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SIX TO EIGHT AND ONE-HALF YEARS

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CHAPTER I

INTRODUCTION

Articulation problems have long been recognized as the most prevalent of all the disorders of speech. The report of the American Speech and Hearing Association to the Mid-Century White House Conference estimated the incidence of speech defects among children in the United States between the ages of five and twenty-one years to be 5% of the total population of 40,000,000. Three percent of these, or approximately 1,200,000, were considered to be functional articulatory problems. The report further states:

> . . . the figures are presented as the lowest defensible estimates; they would be regarded as serious underestimates in certain respects by some authorities. They leave out of account an estimated additional 5 percent, or 2,000,000, children who have relatively minor speech and voice defects.[1]

According to Powers, it is safe to conclude that functional articulatory problems represent between 75 to 80% of all speech

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[1]ASHA Committee on the Mid-Century White House Conference, "Speech Disorders and Speech Correction," Journal of Speech and Hearing Disorders, XVII (June, 1952), 129.

defectives in the school population.[2] Functional articulatory problems, then, constitute a highly significant group of disorders in the total field of speech pathology. The articulatory problem merits serious study and much greater scientific investigation than it has yet received, not only because it is so common, but also because the articulatory problem is by no means so simply explained and treated as one might assume.

According to Van Riper, the causes of articulation problems can be categorized as follows: (1) developmental influences, (2) emotional conflicts, (3) motor in-coordination, (4) organic abnormalities, and (5) perceptual deficiencies.[3] Due to the close relationship between speech development and audition, some investigators have regarded auditory processes as the most promising direction in which to search for factors which might explain functional articulatory problems. Factors of audition which have been experimentally investigated and will be discussed in Chapter II are: (1) basic acuity for pure tones, (2) acuity for higher frequencies, (3) speech sound discrimination, and (4) auditory memory span. The research, as will be shown in Chapter II, has been contradictory. One can usually find a deficiency in one or a combination of these auditory processes in isolated functional articulatory cases,

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[2]Margaret Powers, "Functional Disorders of Articulation -- A Symptomatology and Etiology," Handbook of Speech Pathology, ed. Lee Travis (New York: Appleton-Century-Crofts, Inc., 1954), p. 711.

[3]Charles Van Riper, Speech Correction Principles & Methods (3rd ed.; New York: Prentice Hall, Inc., 1954) p. 183.

but generally these individuals do not differ markedly as a group when matched with normal speakers. This observation has led Powers to state:

> What can we conclude then about the causal significance of auditory factors in relation to functional articulatory disorders? For each of the auditory skills reviewed, there is some evidence both for and against a systematic difference between normal and functional articulatory defectives. However, the weight of evidence for each auditory factor so far considered is against there being a significant and generalized difference.[4]

Auditory perception, however, still remains prominent in therapy planning with functional articulation cases. As Johnson says:

> . . . with a large number of cases -- some authorities go so far as to say all -- teaching the child to produce the correct sound must be preceded by some systematic ear training. Before attempting to play, one must get the tune "inside one's head."[5]

Powers suggests that there has been an increasing trend throughout the past twenty years toward using auditory training as the basic approach to the correction of articulation defects. She also writes:

> . . . the majority of modern writers in speech pathology favor an auditory-training approach to the correction of functional articulation problems. Incidental use is made of visual and kinesthetic cues and of direct instruction in phonetic placement. Exercises for the speech mechanism are used only if some type of motor inadequacy appears to be present. The emphasis in auditory training is in no way inconsistent with the absence of clear-cut evidence that a relationship exists between auditory deficiencies and functional articulation problems, since the purpose of

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[4]Powers, p. 744.

[5]Wendell Johnson <u>et al.</u>, <u>Speech Handicapped School Children</u> (rev. ed.; New York: Harper and Bros., 1956), pp. 121-22.

> giving auditory training is to develop a positive skill, an awareness of speech sounds, rather than to overcome a deficiency. . . . Considerable time is spent in developing the individual's auditory discrimination ability as a basic, generalized skill, which he can then apply to the discrimination of specific sounds and words. . . . In the long run, carry-over seems to be more effective and permanent when time is devoted to building auditory skill first, even when correct articulatory production can be secured easily. Moreover, auditory training should probably continue to occupy a small part of each therapy session throughout the entire course of articulatory training.[6]

Auditory perception has also been investigated as an area of difficulty for those children who fail to learn to read or whose reading level is materially retarded. There appears to be experimental contradiction in the research literature dealing with the development of reading skills and/or cause(s) of failure in reading achievement. Related to this, Heilman says:

> There appears to be a lack of agreement in experimental data as to the relationship between learning to read and auditory discrimination. This is due in part to the fact that in the literature the term auditory discrimination is found to include such abilities as discrimination between the pitch of musical tones, discrimination between the intensity of sounds, and acuity in hearing different frequencies in the speech range. In general, such factors do not differentiate between good and poor readers.[7]

There are, however, studies which indicate that impaired readers lack skill in auditory perception. These studies will be reviewed in Chapter II.

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[6]Margaret Powers, "Clinical and Educational Procedures in Functional Disorders of Articulation," Handbook of Speech Pathology, ed. Lee Travis (New York: Appleton-Century-Crofts, Inc., 1957), p. 790.

[7]Arthur Heilman, Principles and Practices of Teaching Reading (Columbus, Ohio: Charles E. Merrill Books, Inc., 1961), p. 62.

It is possible that there is a strong relationship between speech inadequacies and reading retardation. Powers writes:

> Articulation problems have been mentioned frequently as a cause of reading disability. It has been assumed by many that reading and articulation, both being language-related functions, are somewhat interdependent and that a deficiency in one tends to be associated with a deficiency in the other. Other writers have stressed not a direct causal relationship between speech and reading deficiency but rather the possibility that other more basic skills, such as auditory acuity, auditory memory span, and sound discrimination, are fundamental in both reading and speech, and, if deficient, retard both. If this were true, speech and reading disabilities could be said to have a concomitant rather than a causal relationship.[8]

Anderson suggests:

> As further evidence of the close relationship of the elements of communication . . . a number of research studies have indicated that children with speech defects are more likely to exhibit reading disabilities than are normal speakers. Also, more speech problems have been found among deficient readers than among the school population as a whole. The nature of this relationship has not yet been fully explored. Doubtless there are a number of factors common to both of these forms of language that operate to determine the individual's ability in both speaking and reading. It is encouraging to observe that reading disabilities, as well as speech defects, are being recognized and dealt with in the schools, but it would be a mistake to consider them as wholly separate problems. Where both are deficient, training in the one activity must, in many cases, be accompanied by improvement in the other. Betts has proposed the theory that, since the child's language maturation proceeds through the stages of first understanding speech, then speaking, and finally reading, any disability in one of these skills will impede progress in succeeding ones. [Emmett Betts. <u>Foundation of Reading Instruction</u>. New York: American Book Co., 1946, p. 6]. . . . There is some reason to believe, therefore, that, educationally speaking, we

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[8] Powers, "Functional Disorders of Articulation . . .," pp. 750-51.

> may have been guilty of getting the cart before the horse in stressing the importance of written language without making sure that the child possessed adequate ability in oral communication.[9]

Due to the fact that this study is interested in examining the vocal phonic synthesis and analysis ability of elementary school children, it is logical to suggest that the results should be of interest to investigators of the linguistic skills of speech, reading, and spelling. The research is meager which relates to vocal phonic synthesis and analysis ability and articulatory problems and the same is true for reading and spelling problems. The research which has been completed will be reviewed in Chapter II. Although this study will deal with unselected children, i.e., there will be no provision for determining a child's speech, reading, or spelling adequacy, age-grade norms will be established for the selected population including a breakdown for males and females if a statistically significant difference is found between the two.

Origin and Importance of the Problem

The area of auditory perception is fertile for investigation and interest in this topic was evoked by Van Riper who contends that it is in the area of auditory perception that most of the causes of articulation defects occur, and he has observed that:

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[9] Virgil Anderson, Improving the Child's Speech (New York: Oxford University Press, 1953), pp. 34-35.

> Case after case shows a marked inability synthesizing a series of isolated sounds to make a familiar word (recognizing that n...o...z can be combined to make "nose"). Case after case finds great difficulty in recognizing his own errors even though he may show excellent discrimination of the errors of others. Many such persons may know that a word is incorrectly pronounced without being able to isolate that particular part of the word which is defective. The research has not tested these basic difficulties, and in its absence, we must do what we can to discover whether or not they exist in the case we are examining.[10]

Van Riper and Irwin continue:

> It may well be that there is another factor in the perception of articulation error even more important than auditory memory span, auditory discrimination, or stimulability. We refer to what has been called "phonetic ability," or "vocal phonics."[11]

According to Van Riper, vocal phonics or phonic ability consists of those activities related to the analysis and synthesis (breaking down and recombining) of sound sequences.[12] He also views vocal phonics as a natural process in the speech development of the child and one that should be encouraged.

> If we are to help a child master pronunciation we must help him acquire the skill of taking words apart and putting them together. Again we should follow the natural tendency of the child. Normal children eventually learn the principles of vocal phonics, the synthesis and analysis of words, by rhyming, by punning, by distorting their sequences. . . . By these activities the child learns to observe all the features of a given word. He plays with its beginning, he twists its tail.

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[10]Van Riper, p. 195.

[11]Charles Van Riper and John V. Irwin, Voice and Articulation (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1958), p. 28.

[12]Charles Van Riper, "Children Who Are Slow in Learning Speech," Speech Problems of Children, ed. Wendell Johnson (New York: Grune and Stratton, Inc., 1950), p. 111.

> He becomes familiar with the fact that "n..o..z" comes together to name a part of your face, while "r..o..z" means a flower. He notices the first sounds of words when he begins to vary them: "teeny-weeny; teeny-weeny." Children who practice such combinations in their word play soon begin to correct their initial errors in words they mispronounce. Children who practice spontaneous rhyming soon stop omitting the final consonants. . . . Children improve their vocal phonics by the use of gesture and intonation and rhythm. . . . By these activities the child learns to fit the individual sounds and syllables into a pattern. Parents should teach these skills in every way possible. Once the child manages through gesture, rhythm or intonation to put the parts of the word in their proper order, he is able to speak it correctly. Many adults are unable to say such a word as <u>statistics</u> because they cannot achieve such a pattern. . . . Adults can train, and should train their children in the function of word making as they do in the function of walking. From the time a child has mastered his basic vocabulary of a few hundred words, the parents should devote a few minutes daily to the stimulation of speech play. This play should include not only training in the production of the isolated speech sounds . . . but also training in vocal phonics.[13]

Although not documented, Van Riper states that, ". . . <u>vocal phonic ability</u> increases with age, varies with sex and many other factors, including intelligence."[14] He also says:

> Phonetic ability, although based to a considerable degree on natural abilities, is probably learned. . . . [and] there may be a strong possibility that the articulation case has not been able to master correct pronunciation because he has not learned the basic phonetic skill of combining and analyzing sound sequences. . . . When we find cases with marked deficiencies in phonetic ability of either the analytic or synthesizing type, we can expect difficulty in articulation therapy.[15]

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[13]Charles Van Riper, <u>Teaching Your Child to Talk</u> (New York: Harper and Bros., 1950), pp. 88-91.

[14]Van Riper, <u>Speech Correction Principles and Methods</u>, p. 195.

[15]Van Riper and Irwin, <u>Voice and Articulation</u>, p. 29.

