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The effectiveness of Visual Phonics on the speech production of hearing-impaired children

Zaccagnini, Cindy Marie, M.A.

The University of Arizona, 1989

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THE EFFECTIVENESS OF VISUAL PHONICS ON THE SPEECH PRODUCTION OF HEARING-IMPAIRED CHILDREN

by

Cindy Marie Zaccagnini

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A Thesis Submitted to the Faculty of the FACULTY OF THE DIVISION OF SPECIAL EDUCATION AND REHABILITATION In Partial Fulfillment of the Requirements For the Degree of MASTER OF ARTS WITH A MAJOR IN SPECIAL EDUCATION In the Graduate College THE UNIVERSITY OF ARIZONA 1989
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APPROVAL BY THESIS DIRECTOR

This thesis has been approved on the date shown below:

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Date
DEDICATION

This thesis is dedicated to my husband, Morgan Sharp, for his enduring patience, and to my daughter, Kianna, whose arrival helped me find the time to see this project through.
## TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>LIST OF ILLUSTRATIONS</td>
<td>5</td>
</tr>
<tr>
<td>ABSTRACT</td>
<td>6</td>
</tr>
<tr>
<td>INTRODUCTION</td>
<td>7</td>
</tr>
<tr>
<td>REVIEW OF THE LITERATURE</td>
<td>9</td>
</tr>
<tr>
<td>Multisensory Syllable-Unit Approach</td>
<td>9</td>
</tr>
<tr>
<td>Phonetic Alphabets</td>
<td>11</td>
</tr>
<tr>
<td>Cued Speech</td>
<td>12</td>
</tr>
<tr>
<td>Mechanical Devices</td>
<td>16</td>
</tr>
<tr>
<td>Visual Phonics</td>
<td>21</td>
</tr>
<tr>
<td>Summary</td>
<td>23</td>
</tr>
<tr>
<td>METHODOLOGY</td>
<td>25</td>
</tr>
<tr>
<td>Subject</td>
<td>25</td>
</tr>
<tr>
<td>Setting</td>
<td>27</td>
</tr>
<tr>
<td>Procedures</td>
<td>27</td>
</tr>
<tr>
<td>Baseline Assessment</td>
<td>31</td>
</tr>
<tr>
<td>Ratings of Speech Production</td>
<td>34</td>
</tr>
<tr>
<td>Intervention Procedures</td>
<td>35</td>
</tr>
<tr>
<td>Visual Phonics Intervention</td>
<td>36</td>
</tr>
<tr>
<td>Multisensory Intervention</td>
<td>37</td>
</tr>
<tr>
<td>Generalization and Maintenance Probes</td>
<td>39</td>
</tr>
<tr>
<td>RESULTS</td>
<td>41</td>
</tr>
<tr>
<td>Summary</td>
<td>50</td>
</tr>
<tr>
<td>DISCUSSION</td>
<td>52</td>
</tr>
<tr>
<td>APPENDIX A: SAMPLE WORD-PICTURE CARDS</td>
<td>59</td>
</tr>
<tr>
<td>APPENDIX B: RESEARCH QUESTIONNAIRE</td>
<td>60</td>
</tr>
<tr>
<td>APPENDIX C: TABLE OF RELIABILITY SCORES LESS THAN 60%</td>
<td>62</td>
</tr>
<tr>
<td>REFERENCES</td>
<td>64</td>
</tr>
<tr>
<td>Figure</td>
<td>Description</td>
</tr>
<tr>
<td>--------</td>
<td>---------------------------------------------------------------</td>
</tr>
<tr>
<td>1.</td>
<td>Number of correct productions of fricatives trained with Visual Phonics and multisensory techniques of speech training</td>
</tr>
<tr>
<td>2.</td>
<td>Number of correct productions of final stops (/t/ and /b/) trained with Visual Phonics and multisensory techniques of speech training</td>
</tr>
<tr>
<td>3.</td>
<td>Number of correct productions of final stops (/d/ and /b/) trained with Visual Phonics and multisensory techniques of speech training</td>
</tr>
</tbody>
</table>
ABSTRACT

The effects of intensive multisensory speech training, with and without the use of Visual Phonics techniques, on the speech production of a profoundly hearing-impaired child were studied over a period of 6 weeks. A nine-year-old profoundly hearing-impaired child received 30-40 minutes of intensive speech training daily. Three target phonemes were trained using only multisensory speech training techniques and three target phonemes were trained using multisensory and Visual Phonics training techniques. The subject's productions of target phonemes in trained words and syllables were audio-taped at the end of each training period. Audio-taped productions were rated as correct or incorrect. The number of correct productions in words and syllables were tallied daily. Results show a general trend of improved production for all phonemes trained. There was no differential effect for the training technique used. It was concluded that intensive training, regardless of the technique used, has a positive effect on the speech productions of a profoundly hearing-impaired child.
INTRODUCTION

The importance of learning oral communication skills cannot be overemphasized for the hearing-impaired student. Hearing-impaired individuals live in an hearing society; hence, they must learn to communicate with hearing people. One aspect of oral communication that should be fully developed in hearing-impaired students is intelligible speech. Trybus's (1980) report on the current status of the speech of our nation's hearing-impaired children discussed speech intelligibility in relation to age, socioeconomic status, and ethnic background. From his review of the current literature, Trybus (1980) found that intelligibility did not improve significantly after age seven. Upper class whites acquired better speech intelligibility, and hearing-impaired individuals with less severe hearing losses were usually more intelligible. Trybus concluded that there was a need for improved speech training methods.

Over the past three decades several speech training techniques have been developed and used with hearing-impaired individuals. These techniques include phonetic alphabets, Cued Speech, and mechanical feedback devices. For the most part, these techniques have been developed to aid in the reception of speech rather than the production of speech.
Some success has been reported with the use of mechanical feedback devices as aids to the production of speech (Babcock & Wallen, 1974; Gulian, Fallside, Hinds, & Keiller, 1983; Gulian, Hinds, Fallside, & Keiller, 1983; Oller, Eilers, Veraga, & LaVoie, 1976). However, it is not yet clear whether the enhanced speech production reported was the result of using these devices or the result of the intensive speech training given to subjects during the investigations. Most recently educators have been using a technique called, Visual Phonics which involves the use of hand signals and written symbols to cue correct speech production. Only one study has been reported on the effectiveness of using Visual Phonics on the speech production of hearing-impaired children (Wilson-Favors, 1980). In this study some success in improving speech production was reported but there were no controls for intensity of training. In order to foster the production of intelligible speech in hearing-impaired individuals, educators must consider the effects of intensive speech training as well as the training techniques utilized. The purpose of the study was to compare the relative effectiveness of using Visual Phonics with a traditional approach (Calvert & Silverman, 1983) of speech training while controlling for intensity of speech training.
REVIEW OF THE LITERATURE

The following section reviews current literature on the use of various speech training techniques. These techniques include the Multisensory Syllable-Unit Approach, phonetic alphabets, Cued Speech, mechanical feedback, and Visual Phonics. In some cases the research is scanty and not well controlled. Nevertheless, it is important to gain some perspective on the success of speech training techniques that have been used with hearing-impaired children.

