAY AT(8,12):"SCORE" :: DISPLAY AT(15,5):"CORRECT" :: DIS
PLAY AT(15,18):"INCORRECT"
4001 DISPLAY AT(17,6):K :: DISPLAY AT(17,19):T :: FOR D=1 TO 800 :: NEXT D :: CA
LL CLEAR
```

RHYTHM

```
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10 CALL CLEAR
20 CALL CHAR(40,"00000000000007050505050505050404010139292929292929292929292929E94
7")
30 CALL CHAR(44,"E020202322222424242424252529391A000000C04040404080808000000000000
0")
40 CALL CHAR(48,"02020202010101010000000000000000000000000000000000080808080404020 2
0")
50 CALL CHAR(52,"020204040202010100000000010202020202000E11214244881020408000000000000
0")
60 CALL CHAR(136,"FFFFFFFFFFFFFFFF")
70 FOR Q=1 TO 4
80 CALL MAGNIFY(4):: CALL SPRITE(#1,40,2,90,10,0,0):: CALL SPRITE(#2,44,2,90,42,
0,0):: CALL SPRITE(#3,48,2,122,10,0,0)
90 CALL SPRITE(#4,52,2,122,42,0,0):: CALL SPRITE(#5,40,2,90,170,0,0):: CALL SPRI
TE(#6,44,2,90,202,0,0)
100 CALL SPRITE(#7,48,2,122,170,0,0):: CALL SPRITE(#8,52,2,122,202,0,0)
110 FOR R=7 TO 21 :: CALL HCHAR(R,11,136,11):: NEXT R :: FOR C=16 TO 10 STEP -2
:: CALL COLOR(14,C,1):: FOR D=1 TO 200 :: NEXT D :: NEXT C
120 CALL SPRITE(#1,40,2,90,90,0,0):: CALL SPRITE(#2,44,2,90,122,0,0):: CALL SPRI
TE(#3,48,2,122,90,0,0)
130 CALL SPRITE(#4,52,2,122,122,0,0):: CALL SPRITE(#5,40,1,90,99,0,0):: CALL SPR
ITE(#6,44,2,90,131,0,0)
135 CALL SOUND(1,300,0,-5,0)
140 CALL SPRITE(#7,48,2,122,90,0,0):: CALL SPRITE(#8,52,2,122,131,0,0):: FOR D=1
 TO 50 :: NEXT D
145 CALL COLOR(14,8,1)
150 CALL MAGNIFY(4):: CALL SPRITE(#1,40,2,90,10,0,0):: CALL SPRITE(#2,44,2,90,42,
,0,0):: CALL SPRITE(#3,48,2,122,10,0,0)
160 CALL SPRITE(#4,52,2,122,42,0,0):: CALL SPRITE(#5,40,2,90,170,0,0):: CALL SPR
ITE(#6,44,2,90,202,0,0)
170 CALL SPRITE(#7,48,2,122,170,0,0):: CALL SPRITE(#8,52,2,122,202,0,0):: CALL C
OLOR(14,4,1)
180 NEXT Q
190 FOR Q=1 TO 6 :: FOR R=7 TO 21 :: CALL HCHAR(R,11,136,11):: NEXT R :: CALL CO
LOR(14,16,1):: CALL SOUND(100,110,1):: FOR D=1 TO 100
200 NEXT D :: CALL COLOR(14,14,1):: CALL SOUND(100,220,1):: FOR D=1 TO 100 :: NE
XT D :: CALL COLOR(14,10,1):: CALL SOUND(250,440,0)
210 CALL SPRITE(#1,40,2,90,90,0,0):: CALL SPRITE(#2,44,2,90,122,0,0):: CALL SPRI
TE(#3,48,2,122,90,0,0)
220 CALL SPRITE(#4,52,2,122,122,0,0):: CALL SPRITE(#5,40,1,90,99,0,0):: CALL SPR
ITE(#6,44,2,90,131,0,0)
230 CALL SPRITE(#7,48,2,122,90,0,0):: CALL SPRITE(#8,52,2,122,131,0,0):: FOR D=1
 TO 50 :: NEXT D
240 CALL MAGNIFY(4):: CALL SPRITE(#1,40,2,90,10,0,0):: CALL SPRITE(#2,44,2,90,42
,0,0):: CALL SPRITE(#3,48,2,122,10,0,0)
250 CALL SPRITE(#4,52,2,122,42,0,0):: CALL SPRITE(#5,40,2,90,170,0,0):: CALL SPR
ITE(#6,44,2,90,202,0,0)
260 CALL SPRITE(#7,48,2,122,170,0,0):: CALL SPRITE(#8,52,2,122,202,0,0):: CALL C
OLOR(14,4,1):: CALL SOUND(200,110,1)
270 FOR D=1 TO 50 :: NEXT D :: NEXT Q :: CALL CLEAR
275 FOR D=1 TO 200 :: NEXT D
280 FOR Q=1 TO 6 :: CALL SOUND(100,110,1):: FOR D=1 TO 100 :: NEXT D
290 CALL SOUND(100,220,1):: FOR D=1 TO 100 :: NEXT D :: CALL SOUND(250,440,0)
300 CALL SPRITE(#1,40,2,90,90,0,0):: CALL SPRITE(#2,44,2,90,122,0,0):: CALL SPRI
TE(#3,48,2,122,90,0,0)
310 CALL SPRITE(#4,52,2,122,122,0,0):: CALL SPRITE(#5,40,1,90,99,0,0):: CALL SPR
ITE(#6,44,2,90,131,0,0)
320 CALL SPRITE(#7,48,2,122,90,0,0):: CALL SPRITE(#8,52,2,122,131,0,0):: FOR D=1
 TO 50 :: NEXT D
```

```
330 CALL MAGNIFY(4):: CALL SPRITE(#1,40,2,90,10,0,0):: CALL SPRITE(#2,44,2,90,42
,0,0):: CALL SPRITE(#3,48,2,122,10,0,0)
340 CALL SPRITE(#4,52,2,122,42,0,0):: CALL SPRITE(#5,40,2,90,170,0,0):: CALL SPR
ITE(#6,44,2,90,202,0,0)
350 CALL SPRITE(#7,48,2,122,170,0,0):: CALL SPRITE(#8,52,2,122,202,0,0):: CALL S
OUND(200,110,1)
360 FOR D=1 TO 200 :: NEXT D :: NEXT Q :: CALL DELSPRITE(ALL)
365 FOR Q=1 TO 4 :: CALL SOUND(100,110,1):: FOR D=1 TO 100 :: NEXT D
366 CALL SOUND(100,220,1):: FOR D=1 TO 100 :: NEXT D :: CALL SOUND(250,440,0)
367 FOR D=1 TO 250 :: NEXT D :: CALL SOUND(200,110,1):: FOR D=1 TO 200 :: NEXT D
 :: NEXT Q
400 CALL DELSPRITE(ALL)
```

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