Van Riper gives tentative norms for a group of twenty first-grade, twenty third-grade, and twenty fifth-grade, normal speaking children.[16] This was a test of synthesis of two, three, and four phoneme words. He considered the test crude and the norms inadequate and, to this date, no norms for vocal phonic synthesis or analysis have been established for children or adults. It is interesting to note that we can test vocal phonic ability, but that we have no scales for judgment making as to whether the subject tested is below average, average, or above average in this ability. We do not know if there is a difference between the sexes in these abilities. We do not know for certain if vocal phonic ability follows a developmental sequence as does the articulation of speech sounds. And, we really don't know if there is a relationship between vocal phonic ability and intelligence. This study, then, was undertaken to answer some of these questions.

Statement of the Purpose

The purpose of this study is to investigate the vocal phonic synthesis and analysis abilities of a group of children judged to be normal. A population of children is to be selected from the public schools, vocal phonic synthesis and analysis tests are to be administered to the subjects, and the resulting data are to be analyzed in an effort to determine if there is a difference: (1) in the vocal phonic synthesis ability of

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[16] Van Riper, Speech Correction Principles and Methods, p. 196.

elementary school children at selected age levels, (2) in the vocal phonic analysis ability of elementary school children at selected age levels, (3) between males and females in vocal phonic synthesis ability at selected age levels, (4) between males and females in vocal phonic analysis ability at selected age levels, and (5) between the vocal phonic synthesis and vocal phonic analysis abilities of elementary school children, chronological age and sex being constant.

CHAPTER II

A REVIEW OF THE LITERATURE

The literature that relates to the subject of auditory perception and this study can be divided into three categories, namely, studies and articles that: (1) are concerned with causal factors of articulatory problems, (2) are interested in the relationship between phonics and reading and/or spelling, and (3) have investigated vocal phonic analysis and synthesis as processes of breaking down and recombining sound sequences.

Causal Factors of Articulatory Problems

As previously mentioned in Chapter I, the investigation of auditory perception has been considered the most promising direction in which to search for factors which might explain articulatory problems. A substantial amount of the literature has been written in the following areas: (1) auditory acuity, (2) auditory memory span, and (3) speech sound discrimination.

Auditory Acuity

Authorities have long recognized the importance of auditory acuity and the role it plays in the acquisition of speech. As Carhart says:

> Because it is natural for the ear to be the channel through which we learn to talk, a serious impairment in hearing will hinder a child's normal development of speech. Furthermore, because the ear serves as a guide to accurate control of the speech mechanism, degeneration of speech often follows hearing losses that occur later in life.[1]

These statements indicate that hearing acuity is not only basic to the necessary comparison of sounds made by others in learning to speak but also for the maintenance of correct articulation through auto-evaluation.

Carrell, in a speech survey of 1174 school children, found that 10.2% had defective speech; of the 1174, 8.4% had defects of articulation. He also reports that, "When the sound substitution group was examined on auditory acuity, it was found to be significantly inferior to a control group."[2] In another speech survey, Sullivan found 1501 school children with defective speech and, of these, 22.2% had a hearing loss in one or both ears as opposed to the general school population which showed that only 18.8% had some loss of hearing. In a study of the children with faulty articulation, however, she found that:

> . . . [of the] cases having faulty sibilants . . . 13.2 percent show a hearing loss in the high frequencies, as compared with 12.9 percent of the general school population. . . . The fact that pupils with faulty sibilants

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[1]Raymond Carhart, "Conservation of Speech," Hearing and Deafness, rev. ed., ed. Hallowell Davis and S. Richard Silverman (New York: Holt, Rinehart, and Winston, Inc., 1960), p. 388.

[2]James Carrell, "A Comparative Study of Speech Defective Children," Archives of Speech, I (June, 1936), 202.

> . . . are apparently not differentiated from the general school population on the basis of hearing loss in the high frequencies is not to be regarded as standing in significant relationship to their defective speech.[3]

The general concensus of opinion, nevertheless, as stated by Newby, seems to be:

> Errors in articulation (sound formation) are commonly found in children who have even mild-to-moderate hearing losses. . . . Sounds that involve the precise placement of the blade or tip of the tongue in relation to other articulators are particularly likely to be defective, for example the s, r, l, sh, and ch sounds. Generally it can be said that the sounds which are less visible, more complex in their formation, and have important high-frequency characteristics are the most likely to be affected by a hearing loss. Sounds with these characteristics are also the last sounds to be mastered in the speech development of the normal hearing child. As would be expected, sounds that the child hears least well because of his hearing loss would most likely be defective. Thus, the voiceless consonants which are both weak in phonetic power and contain important high-frequency components, are often defective, especially those which are also relatively invisible and complex in their formation.[4]

This point of view, and the importance of hearing to normal speech development, is also expressed by Mykelbust.

> One of the most obvious symptoms of . . . [peripheral] deafness, if it is present from the pre-speech age, is lack of speech development. The average normal child begins to use words at approximately one year of age. Furthermore, the normal child learns to speak according to the patterns of speech which he hears. . . . If a child has partial hearing for speech, his speech will be comprised of that part of the speech pattern which he hears. For example, if he cannot hear the high frequency consonants but can hear the low frequency vowels, his voice will be low in pitch, and he will not include high frequency

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[3]E. Margaret Sullivan, "Auditory Acuity and Its Relation to Defective Speech," Journal of Speech Disorders, IX (June, 1944), 129.

[4]Hayes Newby, Audiology: Principles and Practice (New York: Appleton-Crofts, Inc., 1958), p. 258.

> consonants in his speech pattern. Those speech sounds which are not heard will not be included in his articulated speech.[5]

Finally, the auditorily handicapped child's problem is sometimes increased because, unlike the deaf child, his hearing loss goes undetected until, perhaps, someone suspects a loss due to an articulatory problem. Carhart says:

> The child who hears low frequencies well but is insensitive to middle- and high-pitched tones faces a different problem [than the child who is born deaf]. It is likely to be years before this child's deficiency is discovered. Because he can hear low frequencies, he reacts to many of the sounds in his world. People, seeing his reactions, reason that his hearing is normal. They fail to realize how distorted and imperfect are his impressions of sounds. Confusion is this child's lot. He misses the acoustic elements which give speech its distinctive character. One outcome of this confusion is slow and uncertain development of his use of language. Moreover, the child incorporates in his own speech the imperfect distinctions which he perceives in the speech of others. The result is a mushy and slurred pattern of talking which may border on the unintelligible.[6]

It is apparent, then, that there are authorities who agree that reduced auditory acuity can be a causal factor in producing articulation errors. In view of this fact, the possible existence of a hearing loss must be ruled out as a possible cause in a differential diagnosis of articulatory problems. Audiometric examinations are now routinely given to all articulatory defectives as one of a battery of tests, but not all articulatory defectives have poor hearing acuity. This

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[5]Helmer Mykelbust, Auditory Disorders in Children (New York: Grune and Stratton, Inc., 1954), p. 111.

[6]Carhart, p. 388.

fact has led investigators in search of other factors of auditory perception which might be causal or differentiating when hearing acuity is found to be within normal limits.

Auditory Memory Span

Because a time factor exists between the speaker's utterance and the listener's perception, the auditory memory spans of normal speaking individuals and those with articulatory problems have been explored. "The term 'memory span' refers to the ability of an individual to retain and associate together for purposes of immediate reproduction a series of impressions, usually auditory or visual."[7] Studies show that auditory memory span increases with age and intelligence and that articulation cases are less capable of recalling sound sequences than normal speaking individuals. Robbins tested 150 speech defectives for auditory memory span using digits, phonemes, and syllables and found that the span for phonemes and syllables increases consistently with age until about age twelve. He also reports:

> Short auditory memory spans were found in 13% of the sound substituters . . . , in 33% of those who omitted phonemes, and in 45% of those who were late in acquiring speech. Short auditory memory span is probably the cause of many cases of elision and of delayed speech. . . .[8]

In a study of 207 subjects, ranging in age from four years to eight years and five months, Beebe found:

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[7]Anderson, p. 108.

[8]Samuel Robbins, "Importance of Sensory Training in Speech Therapy," Journal of Speech Disorders, VII (June, 1942), 188.

> According to these data auditory memory span for meaningless syllables increases with chronological age, but not consistently with each change in age level. . . .
> . . . .
> There is no significant difference between the auditory memory span of boys and girls. . . .[9]

The meaningless syllables, such as goulabi, ranged in length from two to six syllables. The mean number of syllables repeated at each age were: four years, 4; five years, 3.8; six years, 4.3; seven years, 4.3; and eight years, 4.6. Other studies, however, fail to support some of these contentions. Reid, in a study of thirty-eight children, did not find auditory memory span related to articulation ability; a Pearson product-moment correlation of -.21 was obtained by statistical analysis.[10] Metraux reported that auditory memory span showed no increase, with any degree of conformity, with an increase in age or intelligence. She did find, however, that the auditory memory span of the males, in both the speech defective and normal speaking groups, was slightly higher than girls. Metraux also found, "The auditory memory span of the speech defective child . . . appears to be slightly higher for vowels, and lower for consonants, than that of the normal speaking child. . . .[11]

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[9]Helen Beebe, "Auditory Memory Span for Meaningless Syllables," Journal of Speech Disorders, IX (September, 1944), 275.

[10]Gladys Reid, "The Etiology and Nature of Functional Articulatory Defects in Elementary School Children," Journal of Speech Disorders, XII (June, 1947), 143-49.

[11]Ruth Metraux, "Auditory Memory Span for Speech Sounds of Speech Defective Children Compared with Normal Children," Journal of Speech Disorders, VII (March, 1942), 36.

What can be concluded, then, about auditory memory span and its relationship to the articulatory problem? Van Riper and Irwin feel that, "Generally it [research] seems to indicate that auditory memory span is not a common factor in articulation error; but the tests have been far from satisfactory, and, with some exceptions, the number of subjects has been far too few."[12]

Speech Sound Discrimination

Speech sound discrimination, the ability to differentiate aurally between the phonetic units of English, has also been investigated as a possible correlative to defective speech. Studies show that defective auditory discrimination is found in individuals with normal auditory acuity and that normal speakers do better on tests for speech sound discrimination than those with articulatory problems. Travis and Rasmus studied the speech sound discrimination of 548 subjects whose ages ranged from five years through adulthood and found that, "At every age level the defectives made significantly more errors on the test than normals."[13] There was no correlation between Stanford Binet intelligence quotients and sound discrimination test scores. Carrell also found, ". . . that very frequently individuals having sound substitution defects fail to discriminate

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[12]Van Riper and Irwin, p. 27.

[13]Lee Travis and Bessie Rasmus, "The Speech Sound Discrimination Ability of Cases with Functional Disorders of Articulation," Quarterly Journal of Speech, XVII (April, 1931), 225.

between the correct and the incorrect sounds."[14] In a study of thirty-eight children, Reid says:

> When speech improvement [articulatory ability] is correlated with ability to discriminate between speech sounds, holding initial speech scores constant, _r_ equals .37. . . . Here . . . _r_ is low but above what is required for significance at the 5% level.[15]

In a more recent study, Kronvall and Diehl report, ". . . that elementary grade children with severe functional articulatory disorders exhibit significantly more errors in speech sound discrimination than a matched group of normal speaking children."[16] This finding led them to conclude that auditory discrimination techniques should be an integral part of the speech therapy for functional articulatory defectives. Wepman, after twelve years of experimentation with different methods of measuring this function, has concluded:

> The results seem to be in keeping with the writer's frequently expressed opinion based on his studies of adult aphasic subjects and his clinical observation that: (a) the modalities of learning can and should be studied differentially, (b) children develop the ability to discriminate aurally at different rates, (c) delay in the development of auditory discrimination has little, if any, relationship to intelligence, and (d) delays in the development of auditory discrimination relates positively and probably causally, to poor speech articulation, poor reading ability, or both.[17]

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[14] James Carrell, "The Etiology of Sound Substitution Defects," _Speech Monographs_, IV (December, 1937), 31.