Multisensory Syllable-Unit Approach

The Multisensory Syllable-Unit Approach to speech training has been one of the most comprehensive and widely used methods of speech training in the U.S. Calvert and Silverman (1983) refer to the method as being the "traditional" approach to speech training. When using this approach, it is assumed that the hearing-impaired child's lack of ability with the auditory sense modality can be supplemented by stimulating other sense modalities along with audition while training the child to produce intelligible speech. Additional sense modalities include the visual, tactile, and kinesthetic senses. The clinician stimulates the various senses based on the properties of the speech syllables being trained and on the sensory abilities of the
child. A typical training session would involve teaching a progression of skills starting at the phonetic level (i.e., imitative drill and practice of speech sound vocalizations) and moving to the phonologic level (i.e., use of the correctly produced speech sounds in meaningful linguistic expressions). For example, a clinician training the phoneme /t/ might start by asking the child to imitate correct productions of the phoneme; next, the child would be asked to imitate productions of the phoneme in syllables (e.g., "ta ta ta," "ti ti ti," "to to to"); then, the child would be asked to imitate correct productions of the phoneme in words (e.g., tall, ten, toy); and finally, the child would be prompted to use correct productions of the phoneme in connected speech (e.g., The boy is tall, I have ten pennies, Bring me the toy.)

Ling (1976) is the primary proponent of the multisensory syllable unit approach to speech training for hearing-impaired children. He describes in detail teaching strategies which include techniques to stimulate all the sense modalities and emphasizes the use of appropriate amplification, teaching the child to make optimal use of her residual hearing in speech training, then encouraging the child to use the speech skills acquired in meaningful expressions. The multisensory technique of speech training used in this study draws heavily from his work.
Phonetic Alphabets

Phonetic alphabets or orthographic systems are techniques of transcribing English phonetically. These techniques are used by linguists to describe the 46 discrete sounds in the English language. In written English, a 26-letter alphabet is used to represent all 46 phonemes. Consequently, it is often necessary to use two or more letters to represent a single phoneme. For instance in the word "share" two letters are used to represent the first consonant sound, and in the word "lease" three letters are used to represent a single vowel sound. In order to distinguish between discrete phonemes in the English language, several phonetic alphabets have been developed (e.g., International Phonetic Alphabet; Thorndike; Northampton). Programs for the hearing-impaired have employed these alphabets to help hearing-impaired children differentiate between phonemes when learning to speak, read, and write. Many educators of the hearing-impaired believed that teaching these children to read and write with unambiguous symbols to represent each sound they produced in speech should enhance their linguistic development (Duffy, 1966; Avery, 1967; Calvert, 1982).

Phonetic alphabets were one of the first techniques of speech training to become popular as aids to speech production. Duffy (1966) reported that the Initial Teaching Alphabet, with a one-to-one correspondence of English speech
sounds, and written symbols, would allow the hearing-impaired child to achieve high levels of language and speech competence. However, he did not provide any research data to support his position. Orthographic systems are still used by educators of the hearing-impaired. Calvert (1982) advocated the use of General American speech and phonic symbols for indicating features of speech production to hearing-impaired children despite the absence of any research data to support their use. Avery (1967) surveyed 25 teacher education programs and 68 schools for hearing-impaired children and found that 88% of teacher education programs and 85% of schools surveyed utilized the Northampton system. Although the use of orthographic systems was obviously quite prevalent, no research data have been reported on the efficacy of these systems for teaching speech to hearing-impaired children.

Cued Speech

Cued Speech is a technique which uses hand cues to signal the place, manner, and voicing of English phonemes. Cornett (1967) developed this technique to supplement the lipreading skills of hearing-impaired individuals by training them to use and receive hand cues. The technique uses twelve cues. Four of the hand cues are intended to assist in identification of vowels. These cues consist of placements of the hand on the cheek, the chin, the larynx, and to the
side of the face to indicate place of production. The eight remaining hand cues are used to identify consonants. These cues consist of eight hand shapes which are used in conjunction with the placement cues. Diphthongs are cued by combining two vowel cues (placements) in a sweeping motion. The hand configurations of Cued Speech are called "cues" because they provide no information when used in isolation (i.e., unaccompanied by speech). They must be produced simultaneously with the spoken phonemes they cue. Thus, they provide cues to spoken language. Cornett (1967) intended Cued Speech to be used as an aid to speech reception of homophenous vowels and consonants that cannot be discriminated by their visual appearance alone (e.g., the consonants /b/ and /p/ in the words "bat" and "pat" and the vowels in the words "cut" and "cot").

Cued Speech as a technique of speech training drew much attention from educators of the hearing-impaired as well as researchers in the field. Research on the Cued Speech as a speech training aid showed that it is an effective aid to speech reception, but holds little promise as an aid to speech production (Ling & Clarke, 1975; Clarke & Ling, 1976; Nicholls & Ling, 1982; Mohay, 1983).

Ling and Clarke (1975) conducted an evaluative study on the value of Cued Speech as a supplement to speechreading of sentences and phrases. They examined the progress of 12
children between the ages of 7 and 12 years who were exposed to Cued Speech for one school year. These children were given group reception tests of dictated phrases and sentences. These tests were conducted under two conditions, a cued condition (hand cues and auditory cues) and a non-cued condition (auditory cues only). Both were presented under slow and normal rates of speech. The results showed that the children identified more cued phrases and sentences correctly than non-cued phrases and sentences, and that the children were not significantly affected by the rate of the speaker. The children were also able to identify more words presented in phrases than words presented in sentences.

A follow-up study of these children was conducted by Clarke and Ling (1976). The purpose of this study was to replicate the first investigation at the end of the children's second year of using Cued Speech. Once again, the children were given group reception tests of dictated phrases and sentences under cued and non-cued conditions. In this study only 8 of the original 12 children were examined, and the age range was 8-8 years to 10-11 years. After the second year of using Cued Speech, the children were able to identify significantly more cued sentences and phrases than in the first year. These children were also able to identify significantly more non-cued material after the second year, but gains were not as high as in the cued condition. The
researchers concluded that cuing had a positive effect on speech reception.

Nicholls and Ling (1982) tested some of the same subjects as Clarke and Ling (1976) after several years experience with Cued Speech. The researchers investigated the affects of Cued Speech on the reception of spoken language under an auditory-only condition and two auditory-visual (e.g., auditory and speechreading with cues and auditory and speechreading without cues) conditions. The children were given measures of speech reception (reception of consonant-vowel syllables, and reception of key words in phrases), speech production (phonetic and phonologic level speech evaluations; Ling, 1976), and intelligibility ratings. The tests were conducted under 7 different conditions of presentation consisting of various combinations of auditory and visual stimuli. Results showed that Cued Speech enhanced the reception of phonemic and linguistic information. However, the children's ability to use residual hearing and lipread, rather than skill with Cued Speech, seemed to determine the degree of speech intelligibility.