[15] Reid, p. 147.

[16] Ernest Kronvall and Charles Diehl, "The Relationship of Auditory Discrimination to Articulatory Defects of Children with No Known Organic Impairment," _Journal of Speech and Hearing Disorders_, XIX (September, 1954), 337.

[17] Joseph Wepman, "Relationships of Auditory Discrimination to Speech and Reading Difficulties," _ASHA_, I (November, 1959), 96.

On the negative side, Hansen, in applying three tests of sound discrimination to three adult groups having normal hearing acuity found that:

> . . . (a) untrained defectives did not differ significantly from normal speakers in sound discrimination ability as here measured; (b) trained defectives did not differ significantly from untrained defectives in this ability; and (c) trained defectives did not differ significantly from normal speakers in this ability. Thus, the assumption that this type of auditory deficiency exists more frequently in adult functional articulatory defectives than in adults with "normal speech" is one which the present investigation has failed to substantiate.[18]

Templin, in a study of 480 children ranging in age from three through eight, did not find a statistically significant difference between males and females in sound discrimination ability at any single age level studied. Of particular importance to this study, Templin found:

> That the mean sound discrimination scores continue to increase over this age range [6 to 8 years] is evident. . . . The difference between ages 6 and 7 is significant at the .05 level (t=2.50), but that between ages 7 and 8 does not reach this level (*t*=1.69).[19]

She further states:

> Terminal status scores in sound discrimination are taken at both 5 and 8 years, since two different tests are used to measure this ability. The increment in scores between 3 and 5 is about 40 percent. Between 5 and 8 years, however, only a 10 percent increment occurs. Since there is only a slight increment in score between the last

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[18]Burrell Hansen, "The Application of Sound Discrimination Tests to Functional Articulatory Defectives with Normal Hearing," Journal of Speech Disorders, IX (December, 1944), 354-55.

[19]Mildred Templin, Certain Language Skills in Children: Their Development and Interrelationships ("The Institute of Child Welfare Monograph Series," Vol. XXVI, Minneapolis, Minnesota: University of Minnesota Press, 1957), 71.

> two age levels tested, it would seem that by 8 years of age the ceiling in sound discrimination ability, as measured on the test used in this study, is being pushed.[20]

Investigation seeking a relationship between speech sound discrimination and defective articulation will most likely continue because of this conflicting evidence. However, Van Riper and Irwin offer these suggestions:

> . . . (1) that our existing tests of speech sound discrimination are not testing speech sound discrimination ability except in a crude and oblique fashion, and/or (2) that poor discrimination may be only one of many factors important in the case's ability to recognize error-signals in his own speech.[21]

The Phonic Method and Beginning Reading

According to Gray, by 1927 the phonic methods used as a systematic technique of word attack in teaching beginning reading had fallen into disfavor. The apparent rationale used by the educators was that phonics makes for word reading which, in turn, makes for slow reading. This reasoning led educators to believe that instruction in phonics should be minimized if not completely eliminated. By 1950, however, the methods of teaching word recognition by phonics appeared justified, ". . . if only a limited amount of training in phonetics is given in the first grade and continued in the second, third, and later grades until all the important elements are learned."[22]

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[20] *Ibid.*, p. 144. [21] Van Riper and Irwin, p. 25.

[22] William Gray, "Reading -- III. Teaching of Reading," *Encyclopedia of Educational Research*, ed. Walter Monroe (rev. ed.; New York: MacMillan Co., 1950), p. 996.

Hildreth recognizes the importance of both sight and sound associations as well as inference of meanings from the context in attacking word difficulties; and, in relation to sound associations she writes:

> Sounding aids reading to the extent that it enables the reader to hear or pronounce words naturally and to recall a word from sight-sound associations or from partial sounding clues. The technical term for this process is "clang association." The auditory clues help the alert reader guess the words correctly. . . . Pronouncing and sounding are such valuable aids in reading because of the reader's experience with spoken English, which has been built up so thoroughly over a period of years. It would be folly not to use this previous learning to the fullest extent in teaching the child to read.[23]

Robinson points out that, "Auditory discrimination has frequently been linked with early reading success, partly because it appears to be related to language and speech, but also because it appears to be basic to success in learning phonics."[24]

At the Boston University Reading Clinic, Durrell and Murphy have observed that:

> Although there are many factors which combine to determine the child's success in learning to read, it is apparent that his ability to notice the separate sounds in spoken words is a highly important one. Observations in our reading clinic bear out the above findings in intensified form. Almost every child who comes to the clinic with a reading achievement below first grade has a marked inability to discriminate sounds in words. Children who are severely handicapped in this ability seldom achieve primer level in reading. Some are so deficient in auditory analysis that the usual ear training exercises are

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[23]Gertrude Hildreth, "The Role of Pronouncing and Sounding in Learning to Read," Elementary School Journal, LV (November, 1954), 141.

[24]Helen Robinson, "Factors Which Affect Success in Reading," Elementary School Journal, LV (January, 1955), 264.

> useless. For them, it appears necessary to provide the kind of exercises given to deaf children when learning to speak, showing how different sounds are formed with the speech organs. It is difficult to understand how children with excellent speaking vocabularies, clear enunciation, high intelligence, and training in phonics fail to acquire the ability. However, it responds well to teaching, and when it is learned usually results in a marked increase in rate of learning to read.[25]

Ridenour, also working with remedial reading cases, has found that difficulty in blending sounds into words is characteristic of many children who have been unable to learn to read by regular school methods.[26] This difficulty she considers to be associated with a low degree of auditory discrimination.

There is also experimental literature which supports the application of phonic training. Jones found a positive relationship between speech training and silent-reading achievement.[27] In a study of children with severe misarticulations, Sommers and his associates found that speech therapy raised reading comprehension scores.[28] Russell also found that phonics

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[25] Donald Durrell and Helen Murphy, "The Auditory Discrimination Factor in Reading Readiness and Reading Disability," Education, LXXIII (May, 1953), 560.

[26] Nina Ridenour, "The Treatment of Reading Disabilities," Mental Hygiene, XIX (July, 1935), 387-97.

[27] Morris Val Jones, "The Effect of Speech Training on Silent Reading Achievement," Journal of Speech and Hearing Disorders, XVI (September, 1951), 258-63.

[28] Ronald Sommers, et al., "Effects of Speech Therapy and Speech Improvement upon Articulation and Reading," Journal of Speech and Hearing Disorders, XXVI (February, 1961), 27-38.

contributed to comprehension.[29] Tate, Herbert, and Zeman conducted an experiment in which one reading class received incidental instruction in phonics and another reading class no instruction in phonics and they concluded:

> . . . (1) that, without employing phonics, either formal or incidental, as a medium of instruction, teachers can secure reading performances corresponding to those indicated by the norms of standardized tests but (2) that the incidental phonic method is much superior to the nonphonic method in developing the ability to recognize words and to comprehend the meanings of sentences and paragraphs.[30]

Tiffin and McKinnis, in attempting to determine whether phonic ability is related to reading ability, conducted an experiment in the fifth, sixth, seventh, and eighth grades.[31] The 155 children pronounced one hundred nonsense words, such as histen, noistle, and phum, and the authors concluded that phonic ability is positively related to reading ability. Templin, who investigated phonic knowledge as related to reading and spelling in grade four, concluded that a substantial amount of phonic knowledge had been acquired by fourth-grade pupils and that the poor spellers and poor readers applied their phonic knowledge less well than did good spellers and good readers.[32]

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[29]David Russell, "A Diagnostic Study of Spelling Readiness," Journal of Educational Research, XXXVII (December, 1943), 276-83.

[30]Harry Tate, Theresa Herbert, and Josephine Zeman, "Nonphonic Primary Reading," Elementary School Journal, XL (March, 1940), 536.

[31]Joseph Tiffin and Mary McKinnis, "Phonic Ability: Its Measurement and Relation to Reading Ability," School and Society, LI (February, 1940), 190-92.

[32]Mildred Templin, "Phonic Knowledge and Its Relation to the Spelling and Reading Achievement of Fourth Grade Pupils," Journal of Educational Research, XLVII (February, 1954), 441-54.

Rose, in a study of over one hundred remedial readers (retarded two or more years on the basis of mental age) found that impaired readers were below average on auditory memory span as measured by specific sub-tests on the Stanford Binet.[33] Reynolds also found some significant partial correlations between various silent reading test scores and tests of auditory memory.[34] Smith has summarized the research in reading as follows:

> 1. It cannot be assumed that all children need phonics.
> 2. Phonics is effective with children who need word-recognition help, but its greatest effectiveness is attained when it is taught functionally and is related to children's reading needs.
> 3. It is advisable to delay intensive phonics instruction until a child has attained a mental age of seven years.
> 4. Phonics instruction is most valuable at the second- and third-grade levels.
> 5. The use of configuration clues and context clues should be supplemented with phonics.
> 6. It would be well to give more attention to both visual and auditory discrimination in teaching all types of word recognition.[35]

Vocal Phonic Synthesis and Analysis

The following studies represent the experimental literature which have investigated vocal phonic analysis and

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[33] Florence Rose, "The Occurrence of Short Auditory Memory Span Among School Children Referred for Diagnosis of Reading Difficulties," Journal of Educational Research, LI (February, 1958), 459-64.

[34] Maynard Reynolds, "A Study of the Relationships between Auditory Characteristics and Specific Silent Reading Abilities," Journal of Educational Research, XLVI (February, 1953), 439-49.

[35] Nila Smith, "What Research Tells Us About Word Recognition," Elementary School Journal, LV (April, 1955), 445.

synthesis as processes of breaking down and recombining sound sequences aurally.

In the area of reading achievement, Mulder and Curtin state:

> Children often fail in reading if they cannot discriminate among sounds. . . . Consequently the typical reading program of today introduces at an early stage some form of phonetic training, which develops the ability to single out and distinguish the several sounds in a word and to combine or blend these sounds into a total word sound.
>
> If the sounds of a word are to be distinguished, it is obvious that these sounds must be heard. However, the ability to hear the sounds is of no import if the child cannot blend the sounds into words.[36]

They investigated the hypothesis that a relationship exists between (1) the ability to fuse phonetic elements, presented orally, into words, and (2) the ability to read. A tape recording was made of seventy-eight one syllable nouns. A male speaker produced the words separating each of the phonetic elements of the words by a one-second pause. The tape was played to sixty-three fourth-grade pupils approximately twenty at a time. Each pupil was provided with an answer sheet containing three pictures for each test item, e.g., for the test word tie, the subjects were presented pictures of a pie, a tie, and a number five, and were asked to indicate the word they heard by checking their answer sheets. An attempt was also made to have a common sound element, consonant or vowel, for each of the three words of a test item. The range of scores

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[36]Robert Mulder and James Curtin, "Vocal Phonic Ability and Silent Reading Achievement: A First Report," The Elementary School Journal, LVI (November, 1955), 121.

on the vocal phonics test was 37-78 with a mean of 70.2. The reading scores ranged from 2.0-8.9 with a mean of 4.2. A Pearson product moment correlation of .44 was obtained which was significant at the .01 level of confidence. The result indicates a positive relationship between silent-reading ability and the ability to synthesize phonetic elements presented orally into words. They concluded that poor readers are deficient in the ability to synthesize phonetic elements of words into meaningful word patterns and that good readers apparently possess the ability to synthesize to a marked degree. They hypothesized that the inability to identify the stimulus words was a result of either failure to discriminate between speech sounds or ignorance of sound-letter association.