The effect of Cued Speech on the expressive language (i.e., production of speech, gestures, and/or cue approximations) of three deaf children was investigated by Mohay (1983). The subjects consisted of three severely to profoundly deaf children all under 2 years of age. Their
progress was monitored after enrollment in a Cued Speech program through videotapes (consisting of mother-child interactive play) made during monthly home visits. Analysis of the tapes showed that use of Cued Speech appeared to depress the amount of gestural communication used by these children. Two of the children produced no approximations to Cued Speech hand signals, and the other child produced a total of 11 "cue-like" signals. The data indicated that the introduction of Cued Speech before a substantial spoken vocabulary was established did not aid the development of expressive language. In the absence of a control group for the study, the results are questionable.

**Mechanical Devices**

More recent techniques of speech training for the hearing-impaired involve the use of mechanical devices that provide additional information about speech through visual or tactual feedback. Visual feedback consists of a graphic representation or a display of speech sounds which have been translated to a graphic display through mechanical devices. Hearing-impaired individuals are taught to read these displays in order to enhance their understanding of speech and monitor their own speech. Tactile feedback is produced by a tactual vocoder. Tactual vocoders are instruments which receive sound and filter it into a number of frequency bands. The signal from each frequency band is transmitted to the
skin as vibrotactile or electrocutaneous stimulation. Hearing-impaired individuals are trained to interpret these signals in order to identify speech and environmental sounds. These mechanical devices are used in conjunction with intensive speech training to improve the intelligibility of hearing-impaired children's speech. There remains some question as to whether it is the use of these mechanical devices or the amount and intensity of training that is effective in aiding speech production.

A study conducted by Babcock and Wallen (1974) investigated the effects of speech training using visual feedback provided by a spectrographic display device. The researchers trained two 16-year-old girls, who were profoundly deaf from birth, to use the spectrographic display to monitor their speech production during a six-week training course. The training consisted of 20 sessions. Each session was 45 minutes in length. Pre- and post-course tapes were made of the subjects' elicited speech utterances. These tapes were then rated for intelligibility. The results were reported as "marked improvement in the production of sounds the subjects could produce intelligibly before the course." Unfortunately this report included no data on the criteria used for intelligibility ratings; hence, it is difficult to interpret the degree to which the speech production of subjects improved. However, it appears that the intensive
training program did indeed affect the production of speech in a positive manner.

Gulian, Hinds, Fallside, and Keiller (1983) investigated the extent to which visual feedback associated with speech training contributed to the acquisition, retention, and generalization of the voicing distinction. Subjects were nine congenitally, profoundly deaf children ranging in age from 8 to 17 years. These children were divided into three groups: an experimental group and two control groups. The experimental group was given speech training with visual feedback using a microprocessor-based speech training aid (the Fricative and Timing Aid). The first control group received the same speech training as the experimental group without the use of visual feedback. The second control group consisted of children who were not trained by the researchers but whose speech performance was monitored with regard to the features taught to the other groups by giving them the same tests to measure their progress. All subjects in the experimental and first control groups received thirty-minutes of speech training with a speech therapist each day. Due to illness, schedule conflicts, and some technical difficulties, there was a range in the number of sessions completed by each child (between 32 and 95; with an average of 87 sessions). Results for the experimental group and the first control group showed no differential effect for type of training.
Both these groups showed higher intelligibility scores after training; intelligibility remained stable after a holiday period; and the subjects were able to generalize 4 of 6 phonemes. Use of the Fricative and Timing Aid did not result in a significant difference; training was beneficial for both the first control group and the experimental group regardless of the type of training used. Results for the second control group showed very little improvement in intelligibility after training and no improvements in intelligibility after a holiday period; thus, researchers concluded that without specific speech training speech intelligibility was not likely to improve.

These same researchers (Gulian, Fallside, Hinds, & Keiller, 1983) conducted a study to investigate whether or not intensive speech training in conjunction with visual feedback would have a more beneficial effect upon the acquisition of frication than intensive speech training alone. Subjects consisted of nine severely hearing-impaired children ranging in age from 10 years to 17 years. These subjects were allocated to three groups: an experimental group and two control groups. The experimental group was given speech training with the use of visual feedback. The first control group was given the same training as the experimental group without the use of visual feedback, and the second control group was not trained by the researchers. The speech
productions of the second control group were monitored through testing with regard to the features taught to the other two groups. The results for subjects in the experimental and first control groups showed that there was no differential effect for the type of training; intensive training was effective in the acquisition, retention, and generalization of phonemes. Results reported for the second control group were difficult to interpret. The investigators reported that the results for this group were confusing; but, on the whole there was no change in these subject's speech patterns over time. Here again, the most significant findings were that intensive training itself, regardless of the type of instruction utilized during the training sessions, had the most positive effect on speech production.

Oller, Eilers, Veraga, and LaVois (1986) followed the progress of 13 profoundly hearing-impaired children in an elementary and preschool program which utilized vibrotactile and electrocutaneous vocoders in training speech reception and production. Training was conducted through stimulation of all sense modalities (i.e., tactile, visual, and amplified auditory). Children attended five or six thirty-minute training sessions each week, over a period of 40 weeks. Sixty percent of the training sessions were individual training sessions with a speech pathologist, and the other forty percent of the training sessions were conducted in small
groups of two to three children with an educator of the hearing-impaired. Each child received weekly individual and group training. More than one half the training was conducted by stimulating all sense modalities (tactile, visual, and amplified auditory); one-fourth of the training focused on the tactile sense alone; the remaining training time was devoted to use of the auditory only and visual only modalities. Subjects showed improvement in both imitative and functional use of speech for communication over the year. Although vocoders may be useful tools in speech training, the improvements noted in this study cannot be attributed solely to the use of these devices; it is equally likely that the improvements may have been the result of intensive speech training.

**Visual Phonics**

Visual Phonics is a training technique which consists of hand signals and corresponding written symbols developed at the International Communication Learning Institute (Edina, Minnesota) in 1982 by the mother of three deaf children. The technique was intended to help students improve their speech and reading skills. In this technique 46 hand signals and their corresponding written symbols are used to represent individuals sounds. Hand signals are delivered simultaneously with the spoken phonemes they represent. Signals are indicative of the place and manner of production of the
phonemes they represent. For example the hand signal for /t/ begins with the thumb and index finger touching in front of the mouth then flicking open in an upward direction similar to the movement of the tongue against the alveolar ridge as the /t/ is produced.

The Visual Phonics technique as a method of speech training is now drawing much interest from educators of the deaf. However, research on the efficacy of this technique as a speech training aid is scanty. Presently only one article has been published which evaluates the usefulness of Visual Phonics.