Summers tested 100 undergraduates at Indiana University of whom twenty-nine were males and seventy-one were females. The purpose of the study was to determine the ability of the subjects to perceive, analyze, and produce isolated speech sounds. Four tests were constructed and presented by the examiner:

> The perception test presented a sound orally and then one word which contained the sound — in the initial position whenever possible and never as part of a blend. The subject's answer consisted of one of four words (from a multiple-choice list) which contained the sound originally presented. Twenty-six consonants and nine vowels were tested.
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> . . . .
>
> The speech sound discrimination test . . . was constructed so that the subject had to retain the key sound while he was choosing one of three nonsense syllables which contained the sound. One nonsense syllable was presented which, after a brief pause was followed by three other

> nonsense syllables -- one of which was the same as the original. The subject was to indicate which of the three syllables was like the original.
>
> . . . .
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> The sound-letter-association test was constructed to determine an individual's ability to analyze a sound from a word and to circle one of three letters which represented that sound.
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> . . . .
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> The analysis-production test was designed to determine how well individuals could produce speech sounds in isolation. Two skills were involved if the subject was to produce the correct sound: (1) the ability to analyze words into their component sounds and (2) the ability to produce the analyzed speech sounds in isolation. The study was not designed to indicate which ability predominated. It simply measured the subject's ability to produce a sound correctly after he had discriminated it. . . . The examiner presented a word orally and the subject repeated the word and then gave the isolated sounds that made up that word.[37]

Summers found that sounds are perceived most accurately in the final position. Those sounds perceived most accurately were also most accurately analyzed and produced. Speech sound discrimination was correlated with speech sound perception but not with speech sound analysis-production. The subjects showed a wide range of speech sound perception and analysis-production ability. He also found that the subjects were confused by the nonphonetic character of the language while analyzing and producing sounds.

Mange studied the relationship between articulative ability and five auditory factors: the Seashore measures of pitch, loudness, and timbre; a test of auditory flutter fusion rate; a test of word synthesis. A comparison of mean scores

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[37] Raymond Summers, "Perceptive Versus Productive Skills in Analyzing Speech Sounds from Words," Journal of Speech and Hearing Disorders, XVIII (June, 1953), 140-42.

was made between a control group of normally speaking children and an experimental group of children with a functional misarticulation of the [r] phoneme. Of interest to this study, Mange found that, "There was a significant, but low, partial correlation between phonetic word-synthesis ability and number of articulation errors; there was no significant relationship between other auditory abilities and the number of articulation errors."[38]

In an examination of vocal phonics, Wensley was interested in comparing the vocal phonic ability of children in grades one through four with normal speech and those with articulation problems. His study, using eighty matched subjects, was designed to investigate the ability of the subjects to synthesize and did not include analysis. A significant difference, in favor of the normal speaking children, was found between the two groups in their ability to synthesize speech sounds into meaningful words. This difference is based on the correct responses to twenty-four words ranging from two to five phonemes. The mean synthesis scores for the control group (normal speakers) were: grade one, 3.5; grade two, 6.8; grade three, 10.1; grade four, 20.2. The mean synthesis scores for the experimental group (defective speakers) were: grade one, 1.2; grade two, 3.1; grade three, 8.7; grade four, 9.0. Wensley concluded that:

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[38]Charles Mange, "Relationships between Selected Auditory Perceptual Factors and Articulation Ability," Journal of Speech and Hearing Research, III (March, 1960), 73.

> While it is apparent that vocal phonic synthesis ability improves with age, there appears to be a trend for the normal speaking subjects in grades 1-4 to demonstrate this ability at an earlier grade level than the defective subjects, and generally speaking to perform more proficiently than those of the same grade level who have articulation defective speech.[39]

It is evident from the literature reported that a substantial amount of research has already been done to explain articulatory problems and reading deficiencies; this research included: (1) auditory acuity, (2) auditory memory span, (3) speech sound discrimination, and (4) vocal phonic synthesis and analysis. A great deal of contradiction is apparent from the studies in auditory perception and the research in vocal phonic synthesis and analysis is extremely meager. In this experimenter's judgment, there are many more questions left to be answered in the area of vocal phonic synthesis and analysis. The importance of an investigation in this area lies in the fact that these functions include auditory acuity, auditory memory span, and speech sound discrimination. These skills have usually been studied one factor at a time with the technique of group comparison, and Powers suggests that:

> The research to date has succeeded fairly well in eliminating as causal factors single and simple auditory skills. It remains for future research to probe some of the more complex relationships between auditory and articulatory learning and performance.[40]

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[39] Orville Wensley, "An Investigation of the Vocal Phonic Abilities of Children with Normal Speech and Articulation Disorders" (unpublished Master's Thesis, Western Michigan College of Education, 1956), p. 36.

[40] Powers, "Functional Disorders of Articulation . . .," p. 746.

The study of vocal phonic synthesis and analysis, due to the fact that these functions include a number of auditory processes, appears to be a fruitful direction in which to search. As Van Riper and Irwin write:

> It may well be that there is another basic factor in the perception of articulation error even more important than auditory memory span, auditory discrimination, or stimulability. We refer to what has been called "phonetic ability," or "vocal phonics."[41]

Development of Articulatory Skills
Age and Sex

The present study is interested in finding out if there is any difference in the vocal phonic synthesis and analysis ability of children in the elementary schools with regard to age and sex variables. With this purpose in mind, the investigator felt that a review of the following studies would be importantly related.

Mills and Streit, in a speech survey of 4,685 elementary school children, found that: (1) in grades one through three, (a) about two-thirds of all the speech defectives were boys, (b) two-thirds of the serious speech cases were boys, (c) that boys exceed girls in all speech defective classifications, and (d) that in articulatory defects, boys exceed girls; (2) in those surveyed above the third grade, (a) three-fourths of the referred cases were boys, (b) three-fourths of the serious cases are boys, and (c) that boys exceed girls in

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[41]Van Riper and Irwin, p. 28.

all speech defective categories.[42] This study also showed a decline in the percentages of articulation problems from grades one through three.

In a somewhat different type of speech survey, Roe and Milisen gave individual tests of speech sound articulation to 1,989 children in grades one through six in public schools of nine Indiana cities. There was no attempt to classify any child as a speech defective. The findings are reported in terms of the number and types of articulation errors found. The results led them to conclude:

> The mean number of errors decreased as the grade level increased, with the exception of the sixth grade where there was a slight increase, probably due to the accident of sampling. There was a statistically significant difference between the mean number of errors in grades 1 and 2, 2 and 3, 3 and 4, indicating that growth and maturation eliminated many sound errors in these grades. The lack of significant difference in the mean number of errors between grades 4 and 5, 5 and 6, would indicate that maturation does not effect any noticeable improvement in the speech sounds of higher grades. This is also evident in the fact that many errors still exist in the fifth and sixth grades.[43]

It is interesting to note the mean number of errors for the average child in each grade: grade one, 13.30; grade two, 9.99; grade three, 8.85; grade four, 7.62; grade five, 7.61; grade six, 8.01. It is evident that the largest difference is between grades one and two, the difference being 3.31. The

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[42]Alice Mills and Helen Streit, "Report of Speech Survey, Holyoke, Massachusetts," Journal of Speech Disorders, VII (June, 1942), 161-67.

[43]Vivian Roe and Robert Milisen, "The Effect of Maturation upon Defective Articulation in Elementary Grades," Journal of Speech Disorders, VII (March, 1942), 44.

data also showed a slight but not statistically significant difference between the mean number of errors for males and females, the males making more errors.

Following the lead of Roe and Milisen, Sayler did a comparable study of 1,998 school children in grades seven through twelve. Again, no effort was made to classify any of the children as speech defectives. The results were written as follows:

> There was a slight decrease in the mean number of articulation errors from grade 7 to 10. Since this amount of improvement was so small it would seem to indicate that maturation does not reduce the number of errors in the secondary grades to the extent that it does in grades 1 through 4. . . . There was no significant difference in the average number of errors made by boys and girls who had articulatory defects. There were, however, more boys than girls who made errors in all grades but 12. This would appear to confirm the opinion . . . that sex is not a significant factor in the production of articulatory defects.[44]

Reid, in an experiment using an experimental group which received speech therapy and a control group which received none, found that speech therapy produced greater error elimination than could be attributed to maturation alone.[45]

Templin, over a five year period, studied the growth from three through eight years of four aspects of language: (1) articulation of speech sounds, (2) speech sound discrimination, (3) sentence structure, and (4) vocabulary. The

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[44]Helen Sayler, "The Effect of Maturation upon Defective Articulation in Grades Seven through Twelve," Journal of Speech and Hearing Disorders, XIV (September, 1949), 207.

[45]Gladys Reid, "The Efficacy of Speech Re-education of Functional Articulatory Defectives in the Elementary School," Journal of Speech Disorders, XII (September, 1947), 301-13.

total sample contained 480 children which was evenly divided between males and females. There were eight subsamples of sixty children each at 3, 3.5, 4, 4.5, 5, 6, 7, and 8 years. She found:

> . . . a substantial amount of articulation growth has taken place by 3 years, and essentially adult articulation is apparent by 8. The maximum increment occurs between 3 and 3.5 years, the two earliest ages tested, and a sharp deceleration is evident after 7 years.[46]

Templin also reports that females attain mature articulation at about seven years while boys reach a similar level at eight years.

If vocal phonic synthesis and analysis ability develops correspondingly to articulatory skills, we should predict that (1) the development will occur early in the ages studied and (2) that there will be no significant difference in these abilities between the sexes.

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[46]Templin, Certain Language Skills in Children . . ., pp. 27-28.

CHAPTER III

METHOD AND PROCEDURE

Data for this study, to determine whether chronological age and sex were variables involved in the vocal phonic synthesis and analysis ability of grade school children, were collected during the months of October 1962 through January 1963, utilizing subjects from four public elementary schools in Norman, Oklahoma. These schools were selected from the eight elementary schools in the system because of the availability of a testing room and the willingness of the principals and teachers to be involved in such a study. The subjects were selected from the classrooms of twenty-four teachers.

A "phonic approach" to beginning reading is employed in the Norman School System in the primary grades; all the schools utilize material published by The Economy Company.[1]

The Subjects

A total of 300 subjects were utilized from four elementary schools and divided as follows:

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[1] Phonetic Keys to Reading: A Basic Reading Series (Oklahoma City: The Economy Co.).

TABLE 1.--Division of subjects by age and sex.

Age	Males	Females	N=300
6-0/6-5	30	30	60
6-6/6-11	30	30	60
7-0/7-5	30	30	60
7-6/7-11	30	30	60
8-0/8-5	30	30	60

The age levels were divided into six-month intervals, since there was limited knowledge available concerning the chronological development of vocal phonic ability. This provision was created so that if there were growth changes within a one year span, the more frequent measures would make the results more sensitive to this change.

The age levels 6-0/6-5 through 8-0/8-5 were selected on the basis of utility with no attempt to establish minima or maxima of the growth curves. It appeared to the investigator that these age levels would encompass the children in the latter stages of speech sound development and, therefore, the obtained results would be of use to clinical speech pathologists who are responsible for the diagnosis and therapy of functional articulatory defectives. These age levels, of course, are of particular importance to the public school speech therapist whose case load is frequently drawn from the first three grades and, of which, 75-80% of the speech defectives are functional articulatory defectives. The age levels selected and the resulting data were also felt to be useful to those teachers of phonics in the public schools. (Percentile ranks for the synthesis and analysis raw scores may be found in the Appendixes.)

The selection criteria for each subject were: (a) a chronological age within one of the divisions listed above, (b) no hearing loss greater than fifteen decibels at any one frequency in both ears, (c) a member of the Caucasian Race, (d) no gross deviations of the peripheral speech mechanism, and (e) an intelligence quotient within the range of 90-124. Each of these criteria is discussed further in the chapter.

The Test Instrument

Tests were constructed for vocal phonic synthesis and analysis on the following bases:

1. The tests of vocal phonics are tests of auditory perception. Words or nonsense syllables could be used for this purpose because the concept of "meaning" is not related to the direct issue of this study; which is, the individual's ability in analyzing a series of speech sounds presented orally as a "whole" and his ability to synthesize a series of speech sounds presented orally into a "whole." Words, rather than nonsense syllables, were decided upon for this experiment for two reasons (a) it appeared to be much easier to give examples of what is expected of the subject with words and (b) the interest level of the subject was thought to be better maintained with the use of words. The use of words is also in keeping with the studies of Wensley[2] and Mulder and Curtin.[3]

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[2]Wensley. [3]Mulder and Curtin.

2. Again, although "meaning" is not a direct issue in this study, familiar words were chosen over unfamiliar ones to control any possible hesitancy on the part of the subject. It is conceivable that an unfamiliar word might be an intervening variable which could alter the results. With this in mind, a group of nouns were selected from Horn's 1003 most frequently used words by kindergarten children.[4] The nouns selected, then, should be familiar to the majority of the subjects utilized in the study. These words can be found in Appendix A.

3. Oral responses by the subject are necessary on both vocal phonic tests. The synthesis test calls for the subject to synthesize isolated phonemes into a word and then the word is given to the examiner orally. The analysis test calls for the subject to analyze a word presented by the examiner into its isolated phonemes presented orally. Because of this oral method of presentation by the subject, the experimenter felt that the words used on the test should be chosen for ease of articulation. This provision should eliminate, for most of the subjects, the necessity of having to produce difficult combinations of sounds orally which might have an effect on their willingness to synthesize the phonemes or analyze the words. The words chosen for the synthesis and analysis tests, then, contained only those phonemes which would be correctly articulated by four year old children according

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[4]Lu Verne Crabtree, "The Thousand and Three Words Most Frequently Used by Kindergarten Children," Childhood Education, III (December, 1926), 118-22.

to the norms established by Templin.[5] The majority of the children used in this study, therefore, should have no difficulty with the oral production of the words once synthesized or the oral production of the phonemes in the analysis of the words.

4. The tests were constructed so that they would increase in difficulty every five words. That is, each test was comprised of five two-phoneme words, five three-phoneme words, five four-phoneme words, five five-phoneme words, five six-phoneme words, and five seven-phoneme words, thus totaling thirty words for each of the two vocal phonic tests. Although other variables could have been considered, a pilot study showed length to be a critical factor. The range from two through seven phonemes was decided upon so that the tests would be more discriminating than if the range were more narrow.

These two tests of vocal phonic synthesis and analysis may be found in Appendix A.

Description of the Variables

The _independent variables_ are chronological age and sex. The _dependent variables_ are raw scores obtained on both the synthesis and analysis tests of vocal phonics. _Other variables_ selected for control are:

1. _Hearing_. Adequate hearing acuity of the subjects was essential to this study because all directions, test words,

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[5] Templin, _Certain Language Skills_ . . ., p. 51.

and phonemes were presented orally. The subjects had no visual clues other than the facial and oral movements of the examiner. To determine whether the subject's hearing was within normal limits, an assessment was made with the use of a Beltone Audiometer (Model 10-AC). The frequencies of the sweep test included 500, 1,000, 2,000, 4,000, and 6,000 cycles per second. The sweep test technique is described by Newby:

> A technique referred to as the 'sweep' test has been devised to enable individual screening at a rapid rate. In the sweep test the audiometrist sets the hearing-loss dial of the audiometer at a fixed level, usually 15 db, and then 'sweeps' from low through high frequencies, checking to see if the subject is responding at each frequency.[6]

Any child with a loss greater than fifteen decibels at any one frequency in both ears was eliminated from this study.

2. Race. Only those children of the Caucasian Race were considered for this study. In the Norman Public Schools, Norman, Oklahoma, from which the subjects were selected, there were some Negro and Indian children but so few that a representative sample of each minority was not possible.

3. Speech mechanism. Each subject had to isolate phonemes or produce words orally and an organic impairment of the speech mechanism was considered to be a hindrance to this process. Thus, the peripheral speech mechanism of each subject was examined to determine adequacy of structure and movement. The examination included observation of the mandible, lips, teeth, palatal vault, soft palate, and oropharynx. Any gross

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[6] Newby, p. 208.

deviation from normal structure and/or movement eliminated that individual from further study.

4. Native intelligence. This assessment was obtained by the use of the Peabody Picture Vocabulary Test.[7] Although a recently standardized test, its validity correlates quite well with other well known standardized tests of intelligence. Dunn says:

> "Congruent" validity, is the extent to which the PPVT compares with other well-established measures of the same function. On mentally retarded and cerebral palsied subjects, age equivalent scores on the PPVT and the Revised Stanford-Binet Tests of Intelligence were correlated. For 315 "educable" children ages six to 18 years, the validity coefficient was 0.76. For 220 "trainable" children, ages six to 16 years, a coefficient calculated in the same fashion was 0.66. With 20 cerebral palsied children, ages 7-1 through 16-2, Form A of the PPVT correlated 0.94 with the Revised Van Alstyne Picture Vocabulary Test, 0.91 with the Ammons' Full-Range Picture Vocabulary Test, and 0.82 with the Revised Columbia Mental Maturity Scale. . . .[8]

It was also felt that because no classification other than "normal intelligence" was necessary for this study, a quick, screening device, such as this test, was quite adequate. In view of the fact that this study was concerned with the question of whether or not there is a chronological development of vocal phonic ability, it was felt that intelligence could be assumed to be a prime factor in this type of development as in any other. Therefore, the intelligence quotient ranges

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[7]Lloyd Dunn, Peabody Picture Vocabulary Test (Nashville: American Guidance Service, Inc., 1959).

[8]Lloyd Dunn, Manual for the Peabody Picture Vocabulary Test (Nashville: American Guidance Service, Inc., 1959), pp. 31-32.

and percentages of the Peabody Picture Vocabulary Test were used to determine whether or not the subject tested was to be included in the study. The following intelligence quotient ranges include 70% of the population tested in the development of the Peabody Picture Vocabulary Test: (1) intelligence quotients 90-109=50% and (2) intelligence quotients 110-124=20%. Any subject, then, whose intelligence quotient, as obtained from the Peabody Picture Vocabulary Test, fell within the range of 90-124 was considered adequate for use in the study.

All of the above tests were individually administered by the experimenter.

The Procedure

Because age and sex were to be the independent variables in this study, the first step involved examining a specific classroom for children who would fall into one of the age classifications to be studied. The teacher's register gave this information and a list of children to be tested was made. Children were drawn from grade one whose chronological age fell between 6-0 and 6-5 or 6-6 and 6-11, from grade two whose chronological age fell between 7-0 and 7-5 or 7-6 and 7-11, and from grade three whose chronological age fell between 8-0 and 8-5. In actuality, then, there is a chronological age-grade relationship.

After determining the chronological ages for the children in a particular classroom, each was screened for adequacy of hearing acuity, peripheral speech mechanism, and native intelligence. All of these tests were individually administered by the experimenter.

Having been screened and judged as an adequate candidate for this study, the child was then individually given the vocal phonic synthesis and analysis tests. (See Appendix A for this form.) The tests were rotated in presentation to control the possibility of one influencing the other, i.e., if one child was given the synthesis test and then the analysis test, the next child would receive the analysis test first and the synthesis test second. The instructions for the synthesis and analysis tests were individually given by the investigator as follows:

"Today we're going to play two word guessing games and the first one goes like this:

Synthesis -- 'I'm going to make some sounds and, if you listen carefully and put them together, you will hear a word. Then, you tell me what the word is. Let's try one.'

Analysis -- 'I'm going to say a word and then I want you to tell me all the sounds that you hear in the word. For example, if I were to say the word "no" then you should tell me that you hear "n...o" because those are the sounds in the word no. Now you try one.'"

Each subject was required to synthesize or analyze at least one of the pretest words correctly before the tests were administered. The pretest words for synthesis were eat, go, two, up, and out. The pretest words used for analysis were no, shoe, show, eight, and see. If, after having failed to synthesize or analyze any of the five pretest words, the test was not administered and the total raw score was recorded as zero. For each item, on both the synthesis and analysis tests, a correct response by the subject on the first trial was recorded as two points and a correct response on a second trial was recorded as one point. This method of achieving a raw score was used to spread the scores over a wider range thus making each test more discriminating than if only pass or fail were used. The total raw scores on each test, therefore, could range from 0-60 since there were thirty items on each test.

The Obtained Data

The following data were obtained for each of the subjects participating in the study: (a) name and sex of child, (b) chronological age in years and months, (c) intelligence quotient, (d) point score for each vocal phonic test item, and (e) total raw scores for the vocal phonic synthesis and analysis tests.

Analysis of the Data

In order to answer the five questions posed in Chapter I, a statistical tool was needed which would allow the acceptance or rejection of each of the questions when rewritten in the form of a null hypothesis. Five age levels and two sexes were used as independent variables which necessitated using a technique which would test the significance of difference of ten means. Each subject, however, was to be given a test of vocal phonic synthesis and a test of vocal phonic analysis. This means that the two raw scores obtained from each subject (dependent variables) would be correlated data. To handle this correlated data for the ten means, an analysis of variance known as a "Mixed" Design Type III was selected.[9] Lindquist says, "A 'mixed' design may be defined as one in which some of the treatment comparisons are <u>inter</u>-subject and some are <u>intra</u>-subject comparisons."[10]

After having found that the means differed significantly by the use of the analysis of variance mentioned above, the next procedure was to answer the following questions: How do the means differ? Is every mean significantly different from every other? Are there significant differences between some means and not others? To answer these questions, a technique of multiple comparisons among the means was needed. The one selected for this study was Duncan's New Multiple Range Test.[11]

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[9] E. F. Lindquist, Design and Analysis of Experiments in Psychology and Education (Boston: Houghton Mifflin Co., 1953), pp. 281-84.

[10] Ibid., p. 267.

[11] Allen Edwards, Experimental Design in Psychological Research (rev. ed., New York: Rinehart and Co., 1960), pp. 136-40.

CHAPTER IV

RESULTS

This study investigated the vocal phonic synthesis and analysis abilities of 300 children. They ranged in age from six to eight years and five months. The sample population was selected from the public schools of Norman, Oklahoma, and vocal phonic synthesis and analysis tests were administered in an effort to determine if there was a difference: (1) in the vocal phonic synthesis ability of elementary school children at selected age levels, (2) in the vocal phonic analysis ability of elementary school children at selected age levels, (3) between males and females in vocal phonic synthesis ability at selected age levels, (4) between males and females in vocal phonic analysis ability at selected age levels, and (5) between the vocal phonic synthesis and vocal phonic analysis abilities of elementary school children, chronological age and sex being constant.

Tables 2 and 3 summarize the data obtained from the 300 subjects. The tables include the mean, range, standard deviation, and median intelligence quotient for each selected age level and sex division.

TABLE 2.--The summary of the test of synthesis showing the mean, range, and standard deviation of the raw scores, and the median I.Q.

Grade	Age	Sex	No.	Mean	Range	S.D.	Md I.Q.
I	6-0/6-5	M	30	9.37	0-27	6.74	109.0
	6-0/6-5	F	30	9.73	0-29	8.05	109.0
	6-6/6-11	M	30	12.40	0-33	8.88	98.0
	6-6/6-11	F	30	12.37	0-32	8.32	98.0
II	7-0/7-5	M	30	43.30	28-59	8.27	111.0
	7-0/7-5	F	30	41.53	21-58	8.61	105.0
	7-6/7-11	M	30	41.03	18-58	7.80	106.0
	7-6/7-11	F	30	41.50	22-55	8.97	99.5
III	8-0/8-5	M	30	41.10	24-59	9.12	113.0
	8-0/8-5	F	30	43.90	26-56	7.70	103.5

TABLE 3.--The summary of the test of analysis showing the mean, range, and standard deviation of the raw scores, and the median I.Q.