Wilson-Favors (1987) conducted a preliminary investigation to determine the effectiveness of Visual Phonics in improving the speech of deaf preadolescent students. In this study six subjects between the ages of 10 and 12 years with bilateral, severe to profound, sensorineural hearing losses were monitored during a school year. Subjects were trained with hand signals and tested without the use of hand signals. Subjects were given pre- and post-articulation tests, and their progress in learning to produce sounds correctly both with and without hand signals was measured. All six children showed progress in the correct production of their target sounds during post-testing without the use of hand signals. With the use of hand signals on a post-test, subjects were to improve their approximate productions of additional non-
trained sounds. When stimulus words were presented using hand signals, there was an increase in the production of the correct number of syllables in words.

**Summary**

From the literature it appears that a variety of speech training techniques have been used with hearing-impaired children. The "traditional" speech training technique involves an intensive multisensory approach coupled with a well defined sequence of speech skills (Calvert & Silverman, 1983; Ling, 1976). Duffy (1966), Calvert (1982), and Avery (1967) emphasized the use of phonetic alphabets for speech training with hearing-impaired children. Investigations on the use of Cued speech as a supplemental technique to speech training (Ling & Clarke, 1975; Clarke & Ling, 1976; Nicholls & Ling, 1982; Mohay, 1983) show that Cued Speech appeared to be a useful aid to speech reception but did not appear to be helpful as an aid to speech production for hearing-impaired children. In the literature on the use of mechanical devices as a technique for training speech production, the most prevalent result appeared to be that intensive speech training was most effective in producing intelligible speech in hearing-impaired children (Babcock & Wallen, 1974; Gulian & Fallside et al., 1983; Gulian & Hinds et al., 1983; Oller & Eilers et al., 1986). Results reported by Wilson-Favors (1987) indicated that the Visual Phonics technique may
be a viable aid to speech training of hearing-impaired children. Because no other research is currently available on the effectiveness of Visual Phonics, it is evident that this speech training technique warrants further investigation. The purpose of this study is to evaluate the efficacy of Visual Phonics for helping hearing-impaired children to improve their production of specific phonetic targets in trained words and to measure any generalization of these skills to untrained words. Additionally, this study addresses the confounding variable of training technique versus intensive speech training program and attempts to answer the question: Does intensive speech training with the use of Visual Phonic cues have a more beneficial effect upon speech intelligibility than intensive speech training alone?
METHODOLOGY

Subject

This study investigated the effects of two speech training techniques on the speech production of one hearing-impaired child. The subject was selected on the basis of her hearing loss and the intelligibility of her speech. The subject was a nine-year-old, profoundly hearing-impaired girl enrolled in a residential program for the deaf. Her most current audiogram indicated a profound bilateral sensorineural hearing loss with an irregular audiogram configuration. Tympanometric examination indicated normal middle ear functioning bilaterally; but inconsistent threshold scores were reported and noted as suggestive of a fluctuating loss. Etiology of the subject's hearing loss was listed as unknown. Her hearing loss was suspected, identified, and she was subsequently aided at the age of two. The subject had no other health problems. She was enrolled in the residential school two months prior to her participation in this study. Previous school placement consisted of attendance in a regular third grade classroom with daily speech/language therapy and oral instruction. School records indicate the subject was achieving at a second grade level in math and reading; however, reading comprehension problems were noted
and spelling skills were described as "weak." The subject demonstrated good social interaction with both hearing and hearing-impaired peers and was described as "cooperative," with an ability to work independently.

Data pertaining to the subject's speech skills were obtained from her school files. She was able to consistently detect and recognize /a/, /i/, /u/, and /ʃ/, but not /s/. She performed significantly better than her hearing-impaired peers on auditory tasks. Her speech records listed her strengths as production of suprasegmental aspects of speech (i.e., duration, intensity, and pitch); production of all vowels and diphthongs; and production of single, repeated syllables with the phonemes /b/, /w/, /t/, /h/, /p/, and /tʃ/. Weaknesses were listed as the production of single syllables with the phonemes /ʃ/, /m/, /ð/, /s/, /n/, and /œ/; word initial blends; most final consonants in conversation; and prolongation of vowels. Her speech was described as difficult to understand with only isolated words or phrases being intelligible; short phrases were more intelligible than continuous speech; and the presence of moderate pharyngeal resonance, mild nasality, and prolongation of vowels were noted.

The subject received individual speech training sessions on a daily basis at school which were not related to the training provided during this study. The child's speech
therapist was consulted prior to the subject's participation in this study to assure no training would be conducted on speech targets that would be trained during the study. Visual Phonics cues were occasionally used in school training sessions as a supplementary training technique, but no specific procedures for the use of this system were followed.

**Setting**

All training sessions for the study were conducted in a small therapy room at the child's school. The room was regularly used by the school psychologists for individual therapy sessions and not designed acoustically for speech therapy. However, the room was carpeted and there was no evidence of any serious acoustic problems. The subject wore her personal hearing aids during training.

**Procedures**

A single-subject research design was selected for this investigation. The single-subject design provided a research framework similar to the clinical setting for speech training (i.e., individual training with client and clinician). This design provided a research framework which could easily be controlled by the investigator. Additionally, the design allowed for a rigorous evaluation of the treatment, which was a priority of this investigation.
An alternating treatments design was used to determine which speech training technique had the greatest effect on speech production. This design included a baseline phase and an intervention phase which incorporated two treatments (Visual Phonics and Multisensory speech training) alternated within each training period. Intermittent probes for generalization and maintenance of speech skills were conducted. During the baseline phase of the study testing continued for each phoneme until the subject had scored three or less correct productions over a period of three or more consecutive sessions. The intervention phase of the study continued for each phoneme until the subject scored 8 or more correct productions of the target phoneme for three or more consecutive training sessions. At that point the subject was considered to have reached criterion level for that particular phoneme and training for the phoneme ceased. Subsequent generalization and maintenance probes were conducted on phonemes that had reached criterion level, while training continued on a new target phoneme.

Ten phoneme targets (/p/, /b/, /s/, /∫/, /t∫/, /d/, /l/, /r/, /θ/, and /j/) were selected on the basis of data obtained from the subject's school records and consultation with the subject's school speech therapist. During baseline the phonemes /l/, /r/, /θ/, and /j/ were dropped due to inconsistent ratings, and the remaining six phonemes (i.e.,
/s/, /t/, /d/, /f/, /b/, and /p/) were selected as targets for training. These six phonemes were paired by type (i.e., fricatives and final stops); one phoneme from each pair was trained with the Visual Phonics technique and the other with the multisensory technique.

A list of 35 words to be used in baseline and training sessions was developed for each of the phoneme targets listed above. Word-picture cards (see Appendix A for examples) were made which included a written grapheme and a picture for targets in both interventions. Targets which were trained with the Visual Phonics technique also included the Visual Phonics symbols written beneath the target phoneme. Ten of the cards for each phoneme target were retained for use in generalization/maintenance probes. The remaining 25 cards were rotated in a balanced fashion so that five groups of ten words were available for training sessions (one group of ten used per session). Ten syllable cards containing written graphemes of the phonemes /s/, /f/, /t/, /d/, /p/, /b/, /θ/, /j/, /r/, and /l/ paired with the vowel /a/ were made for the training sessions, and ten syllable cards containing the same phonemes paired with the vowel /o/ were made for the generalization/maintenance probes.