Grade	Age	Sex	No.	Mean	Range	S.D.	Md I.Q.
I	6-0/6-5	M	30	3.47	0-24	5.71	109.0
	6-0/6-5	F	30	2.97	0-19	4.97	109.0
	6-6/6-11	M	30	5.50	0-20	6.96	98.0
	6-6/6-11	F	30	3.83	0-18	4.97	98.0
II	7-0/7-5	M	30	27.93	15-54	11.06	111.0
	7-0/7-5	F	30	27.17	10-55	12.61	105.0
	7-6/7-11	M	30	30.83	11-58	13.80	106.0
	7-6/7-11	F	30	32.97	18-55	10.61	99.5
III	8-0/8-5	M	30	36.70	18-58	13.90	113.0
	8-0/8-5	F	30	38.50	11-59	13.40	103.5

Analysis of the Data -- Vocal Phonic Ability Synthesis and Analysis Scores Combined

The first two questions that required answers were (1) whether or not there was a difference in the vocal phonic ability (synthesis and analysis scores combined) of the subjects at the selected age levels and (2) whether or not there was a difference between males and females in vocal phonic ability (synthesis and analysis scores combined) at the selected age levels. An analysis of variance, "Mixed" Design Type III, was used to evaluate the obtained data.[1] It was predetermined that a 5% level of confidence would be sufficient to reject either of the following null hypotheses: (1) There is no significant statistical difference in the vocal phonic ability (synthesis and analysis scores combined) of children at the 6-0/6-5 to 8-0/8-5 age levels. (2) There is no significant statistical difference between males and females in vocal phonic ability (synthesis and analysis scores combined) of children at the 6-0/6-5 to 8-0/8-5 age levels.

Table 4 (between-subjects) shows the results of this analysis. From Table 4 it can be seen that there is a significant statistical difference (F=251.37) in the vocal phonic ability (synthesis and analysis scores combined) of children between the 6-0/6-5 to 8-0/8-5 age groups, whereas, there is no significant statistical difference between males and females in vocal phonic ability (synthesis and analysis scores combined) at each of the age levels tested (F=.09 and .53 respectively). In vocal phonic ability at the selected age levels, then, age is a factor but sex is not.

Because the age factor was found to be significant, showing that there is a difference between the means of the

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[1]Lindquist, pp. 281-84.

TABLE 4.--Results of an analysis of variance for 300 subjects using Lindquist's Type III "Mixed" Design.

Source	df	ss	ms	F
Between-Subjects[a]	299	167,103.60		
Age	4	129,480.41	32,370.10	251.37[b]
Sex	1	10.94	10.94	.09
Age x Sex	4	271.94	67.98	.53
Error (b)	290	37,344.32	128.77	
Within-Subjects[c]	300	27,802.00		
Test Scores	1	11,223.38	11,223.38	220.91[b]
Scores x Age	4	1,780.23	445.06	8.76[b]
Scores x Sex	1	1.40	1.40	.03
Scores x Age x Sex	4	63.47	15.87	.31
Error (w)	290	14,733.52	50.80	
TOTAL	599	194,909.60		

[a]Synthesis and analysis test scores combined.

[b]Significance greater than .001.

[c]Synthesis and analysis test scores analyzed separately.

combined synthesis and analysis scores at the selected age levels, the next step was to locate the significant differences between the successive age groups. No sex factor was found to be differentiating so the data for males and females at each age level were combined for a multiple comparison of the means (synthesis and analysis scores combined) for each age level using Duncan's New Multiple Range Test.[2] Table 5 shows the results of the difference between the means (synthesis and analysis scores combined) for each of the successive age levels, 6-0/6-5 through 8-0/8-5. It can be seen from Table 5 that there is a significant difference between the means at age levels 6-6/6-11 and 7-0/7-5. The means are not significantly different between the 6-0/6-5 and 6-6/6-11, 7-0/7-5 and 7-6/7-11 age levels or between the 7-6/7-11 and 8-0/8-5 age levels. The major difference that exists in means at successive age levels is found between the 6-6/6-11 and 7-0/7-5 age groups, a mean difference of 26.48.

Now that chronological age has been established as a differentiating factor in vocal phonic ability, we should like to know if there is a difference: (1) between vocal phonic synthesis and vocal phonic analysis by age and by sex, (2) between vocal phonic synthesis and age and sex, and (3) between vocal phonic analysis and age and sex.

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[2]Edwards

TABLE 5.--Results of a multiple comparison of the difference between the means (synthesis and analysis scores combined) at successive age levels using Duncan's New Multiple Range Test (n=60).

Age	6-6/6-11	7-0/7-5	7-6/7-11	8-0/8-5
6-0/6-5	2.12			
6-6/6-11		26.48*		
7-0/7-5			1.61	
7-6/7-11				3.46

*Significance greater than .05.

Analysis of the Data -- Vocal Phonic Synthesis, Analysis, and Synthesis Versus Analysis

The next question to be answered was whether or not there was a significant difference between vocal phonic synthesis ability and vocal phonic analysis ability of the 300 subjects at the 6-0/6-5 through 8-0/8-5 age levels. The 5% level of confidence was considered to be sufficient to reject the null hypothesis that there is no significant statistical difference between the vocal phonic synthesis ability and vocal phonic analysis ability of children at the 6-0/6-5 through 8-0/8-5 age levels. Table 4 (within-subjects) shows that there is a significant difference between vocal phonic synthesis ability and vocal phonic analysis ability (F=220.91). The mean difference between vocal phonic synthesis scores and vocal phonic analysis scores for the 300 subjects is 8.65 which, by t value (14.86), is significant beyond the .001 level of confidence.

That there is a difference in the ability of the subjects to synthesize and analyze speech sounds has been confirmed. The question that follows is: Are chronological age and/or sex found to be variables in the ability to synthesize and analyze the speech sounds? Table 4 (within-subjects) shows that there is a significant statistical difference between the age levels selected and the vocal phonic synthesis and analysis test means ($F=8.76$). No significant statistical difference was found between the means of males and females at the age levels selected in vocal phonic synthesis or analysis ability ($F=.03$ and .31 respectively).

Because the age factor was found to be significant, indicating that there is a significant difference between the means in vocal phonic synthesis and analysis, the next step was to locate the significant differences between the successive age groups for vocal phonic synthesis, analysis, and synthesis versus analysis. No sex factor was found to be differentiating so the data for males and females at each age level were combined for a multiple comparison of the means using Duncan's New Multiple Range Test.

Table 6 summarizes the results at successive age levels of the differences between the vocal phonic synthesis means. From this table it can be seen that there is a significant difference between the means at the 6-0/6-5 and 6-6/6-11, and 6-6/6-11 and 7-0/7-5 age levels. There is no significant difference, however, between the means at the 7-0/7-5 and 7-6/7-11, and 7-6/7-11 and 8-0/8-5 age levels. The greatest mean difference at successive age levels is located between the 6-6/6-11 and 7-0/7-5 age groups, a mean difference of 30.04. This major difference can be seen graphically in Figure 1.

TABLE 6.--Results of a multiple comparison of the difference between the vocal phonic synthesis means at successive age levels using Duncan's New Multiple Range Test (n=60).

Age	6-6/6-11	7-0/7-5	7-6/7-11	8-0/8-5
6-0/6-5	2.83*			
6-6/6-11		30.04*		
7-0/7-5			1.16	
7-6/7-11				1.24

*Significance greater than .05.

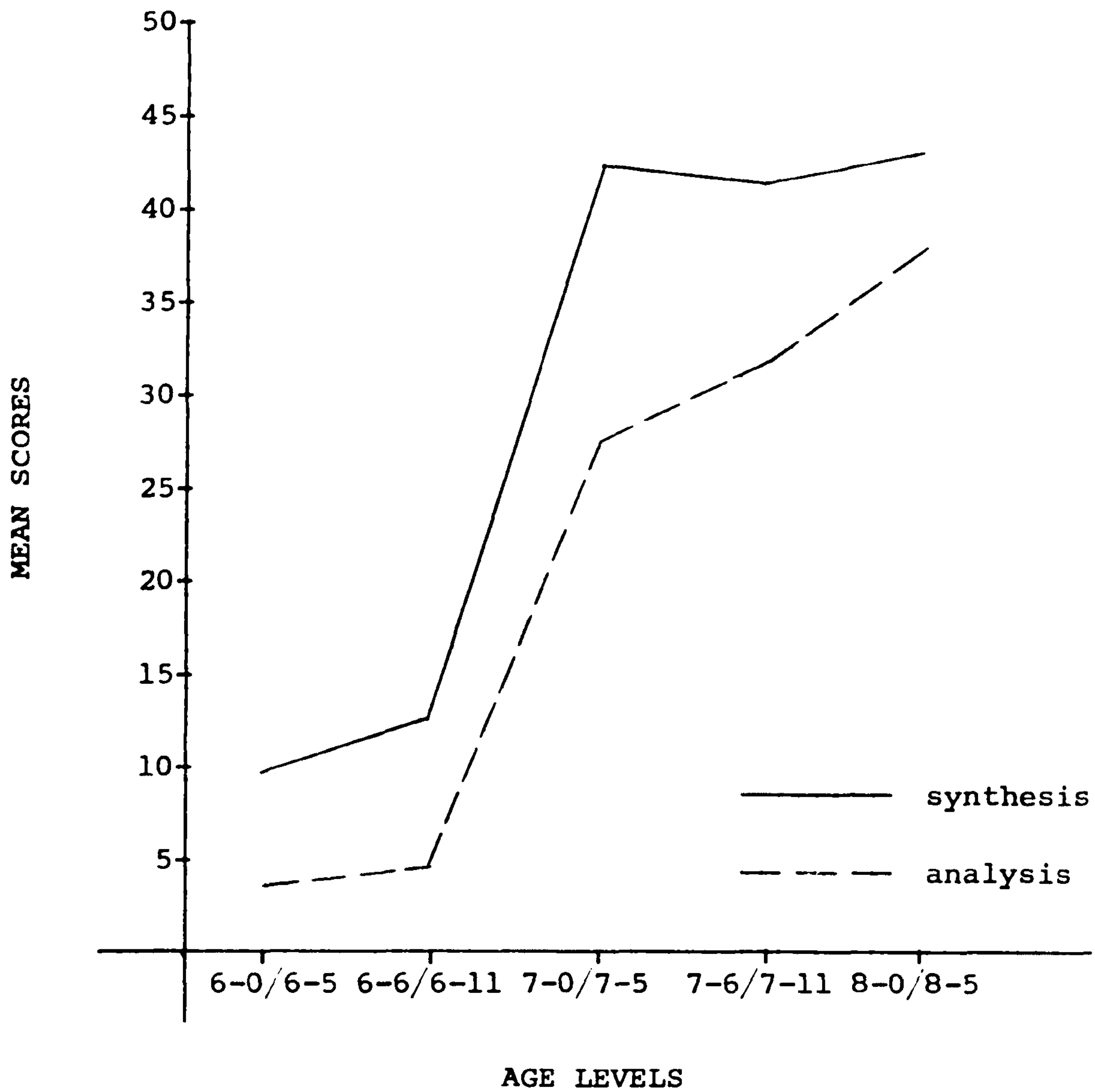
Table 7 shows the results of the differences between the vocal phonic analysis means at successive age levels. It

TABLE 7.--Results of a multiple comparison of the difference between the vocal phonic analysis means at successive age levels using Duncan's New Multiple Range Test (n=60).