Two intervention treatments were used in the study: (a) Visual Phonics training, which consisted of using the Visual Phonic hand signals and written symbols (described
earlier) in addition to multisensory training; and, (b) multisensory training, which involved the use of a variety of materials and strategies (listed below) to stimulate all the sense modalities while training the child to produce particular target phonemes. The only difference between the intervention techniques was the use of the Visual Phonic hand signals and written symbols during the Visual Phonics intervention sessions. Three phoneme targets (/s/, /t/, /d/) were trained with the Visual Phonics technique and three targets (/f/, /b/, /p/) were trained with the multisensory technique; targets were assigned to a training technique through random selection.

Each training session included training with both techniques. Each session was divided into two segments, each segment devoted to a separate training technique. The interventions were alternated and counterbalanced by session. The study spanned a period of eight weeks. Training sessions were conducted daily, and each session was approximately 40-minutes in length. Subject illness and schedule conflicts resulted in a total of 30 training sessions.

Each session in both baseline and intervention phases began with a Ling 5 sound test (Ling, 1975) to check the amplification devices worn by the subject. The subject's audiogram indicated that she should consistently identify four of the five sounds (/u/, /a/, /i/, and /s/). The
subject could not identify or detect the phoneme /s/ consistently. The child's personal aids were never found to be malfunctioning during the study. The child did develop a middle ear infection during the training without the benefit of amplification. During this time the subject was unable to identify any of the Ling 5 sounds.

**Baseline Assessment**

On the first day of training a tape of the subject's phonologic speech was recorded. This tape was rated by two educators of hearing-impaired children for intelligibility. Ratings were based on the intelligibility rating scale produced by the National Technical Institute for the Deaf (1981). Results of the intelligibility measure coincided very closely with the description of the subject's speech obtained from her school file. The subject's speech was judged to be intelligible for about half the content of the message; pitch register was rated as appropriate for the child's age and sex; pitch control was rated as flat within a limited speaking range; rate was slightly below the optimal rate for efficient communication; control of air expenditure was rated as slightly excessive of deficient; a mild problem was noted in prosodic features (this may be due in part to the nature of the speech sample because the subject was reading from a book). Other speech qualities noted were a
mild to moderate breathiness, moderate tenseness, moderate nasality, and moderate pharyngeal resonance.

An informal survey questionnaire (see Appendix B) was given to the subject's teacher and parents prior to training. Unfortunately the parents did not return the questionnaire so no data concerning the subject's use of speech skills at home could be obtained. The classroom teacher’s responses included the following data. The subject produced voiced consonants and vowels in isolation most clearly. Sounds produced at the end of a word seemed to be most difficult for the child; i.e. most endings were "nonexistent." Words in "every day communication... Thank You, Where are you going? etc." were produced most clearly. Connected speech seemed to be most difficult due to the increase in rate (i.e., the faster the subject spoke the less intelligible she became). The teacher mentioned that the subject's exposure to Visual Phonics was very recent and that it was too early to attribute any effects due to use of this system.

Phonemes selected for assessment during baseline were chosen on the basis of the subject's school speech therapist. The phonemes assessed during baseline procedures included the phonemes /p/, /b/, /s/, /z/, /t/, /d/, /l/, /r/, /θ/, and /j/. The phonemes /l/, /r/, /θ/, and /j/ were dropped due to inconsistent baseline ratings, and the remaining six phonemes were targeted for the intervention phase of the study.
During baseline all phonemes were presented to the subject using the word-picture cards described previously. To ensure that the subject was familiar with these words, a familiarity check was made by presenting the word-picture cards in random groups of 10. The child was first asked to say and sign each word presented. Following the child's initial production, the investigator pointed to each word and said and signed it for the child. The child was then asked to say and sign each word in the group again. Words the child could not say and sign the second time were deleted from the word pool for the study. This familiarity check was conducted over two sessions.

During each baseline training session the subject was presented with several groups of words. Each group contained 10 words, all of which were drawn from the pool of familiar words. Words were presented to the subject on word-picture cards which were laid out in front of the child. The investigator pointed to each card and said and signed the word represented by the card. Once all ten cards were demonstrated to the child in this manner, she was asked to say and sign each word using her best speech. Initially the subject was also told that she must say all 10 words within one minute's time. This instruction was soon dropped because the subject consistently produced 10 words within the minute
interval (when timed, she performed this task in approximately 40 seconds). Speech productions were audio-taped.

The subject was also presented with 10 syllable cards at each baseline session. Syllable cards were presented in groups of 10; each card depicted a different phoneme target paired with one of the five vowels. Once again, the investigator laid all ten cards in front of the subject and pointed to each one as she said them. The child was then asked to repeat this procedure (subsequent sessions did not include this first step). Finally, the child was asked to say the syllables one more time while being audio-taped. Syllable cards were presented in random order by shuffling the cards prior to each presentation.

Training targets were selected after a period of two weeks of baseline assessment. A phoneme became a target when the subject was rated as having three or fewer correct productions out of 10 trials over a period of three or more consecutive sessions.

Ratings of Speech Production

All tapes made during the investigation were rated by three raters. The raters received a list of the words and syllables produced during each session. Raters were naive as to the type of training the subject received for any of the targets. Production was scored as correct when two of the three raters judged the target phoneme to be present in the
word or syllable. It was not necessary for the word or syllable to be intelligible to the rater, but the presence or absence of the target phoneme rather than its intelligibility was scored by the raters.

Inter-rater reliability was computed by counting the number of similarly rated words or syllables in a group of 10, dividing that number by 10, then multiplying the resulting figure by 100 to obtain a percentage score. Seven of the daily phoneme scores tallied for the subject received a reliability score of less than 80% (see Appendix C). A level of 80% reliability or better was achieved for all other phoneme scores.

**Intervention Procedures**

The intervention training sessions for both techniques were conducted by first introducing the target in syllables and asking the child to imitate the clinician's productions of the target. The training progressed to imitations of the target phoneme in words using the word-picture cards (one group of ten cards from the card pool) as prompts. Finally, the child and clinician would play a card game (for example, a children's game of "Go Fish" or "Concentration") using one group of ten word-picture cards containing the target phoneme being trained. The child was prompted to produce the target words using the word-picture cards during this play period. Each training session was 10-
15 minutes in length and was followed by a testing period during which the child's productions of the ten trained words and ten syllables was audio-taped. Syllable testing always included the following ten phonemes paired with the vowel /a/ - /b/, /d/, /s/, /f/, /t/, /ç/, /l/, /r/, /o/, and /j/.

Testing sessions were conducted in the same manner as those conducted during the baseline phase of the study. After the testing period, another 10-15 minute training period was conducted using the alternate training technique and followed by a second testing period. The subject received training using both techniques during each session.

**Visual Phonics Intervention**

The Visual Phonics training technique involved training the subject to produce the target phoneme in syllables (i.e., the target paired with a vowel) while using the corresponding Visual Phonics hand signal as a prompt for production. The researcher utilized the Visual Phonics hand signals every time she produced the target in Visual Phonics training sessions. The subject was asked to use the hand signals as well during these sessions and prompted to continue using them throughout the sessions. These sessions progressed to imitative use of the target phonemes in words then participating in a card game utilizing the trained words and the corresponding hand signals for the target phoneme.
Multisensory Intervention

In the multisensory training technique the subject was trained to produce the target phoneme by first participating in imitative phoneme drill practice (i.e., several repetitions of the target phoneme paired with a vowel). Next the subject was asked to produce the target phoneme imitatively in words. Finally, the subject participated in card games (5-10 minutes in length), during which she was asked to produce the target phoneme in the trained words.

Both techniques involved the use of a variety of the following training strategies. These training strategies were employed when the subject was unable to imitate the researcher's correct productions of target phonemes during training sessions.

1. Auditory strategies: The subject was required to use audition alone and asked to (a) detect the presence or absence of target phonemes; (b) discriminate between pairs of phonemes where one phoneme was a correct production of the target and the other was an imitation of the child's incorrect production of the target phoneme; and (c) discriminate between the target phoneme and another phoneme similar in place and manner of production.

2. Visual strategies: The researcher used hand analogies and/or pictures of the vocal anatomy to
demonstrate how the sound was produced; a mirror was used to allow the subject to visually imitate and compare the lip and jaw movements of the researcher to her own.

3. Tactile strategies: The child was asked to contrast phoneme productions by placing her hand to her cheek and feeling jaw movements then placing her hand to the researchers cheek and feeling jaw movements; the researcher described the feel of the tongue tip touching parts of the mouth as the target was produced; the subject was asked to feel for voicing vibrations by placing her hand lightly on the speaker's throat; the subject was asked to feel the researcher's oral breathstream as the target was produced.

4. Analogy of production: The subject was asked to produce a phoneme similar in the place of production, or manner of production and/or the voicing distinction of the target phoneme; the child was then guided to correct productions of the target with explanations and contrasts of this similar phoneme.

5. Teacher feedback: The clinician gave explanations of the subjects misproductions by describing the
correct place, manner, and voicing of the target phoneme during training sessions.

**Generalization and Maintenance Probes**

As the subject's production of target phonemes in trained words and syllables reached criterion levels, the subject's production of these phonemes in untrained words and syllables was probed. Generalization/maintenance probes were differentiated in this study by their occurrence in relation to intervention training sessions for each target phoneme. Generalization probes were probes conducted during or immediately following the intervention phase for a particular target phoneme. Maintenance probes were probes conducted a week or more after the intervention phase had been completed for a particular target phoneme. For example, during training session 22 the phonemes /s/, /ʃ/, /t/, and /b/ were probed (see Figures 1 and 2). For the target phonemes /s/ and /ʃ/, the data obtained depicted the subject's ability to maintain acquired skills, as training was completed for these targets a week prior to the probe. For target phonemes /t/ and /b/, the data gathered during the probe period pertained to generalization skills because training was completed for these targets one day prior to the probe. Both generalization and maintenance probes were conducted for each of the target phonemes trained in the study.
Procedures for generalization and maintenance probes were identical. Probes were conducted immediately following the second intervention sessions (session number 30 and 31 were the only sessions devoted entirely to probes). During probes the child was required to produce a group of 10 untrained words for each target phoneme which had reached the criterion level and one group of 10 untrained syllables (phonemes /s/, /ʃ/, /θ/, /β/, /ð/, /t/, /d/, /l/, /r/, and /j/ paired with the vowel /o/; this vowel was never used when syllables were trained). The child was given the same instructions as in previous baseline testing periods and her productions of untrained words and syllables was audio-taped. Syllable and word-picture cards (presented in random order) were presented as prompts in each probe.
RESULTS

All data gathered in this study have been presented graphically in Figures 1-3. The two graphs in each figure depict the number of correct word productions obtained in 10 trials for target phoneme pairs. Data pertaining to the target phoneme trained with the Visual Phonics technique are plotted on the uppermost graph and data pertaining to the Multisensory technique are plotted on the graph below. Study phases were portrayed by dividing each graph into three sections; i.e., baseline, intervention, and probes. Each data point represents the number of times the target phoneme was correctly produced in words over ten trials (correct production of the target phoneme in a syllable is shown by a circled data point). Though the sessions are sequentially numbered the amount of time between sessions varied due to illness and schedule conflicts.

The data show a general increase in the subject's correct production of target phonemes in words during the intervention phase and subsequent probes. Figure 1 depicts the results obtained from training the fricatives /s/ and /ʃ/. The phoneme /s/ was trained using the Visual Phonics technique of speech training. During baseline the subject was unable to produce the phoneme /s/ correctly in untrained
Figure 1. Number of correct productions of fricatives trained with Visual Phonics and multisensory techniques of speech training. — Circled data points indicate correct production of the target phoneme in a syllable; uncircled data points indicate incorrect production of the target phoneme in a syllable. Data points represented by a 'g' indicate generalization probes; data points represented by an 'm' indicate maintenance probes. Session 22 occurred one week after training had been completed; session 30 occurred two weeks after training had been completed; and session 31 occurred three months after training had been completed.
words for five consecutive sessions; however, she was able to produce the phoneme /s/ correctly in a syllable in the first session and the last session. During the training phase of intervention, the subject's number of correct productions was initially low (0-1 correct in untrained words, 0 correct in syllables) but jumped sharply in the third session to 8 correct productions in trained words. This level of accuracy was maintained for two more sessions, when there was a sudden drop in the subject's scores to 0 correct productions. Two sessions later the subject achieved a score of 10 correct productions; but in the last intervention session the subject's score for correct productions was 4. When tested for generalization of the target /s/ to untrained words and syllables, the subject scored 7 or more correct productions in untrained words and correct syllable production for both generalization probes. The first maintenance probe shows that the subject did maintain a high level of correct production for the phoneme /s/ after a week without training. The second maintenance probe shows that the subject continued to maintain criterion levels of production after two weeks without training. After three months without training, the subject's score dropped to 0 correct production in words and incorrect production in a syllable.

The fricative /ʃ/ was trained using the Multisensory technique. During baseline the subject's productions of /ʃ/
were irregular, spanning from 0-5 correct productions in untrained words and syllables (Figure 1). After just one training session the subject achieved a score of 10 correct productions in trained words. She maintained this level of accuracy for one more session, then the number of correct productions dropped to 6. In the last four sessions of training, the subject scored 9-10 correct productions in trained words and was able to produce the target correctly in trained syllables. In the first generalization probe the subject scored 8 correct productions in untrained words and correct production in an untrained syllable. The second generalization probe yielded perfect scores (i.e., 10 correct productions in untrained words and correct production in a syllable). After one week without training, the subject continued to score with perfect accuracy. The subject maintained this level of accuracy after two weeks without training and again after three months without training.