Age	6-6/6-11	7-0/7-5	7-6/7-11	8-0/8-5
6-0/6-5	1.44			
6-6/6-11		22.89*		
7-0/7-5			4.35*	
7-6/7-11				5.70*

*Significance greater than .05.

Figure 1.--A graphic representation of the vocal phonic synthesis and analysis mean scores at each age level investigated (n=60).



can be seen from this table that there is no significant difference between the means at the 6-0/6-5 and 6-6/6-11 age levels. The following means, however, are significantly different from each other at successive age levels: 6-6/6-11 and 7-0/7-5, 7-0/7-5 and 7-6/7-11, and 7-6/7-11 and 8-0/8-5. The largest mean difference in successive age levels occurs between the 6-6/6-11 and 7-0/7-5 age levels, a mean difference of 22.89. This large difference is graphically displayed in Figure 1.

Table 8 summarizes the results of a multiple comparison of the difference between the vocal phonic synthesis and analysis means at each of the five age levels investigated. This table shows that there is a significant difference between the vocal phonic synthesis and analysis means at each of the successive age levels 6-0/6-5 through 8-0/8-5. The largest difference between vocal phonic synthesis and analysis means occurs at the 7-0/7-5 age level (14.87). Figure 1 graphically shows that the vocal phonic synthesis means are greater at each successive age level than the vocal phonic analysis means and it has been statistically confirmed that the differences between the means at each successive age level are significant at the .05 level of confidence.

Table 9 shows the results of the difference between the differences of the vocal phonic synthesis and analysis means at each age level. A difference between the differences was obtained (1) by subtracting the analysis mean score from

TABLE 8.--Results of a multiple comparison of the difference between the vocal phonic synthesis and analysis means at each age level using Duncan's New Multiple Range Test (n=60).

		Analysis				
	Age	6-0/6-5	6-6/6-11	7-0/7-5	7-6/7-11	8-0/8-5
	6-0/6-5	6.33*				
Synthesis	6-6/6-11		7.72*			
Synthesis	7-0/7-5			14.87*		
Synthesis	7-6/7-11				9.36*	
	8-0/8-5					4.90*

*Significance greater than .05.

TABLE 9.--Results of the difference between the differences of the vocal phonic synthesis and analysis means at the successive age levels and between the lowest and highest age groups studied using the t test of significance (n=300).

		Synthesis -- Analysis			
	Age	6-6/6-11	7-0/7-5	7-6/7-11	8-0/8-5
Synthesis-Analysis	6-0/6-5	1.39			1.43
Synthesis-Analysis	6-6/6-11		7.15*		
Synthesis-Analysis	7-0/7-5			5.51*	
Synthesis-Analysis	7-6/7-11				4.46*

*Significance greater than .05.

the synthesis mean score at one age level, then (2) subtracting the resulting difference from the difference between the differences at another age level. From Table 9 it can be seen that between the successive age levels 6-0/6-5 and 6-6/6-11 there is no significant difference between the differences, but that there is a significant difference between the differences at the 6-6/6-11 and 7-0/7-5, 7-0/7-5 and 7-6/7-11, and 7-6/7-11 and 8-0/8-5 age levels. Table 9 also shows no significant difference between the differences (1.43) at the 6-0/6-5 and 8-0/8-5 age levels which indicates that, at the lowest and highest age groups studied, there is no interaction between vocal phonic synthesis and analysis. This table also shows that the major interaction between vocal phonic synthesis and analysis occurs at the 7-0/7-5 age level.

As a check on the results derived from the multiple comparisons made using Duncan's New Multiple Range Test, individual t tests were run between means and the two techniques were found to be comparable.

The results obtained from these statistical computations will be discussed in Chapter V.

Summary of the Testing -- Vocal Phonic Synthesis and Analysis

The results of the testing of vocal phonic synthesis for the total sample (N=300) are given in Table 10. Because no statistically significant difference was found between males and females in vocal phonic synthesis ability, the mean scores were combined. From Table 10 it can be seen that the means for the synthesis test increase progressively at each age level with the exception of 7-6/7-11. The largest mean difference, for any successive age level, occurs between the 6-6/6-11 and 7-0/7-5 age levels, a mean difference of 30.04.

TABLE 10.--The results of the test of vocal phonic synthesis for the total sample (N=300) showing the grade and age levels, number, mean, and standard deviation.

Grade	Age	No.	Mean	S.D.
I	6-0/6-5	60	9.55	7.39
I	6-6/6-11	60	12.38	8.60
II	7-0/7-5	60	42.42	8.44
II	7-6/7-11	60	41.26	8.38
III	8-0/8-5	60	42.50	8.41

The findings of the testing of vocal phonic analysis are summarized in Table 11 (male and female scores combined) which also shows that the means for the analysis testing increase progressively at each successive age level. The largest mean difference again occurs between the 6-6/6-11 and 7-0/7-5 age levels, a mean difference of 22.89.

TABLE 11.--The results of the test of vocal phonic analysis for the total sample (N=300) showing the grade and age levels, number, mean, and standard deviation.

Grade	Age	No.	Mean	S.D.
I	6-0/6-5	60	3.22	5.34
I	6-6/6-11	60	4.66	5.96
II	7-0/7-5	60	27.55	11.83
II	7-6/7-11	60	31.90	12.22
III	8-0/8-5	60	37.60	13.65

CHAPTER V

SUMMARY AND CONCLUSIONS

The Procedure

Three hundred children, ranging in age from six years to eight years and five months, were selected from grades one through three in four elementary schools in Norman, Oklahoma, as subjects for this study. Five age levels were studied with an equal number of males and females at each level. These age levels were: (1) 6-0 to 6-5, (2) 6-6 to 6-11, (3) 7-0 to 7-5, (4) 7-6 to 7-11, and (5) 8-0 to 8-5. The selection criteria for each subject were: (a) a chronological age within one of the preceding age levels, (b) normal hearing, (c) a member of the Caucasian Race, (d) no gross deviations of the peripheral speech mechanism, and (e) an intelligence quotient within the range of 90-124. The vocal phonic synthesis and analysis ability of each child was assessed by two tests containing thirty words each which increased in difficulty from two to seven phonemes. The raw scores on each test of phonic ability could range from 0-60 since two trials were given, if needed, with two points being recorded for a correct response on the first trial and one point recorded for a correct response on the second trial. The vocal phonic synthesis and analysis tests were rotated in presentation to control the possibility of one influencing the other. All the testing for this study was done by the investigator. The data were analyzed and the results presented in Chapter IV.

Discussion of the Results

It was proposed in Chapter I that the data accumulated in this study should answer five questions. Specifically, this investigation was conceived as an attempt to determine if a relationship existed: (a) among vocal phonic synthesis ability, age, and sex; (b) among vocal phonic analysis ability, age, and sex; (c) between vocal phonic synthesis and vocal phonic analysis, chronological age and sex being constant. The literature in speech pathology has consistently mentioned the importance of these factors, but there has been no controlled research in this area with an adequate sample of children judged to be normal. In addition to answering the specific questions stated, the investigator felt that the results from such a study would prove useful to clinical speech pathologists in the differential diagnosis of children with articulatory problems and also to remedial reading specialists who are concerned with children retarded in reading ability.

The first question posed in the statement of the purpose was: Is there a difference in the vocal phonic synthesis ability of elementary school children at selected age levels? The results of the analysis of the data in Cahpter IV indicate that there is a significant difference in the vocal phonic synthesis ability of elementary school children at the selected age levels of 6-0/6-5, 6-6/6-11, 7-0/7-5, 7-6/7-11, and 8-0/8-5. The first age group, 6-0/6-5, (mean score 9.55) was found to be significantly different from all the other age groups. In other words, the children in the first age group were not as capable in vocal phonic synthesis as the children studied in each of the other groups. The children in the second age group, 6-6/6-11, (mean score 12.38) were also found to be significantly different from all the other age groups. This implies that these children (6-6/6-11) possessed better vocal phonic synthesis ability than the younger children (6-0/6-5) but were not as capable as the children at the upper age levels (7-0/7-5 through 8-0/8-5) in vocal phonic synthesis. The greatest change in vocal phonic synthesis ability at successive age levels occurs between the 6-6/6-11 and 7-0/7-5 age groups, a mean difference of 30.04. This large difference can be seen in Figure 1, page 53. The results of the data also indicate that after a child reaches the 7-0/7-5 age level, vocal phonic synthesis ability does not change through the 8-0/8-5 age level.

The age-grade relationship was of particular interest to this investigator. All of the children at the 6-0/6-5 and 6-6/6-11 age levels were selected from the first grade, the 7-0/7-5 and 7-6/7-11 age level children from the second grade, and the 8-0/8-5 age level children from the third grade. At the first two age groups (6-0/6-5 and 6-6/6-11) there was a small (2.83) but significant mean difference at the .05 level of confidence which may indicate that chronological age makes the difference between the two age levels within the first grade. All the children in both these age groups had been enrolled in school the same length of time so that training could not have been a factor.

All the children in the 7-0/7-5 and 7-6/7-11 age levels were drawn from the second grade and no significant difference was found between these two groups in vocal phonic synthesis ability. The children in the 8-0/8-5 age level were all from the third grade and they did not differ significantly from the second grade children. Even the mean for the youngest age group (7-0/7-5) in the second grade did not differ significantly from the mean of the third grade group (8-0/8-5) which would seem to imply that neither age nor training are in effect between these age levels in relation to vocal phonic synthesis.

The largest mean difference in successive age levels (30.04) in vocal phonic synthesis is found between the 6-6/6-11 and 7-0/7-5 age groups. One explanation for this large difference might be chronological age; however, a more feasible explanation would be training. Training can be considered here to encompass all school experiences but particularly phonic training as the children selected for this study were enrolled in a school system which stresses training in phonics, especially in grades one through three, as a supplement to other reading tools. The first graders used in this study had had very little training in phonics since they were tested within four to six weeks after entering school. The second graders, at the time of testing, had had approximately eleven to eleven and one-half months of phonic training. This study, therefore, tends to indicate that vocal phonic synthesis ability is related to training rather than chronological age for the population under examination.

The results found through testing the vocal phonic synthesis ability of children from 6-0 through 8-5 are related to other studies previously discussed in Chapter II. Templin, in testing sound discrimination ability, found that test scores over the age range of six through eight years continued to increase but the largest difference in scores was between the ages of six and seven. The results of the data obtained from the vocal phonic synthesis testing also indicates that the largest difference in scores was between the ages of six and seven. Templin also found, ". . . that by 8 years of age the ceiling in sound discrimination ability . . . is being pushed."[1] She also reported that a sharp deceleration in articulation development was found after the age of seven years. Mills and Streit found that the percentages of articulatory problems declined from grades one through three.[2] It may be said that, based on this investigation, vocal phonic synthesis ability has reached a peak at the second grade level and that it also decelerates in growth after age seven.

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[1]Templin, Certain Language Skills. . ., p. 144.

[2]Mills and Streit

Wensley found that the vocal phonic synthesis ability of both normal speakers and articulatory defectives in grades one through four improved with age; the normal speakers also demonstrated this ability at an earlier grade level than the defective subjects.[3] The present investigation does not agree with the findings of Wensley that the age factor continues through the fourth grade because the data clearly indicates no significant difference between the second and third grades. Two possibilities as to why there is disagreement are: (a) Wensley's study did not indicate whether his sample had had any training in phonics. If they had not been trained in phonics, it is conceivable that vocal phonic synthesis ability would develop more slowly than in a system where phonics was taught. (b) Wensley's sample size (n=10) for the normal speakers in grades one through four was very small. The children in the present study from 7-0 through 8-5 years had received phonic training and the sample size was sixty for each age level studied. The two populations, therefore, may have varied in training but definitely varied in sample size. Either of these two factors could account for the difference in results.