Figure 2 depicts the results obtained from training the final stops /t/ and /b/. The phoneme /t/ was trained using the Visual Phonics technique of speech training. During baseline, the subject's correct productions ranged from 0-1 over a period of six sessions. In only one session (session 9) was the subject able to produce the target correctly in a syllable. During the training phase for this phoneme the subject was immediately able to produce the
Figure 2. Number of correct productions of final stops (/t/ and /b/) trained with Visual Phonics and multisensory techniques of speech training. Circled data points indicate correct production of the target phoneme in a syllable; uncircled data points indicate incorrect production of the target phoneme in a syllable. Data points represented by a 'g' indicate generalization probes; data points represented by an 'm' indicate maintenance probes. Session 30 occurred one week after training had been completed; and session 31 occurred three months after training had been completed.
target correctly in 10 trained words, with correct syllable production after one training session. This level of accuracy was maintained for the duration of the training phase for both words and syllables. The subject's score for the generalization probe was 10 correct productions in untrained words and correct production of an untrained syllable. The subject received the same scores for maintenance probes conducted one week after training (session number 30) and three months (session number 31) after training.

The final stop /b/ was trained with the Multisensory technique of speech training. During baseline the subject's scores ranged from 0-2 correct productions in untrained words and no correct productions in syllables. On the first day of intervention the subject scored one correct production of the target phoneme in trained words and incorrect production of the target phoneme in trained words and incorrect production of the target phoneme in a trained syllable. The second day of intervention for this phoneme, the subject's score was 4 correct productions in trained words and correct production in a trained syllable. The subject's score jumped to 10 correct production in trained words and correct production in a syllable after three training sessions. This level of accuracy was maintained for the duration of the intervention phase. The subject scored 10 correct productions in untrained words with correct production in a syllable in the
generalization probe. After one week without training the subject received this same score. After three months without training the subject's score dropped to 1 correct production in untrained words, but correct production in a syllable was maintained. It should be noted here that inter-rater reliability was less than 80% accurate for the raters' abilities to "hear" the final /b/ as it was produced by the subject.

Figure 3 depicts the results obtained from training the final stops /d/ and /p/. Two baseline phases were conducted for this pair of targets due to the instability of the target phoneme /p/ during the first baseline phase. During the first baseline phase the subject's productions of /d/ ranged from 0-3 correct productions in untrained words, with no correct productions in syllables. During the second baseline phase the subject's scores ranged between 0 and 1 for all but one session with untrained words (all syllable productions were correct). During that particular session the subject scored 10 correct productions in untrained words, with correct productions in an untrained syllable.

The target phoneme /d/ was trained with the Visual Phonics technique. During the intervention phase for the target phoneme /d/ there was an immediate change in the level of correct productions. The subject scored 10 correct productions in trained words and correct production in trained syllables for all training sessions. In the generalization
Figure 3. Number of correct productions of final stops (/d/ and /p/) trained with Visual Phonics and multisensory techniques of speech training. — Circled data points indicate correct production of the target phoneme in a syllable; uncircled data points indicate incorrect production of the target phoneme in a syllable. Data points represented by a 'g' indicate generalization probes; data points represented by an 'm' indicate maintenance probes. Session 31 occurred three months after training had been completed.
probe the subject scored 10 correct productions for her productions of the target in untrained words; however, she was not able to produce the target correctly in an untrained syllable. After three months without training the subject scored 10 correct productions for untrained words and correct production of the target in an untrained syllable.

The final stop /p/ was trained with the traditional technique of speech training. During the first baseline period the subject's scores ranged from 0-6 correct productions in untrained words, with no correct productions in syllables. During the second baseline period the subject's scores ranged from 0-10 correct productions in untrained words and correct syllable productions for five of the six sessions. Two of these sessions (session 20 and 24) resulted in inconsistent ratings (interrater reliability less than 80%). The researcher concluded from these baseline scores that the subject had identified the target and was applying knowledge of production previously learned because the subject would make comments about which targets were going to be trained and would verbally note prior to taping the sound on which she needed to concentrate.

During the intervention phase of training with the target phoneme /p/, the subject scored 10 correct productions in trained words and correct production in trained syllables. The same scores were achieved for the generalization probe
conducted one day after training had ceased. After three months without training, the subject continued to score 10 correct productions in untrained words and correct production in an untrained syllable.

A follow-up survey questionnaire (see Appendix B) was completed by the subject's classroom teacher three months after training was completed. The teacher was asked to respond to the same questions she had completed in the first questionnaire. Her responses on the second questionnaire were very similar to her original responses. Those comments, which were somewhat different, are listed below. The subject produced some final consonants clearly; these final consonants were /b/, /d/, /f/, /h/, /j/, /l/, /m/, /n/, /p/, /r/, /t/, /v/, /w/, and /z/. The most difficult phonemes for the subject to produce were listed as initial and final /s/, /y/, /g/, and /k/. The teacher commented that the Visual Phonics system is "helpful as a reminder—for example when she omits the s, I give her the cue for it."

Summary

For the phonemes /ʃ/, /ʒ/, /ɹ/, and /ɬ/ there was a dramatic jump in production from three or less correct productions to 10 correct productions after one training session. For the phoneme /ď/ the subject's production scores improved gradually over the first three sessions before reaching a level of 10 correct productions. Teacher comments
on the survey questionnaire following training indicated improved production of the phonemes /t/, /d/, /p/, and /b/.

For the phoneme /s/ the subject's scores were rather erratic; however, she was able to achieve a score of more than three correct productions for most of the training sessions. Teacher comments indicated that Visual Phonic cuing was helpful in prompting correct production of the phoneme /s/ subsequent to training. The general trend of the subject's production scores after training was in a positive direction for all phonemes trained.
DISCUSSION

The most important finding of this study was that the subject was able to improve her production of all phonemes trained regardless of the training techniques used; these data support previous studies which have found that intensive speech training has a beneficial effect on speech production of profoundly hearing-impaired children. Intensive training appears to have been successful for all target phonemes. This finding is further supported by similar results comparing the effects of intensive training programs with and without the use of mechanical devices (Gulian & Hinds et al., 1983; Gulian & Fallside et al., 1983; Babcock & Wallen, 1974).

Another important result of this investigation was that there was no clear superiority of the Visual Phonics training technique over the traditional training technique. Results obtained from training conducted on fricatives were inconsistent due to some possible flaws of the study and other influencing factors. The results obtained from training conducted on final stops did not yield sufficient evidence that one technique was superior to another. In fact, comments made by the classroom teacher subsequent to the training sessions show that the subject had improved her
production of all four final stops used in training sessions. The most striking result was that the subject was able to achieve criterion levels of production after three or less training sessions for all final stop targets. These findings suggest that the training techniques utilized had no differential effects on the production of target phonemes. Once again, studies of speech training with and without the use of mechanical devices (Babcock & Wallen, 1974; Gulian & Fallside et al., 1983; Gulian & Hinds et al., 1983) support these findings. These studies reported improved intelligibility scores for their subjects after training. Two of these studies (Gulian & Fallside et al., 1983; Gulian & Hinds et al., 1983) reported no differential effects for training techniques, and maintenance of high intelligibility scores after a period without training.

Results of generalization and maintenance probes show that the subject was able to generalize and maintain skills acquired with both training techniques. The number of correct productions achieved during generalization and maintenance probes were quite high for all phonemes trained. For the fricatives /s/ and /ʃ/ the subject scored between 7 and 10 correct productions during generalization probes and in the first maintenance probe; for the final stops /t/, /d/, /th/, and /p/ the subject received scores of 10 correct productions in generalization probes and 10 correct productions
for all but one maintenance probe. The intensive speech training had a positive effect on the subject's ability to produce the trained phonemes during generalization and maintenance probes.

Some mention should be made here of the problems encountered during this investigation. The subject was not able to produce the target phoneme /s/ in a consistent manner during the intervention phase of the study. Although intervention was extended to obtain criterion levels for three or more consecutive sessions, these results were never achieved. Consequently, training for the target phoneme /s/ was discontinued and the intervention was applied to a new target phoneme. It was concluded that training with the phoneme /s/ was ineffective due to the child's inability to auditorily detect and/or identify the phoneme /s/. Ling (1976) states that hearing-impaired children can overcome a lack of ability to hear a target phoneme and learn to produce the target when provided with a very structured training program. It may be that the training techniques used in this study were not structured sufficiently to result in consistent production of the target /s/.

Another flaw in this study was that the child's history of speech therapy was not clear from her school records. Additional information could not be obtained; therefore, the extent of the influence of prior training on targets cannot
be assessed. Furthermore, the speech training received by the child between the first and second maintenance probes was not monitored; hence, the child's ability to maintain high levels of production may be due, in part, to influences outside of this study. One final note regarding problems encountered during this investigation concerns the pairing of phonemes for alternate treatments. The phonemes may have been more appropriately paired by place of production as well as manner of production to obtain more consistent results.

An additional explanation for the subject's lack of consistency with the target phoneme /s/ may lie in the iconicity of the Visual Phonics hand signals. The Visual Phonics signals tend to be indicative of the vocal anatomy as the target is produced. For example, hand movements for the phonemes /d/ and /t/ resemble the movements of the tongue against the alveolar ridge as the phonemes are produced. In contrast, the signal for the phoneme /s/ simulates the movement of the breathstream once it has passed through the vocal anatomy. It is possible that children may not be cognizant of the breathstream once it passes through the vocal anatomy; thus, this hand signal may not be as effective as those that seem to represent movements of the vocal anatomy. It is suggested that further research on the Visual Phonic system take into consideration the iconicity of the Visual Phonics hand signals.
In this investigation only one aspect of the Visual Phonics system was studied. Another aspect of the system is the written symbols and the value of these symbols as phonetic decoding cues. Advocates of the system have made claims that these symbols provided profoundly hearing-impaired children with phonetic word-attack skills. In this investigation, the symbols seemed to give the child some indication of how to pronounce the phonemes; however, she was not required to use symbols and signals for every phoneme in a word. This study did not test the effects of Visual Phonics written symbols on the subject's reading skills. The question of the effects of the symbols on reading ability does seem to merit investigation.

Another aspect of the system that must be addressed, along with the reading of the written symbols, is the use of hand signals in connected speech. Hearing-impaired children who use total communication may find the addition of yet another set of hand signals intrusive to effective communication. In this investigation the subject was not required to incorporate hand signals into her expressive language; however, the investigator has witnessed hearing-impaired children using the signals in connected speech. During this observation the children often became confused with the Visual Phonic hand signals and the Sign Language alphabet. Resulting expressions were fingerspelled words, which moved
in approximation to the Visual Phonics hand signals. It is hoped that future studies on the merits of the Visual Phonics system will take this dilemma into consideration.

This study examined the results of Visual Phonics only on the production of specific targets. It is possible that use of Visual Phonics may affect general intelligibility in a manner not studied by this researcher. The findings from this investigation point out that intensive speech training appears to be more effective for hearing-impaired children than the use of any particular training technique in enhancing production of specific speech targets. It is hoped that this investigation will lead to further studies on the efficacy of using the Visual Phonics technique in the education of hearing-impaired children. It is suggested that in future studies researchers attempt to pair phonemes for alternate treatments by more than one characteristic of production. It is hoped that any replications of this investigation will involve multiple subjects to generate a larger pool of data regarding the use of Visual Phonics and intensive speech training. Further investigation of the Visual Phonics system should involve the use of profoundly hearing-impaired subjects whose articulation skills are quite limited. The use of subjects such as these would help to show the effectiveness of this visual system more clearly, since profoundly impaired subjects would not be able to
benefit from auditory speech training strategies. It might also be useful to employ pre- and post-articulation testing to provide further support for the investigation findings.

Results of this study are most useful in emphasizing that children are individuals with unique learning styles. Hence, the use of a variety of techniques and strategies when training speech production should be a common practice. Clinicians should employ Visual Phonics hand signals and written symbols as they seem appropriate for an individual child learning to produce a specific phoneme. A child may find the use of Visual Phonics cues useful in learning one phoneme and distracting when learning another. For example, the subject of this study did not use Visual Phonics cues when producing the phoneme /s/ unless continually prompted by the investigator; in contrast, the subject consistently used the hand cue for the phoneme /t/. The conclusion here is that Visual Phonics cues should be thought of as an additional speech training strategy and not used as a requirement in speech training programs.
APPENDIX A

SAMPLE WORD-PICTURE CARDS

Sheep

Sock

Cup

Bed

Web

Hat
APPENDIX B

RESEARCH QUESTIONNAIRE
RESEARCH QUESTIONNAIRE

Please read and answer each of the following questions carefully. Please give examples and explanations in your answers.

1. What phonemes or letter sounds are produced most clearly by your child?

2. What phonemes or letter sounds are most difficult for your child to produce?

3. What words can your child produce most clearly?

4. What words seem to be most difficult for your child?

5. Has your child been exposed to the Visual Phonics hand cues and written symbols? If so, do you feel the use of these cues has improved the clarity of your child's speech?

6. Has your child used the Visual Phonics system at school or in speech therapy? If so, do you feel the use of these cues has improved the clarity of your child's speech?

7. What types of speech training outside of school has your child been exposed to?
APPENDIX C

TABLE OF RELIABILITY SCORES LESS THAN 60%
### TABLE OF RELIABILITY SCORES LESS THAN 80%

<table>
<thead>
<tr>
<th>Target Phoneme</th>
<th>Session Number</th>
<th>Reliability Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>/s/</td>
<td>16</td>
<td>70%</td>
</tr>
<tr>
<td>/s/</td>
<td>17</td>
<td>40%</td>
</tr>
<tr>
<td>/s/</td>
<td>19</td>
<td>60%</td>
</tr>
<tr>
<td>/b/</td>
<td>17</td>
<td>70%</td>
</tr>
<tr>
<td>/b/</td>
<td>19</td>
<td>50%</td>
</tr>
<tr>
<td>/p/</td>
<td>20</td>
<td>70%</td>
</tr>
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REFERENCES