The study by Roe and Milisen showed that articulation errors decreased as the grade level increased.[4] Grades one and two, two and three, and three and four were significantly different from each other revealing the possibility that growth and maturation eliminated many sound errors in these grades.

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[3]Wensley. [4]Roe and Milisen.

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[3]Wensley. [4]Roe and Milisen.

There was no significant difference between grades four and five and five and six which indicates that maturation alone doesn't account for any noticeable improvement in the speech sounds at higher grades. It is also interesting to note that the largest mean difference in the reduction of articulation errors came between grades one and two. It seems possible that the decline in articulation errors could be accounted for by a marked increase in vocal phonic synthesis ability, especially between grades one and two as shown by the present study, due to an increased awareness of isolated phonemes. The investigation by Roe and Milisen has been used by many speech pathologists as an argument that the child be allowed to mature in his development of speech sounds before accepting him for speech therapy; particularly those children in the first and second grades. Perhaps the present study lends support to this hypothesis at least in terms of first grade children.

As a result of an investigation by Mulder and Curtin, it was concluded that: (1) there is a positive relationship between silent-reading achievement and the ability to synthesize words presented orally and (2) that poor readers are deficient in the ability to synthesize the phonetic elements of words into meaningful word patterns.[5] Thus, this investigator suggests that the results of his present study of vocal phonic synthesis and analysis may be useful to teachers of the first three grades and remedial reading specialists. If, for example,

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[5]Mulder and Curtin.

children are found in the first three grades with reading problems, an investigation of their vocal phonic synthesis and analysis ability and a comparison with the results of the normal population reported here might reveal the source of their difficulty. (See Appendixes B and C.)

The second question considered in this study was: Is there a difference in the vocal phonic analysis ability of elementary school children at selected age levels? The results of the analysis of the data in Chapter IV reveal that there is a significant difference in the vocal phonic analysis ability of elementary school children at the selected age levels of 6-0/6-5, 6-6/6-11, 7-0/7-5, 7-6/7-11, and 8-0/8-5. The first age group, 6-0/6-5, was not found to be significantly different from the 6-6/6-11 age level (means of 3.22 and 4.66 respectively, with a mean difference of 1.44), but was significantly different from all the others. In other words, the children in the 6-0/6-5 and 6-6/6-11 age levels were not as proficient in vocal phonic analysis as the children studied in each of the other groups (7-0/7-5, 7-6/7-11, 8-0/8-5). The means of age groups 7-0/7-5, 7-6/7-11, and 8-0/8-5 were all found to be significantly different from each other. This indicates that at each of the successive age levels, from 6-6/6-11 through 8-0/8-5, the vocal phonic analysis ability increased with chronological age. The greatest change in vocal phonic analysis ability at successive age levels once again occurs between the 6-6/6-11 and 7-0/7-5 age groups, a mean difference of 22.89. This large difference can be seen in Figure 1, page 53. The results also indicate that, because there were significant differences from each age group from 6-6/6-11 through 8-0/8-5, vocal phonic analysis may continue to improve with chronological age, although this does not seem likely. The analysis means were found to be consistently lower than synthesis means at each age level. This suggests that vocal phonic analysis ability would not surpass vocal phonic synthesis ability. This question remains speculation, however, unless studied further.

The age-grade relationship is once again of interest. All of the children at the 6-0/6-5 and 6-6/6-11 age levels were selected from grade one, the 7-0/7-5 and 7-6/7-11 age groups from the second grade, and the 8-0/8-5 age group from the third grade. Chronological age is apparently not a factor in vocal phonic analysis within the first grade because the mean scores of the two age levels (6-0/6-5 and 6-6/6-11) did not differ significantly. Phonic training, given to all the subjects in the first two age groups, could have had but only a small effect as the children had been enrolled for only four to six weeks at the time of testing.

The children used in age groups 7-0/7-5 and 7-6/7-11 were all drawn from the second grade. They had all been in school the same length of time, thus, because these two groups were significantly different in vocal phonic analysis ability, chronological age is seemingly a factor in vocal phonic analysis development at these age levels.

All the children in the 8-0/8-5 age group were drawn from the third grade and their mean vocal phonic analysis score was the highest of any group, a mean score of 37.60. Chronological age is evidently a factor; however, these children had also had more training than the second grade children having been enrolled in school for a longer period of time. Whether chronological age or training accounts for the difference is not known.

The largest mean difference in successive age levels (22.89) in vocal phonic analysis is found between the 6-6/6-11 and 7-0/7-5 age groups. One explanation for this large difference may be chronological age; still, a more likely one would be phonic training; the subjects in the 6-6/6-11 age group had been enrolled for only about four to six weeks, whereas, the 7-0/7-5 age group had attended school for approximately eleven to eleven and one-half months.

The results achieved from the vocal phonic analysis testing show some relationship to the studies reviewed in Chapter II. As with vocal phonic synthesis, the largest mean difference in vocal phonic analysis was found between the 6-6/6-11 and 7-0/7-5 age groups. The studies by Templin and Roe and Milisen are relevant again at this point for their results also show a major difference in sound discrimination and reduction in articulation errors between these age levels.[6, 7]

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[6]Templin, Certain Language Skills. . .

[7]Roe and Milisen.

There are no other experimentally controlled studies of the vocal phonic analysis ability of children with which to compare the present one. However, Durrell and Murphy have observed in their reading clinic that:

> Almost every child who comes to the clinic with a reading achievement below first grade has a marked inability to discriminate sounds in words. Children who are severely handicapped in this ability seldom achieve primer level in reading. Some are so deficient in auditory analysis [italics mine] that the usual ear training exercises are useless.[8]

In this investigator's judgment, the ability to analyze words is of greater importance than the ability to synthesize. Not only must an individual know that there is something "different" about his pronunciation of a word, he must be able to locate the phonetic element(s) that is incorrect; this procedure is vital to normal speech production and may be considered as "self-analysis" or "self-monitoring." This would be true not only in the correction of articulation of speech sounds in words, but as true in the analysis of words for reading or spelling. It is that element of analysis which enables the reader or speller to be independent in these learned skills. Therefore, more experimentally controlled studies are needed in vocal phonic analysis not only with reference to speech development but to reading and spelling achievement as well.

Summers, in a study of 100 college undergraduates, found a wide range of ability among his subjects in analysis-production.[9] The results of the present study also show a wide

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[8]Durrell and Murphy, p. 560. [9]Summers.

range of vocal phonic analysis ability at each of the age levels. This can be seen in Table 3, page 46. Summers also reports that the subjects in his study were confused by the nonphonetic character of the language while analyzing and producing sounds. This investigator observed, without any control, that there was little evidence of this apparent confusion with the nonphonetic character of the language until the 8-0/8-5 age group. This group consisted of third graders and their skill in spelling may be one explanation as to why vocal phonic analysis may be hindered by the nonphonetic character of the language at this point and not before. What seemed to this investigator to happen was that the third grader would not only hear the word but have a visual-letter image of the word which would then become an obstacle if the word contained nonphonetic elements. For example, in this study the words <u>soldiers</u> and <u>Christmas</u> were included in the list for vocal phonic analysis. The word <u>soldiers</u> would often be analyzed and produced incorrectly because the subject would substitute a [d] phoneme for the [dʒ] phoneme. In the case of the word <u>Christmas</u> the subject would often add the phoneme [t]. The 8-0/8-5 age group apparently was not hindered by "silent letters" to any great extent as its mean score for vocal phonic analysis was the highest achieved in the study. To repeat, this was not a controlled factor and merely remains an observation. Perhaps this is a factor which could be pursued further, i.e., to what extent does the spelling ability of a child hinder his vocal phonic analysis ability?

The third and fourth questions which required answering were: Is there a difference between males and females in vocal phonic synthesis ability at selected age levels? Is there a difference between males and females in vocal phonic analysis ability at selected age levels? The results of the analysis of variance (Table 4, page 48) show that there is no significant difference between males and females in either vocal phonic synthesis or in vocal phonic analysis ability for the age levels studied. These findings are in keeping with a number of the studies reviewed in Chapter II. No difference between males and females in auditory memory span was reported by Beebe.[10] Templin did not find a statistically significant difference between males and females in sound discrimination ability at any age level studied (three through eight years).[11] Roe and Milisen did not find a significant difference between males and females in number of articulation errors recorded for grades one through six.[12] Sayler, in an investigation of the articulation errors of children in grades seven through twelve, says, ". . . that sex is not a significant factor in the production of articulatory defects."[13]

The more precocious development of females is frequently referred to in the literature of child development. The present study cannot substantiate this concept in either vocal phonic synthesis or analysis ability within the age groups studied.

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[10]Beebe. [11]Templin, Certain Language Skills. . .

[12]Roe and Milisen. [13]Sayler.

As a possible explanation, Templin says, "It may well be that over the years differences in language ability of the two sexes have actually become less pronounced in keeping with the shift toward a single standard in child care and training in the last few decades."[14]

The final question proposed in this study was: Is there a difference between the vocal phonic synthesis and vocal phonic analysis ability of elementary school children, chronological age and sex being constant? The results of an analysis of the data reveal that there is a significant difference between the vocal phonic synthesis and vocal phonic analysis abilities of children who are from 6-0 to 8-5 years as measured by the tests used in this study. In fact, a significant difference was found between the mean scores at all the age levels studied. No significant difference between mean scores was found, however, for the sexes in vocal phonic synthesis versus vocal phonic analysis ability. (See Table 4, page 48.)

Although the vocal phonic synthesis and analysis means are significantly different at each age level (Table 8, page 55), the largest mean difference is at the 7-0/7-5 age level. Vocal phonic synthesis appeared to develop rapidly after one year of phonic training, whereas, the growth of vocal phonic analysis was not as pronounced. The ability of the children to analyze words phonetically, however, did continue to improve

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[14]Templin, Certain Language Skills. . ., p. 147.

through the 8-0/8-5 age group while the ability of the same children to synthesize did not.

There is no other experimental evidence available with which to compare the results of this study in the findings of vocal phonic synthesis versus analysis. The experience of the investigator, however, led to the prediction of the obtained results that the mean scores for vocal phonic synthesis would be greater than those for vocal phonic analysis. The investigator had used vocal phonic synthesis and analysis as a clinical tool, for both children and adults with defective articulation, for a number of years. In teaching the individual to use these tools, vocal phonic analysis was always the more difficult for the speech defective to grasp. Vocal phonic analysis was also found to be more difficult than vocal phonic synthesis for the subjects in this study. Vocal phonic analysis is apparently a more difficult task, for most people, than vocal phonic synthesis.

That vocal phonic analysis is more difficult than vocal phonic synthesis may appear to be a paradox because in certain types of learning activities engaged in by the child, he may first take apart an object to satisfy his curiosity rather than seek a connection of parts to a whole. We might logically expect, therefore, that a child might be more curious about words as a whole and then analyze them rather than to think in terms of isolated speech sounds which then could be synthesized into a word whole. This may very well happen in the early speech development of the child. As Van Riper writes:

> . . . we should follow the natural tendency of the child. Normal children eventually learn the principles of <u>vocal phonics</u>, the <u>synthesis</u> and <u>analysis</u> of words, by rhyming, by punning, by distorting their sequences. . . . By these activities the child learns to observe all the features of a given word.[15]

At the age levels examined in this study, however, the training in phonics and other school experiences tend to emphasize synthesis rather than analysis. Morrison and Perry suggest:

> At one time teachers began each learning process with small elements and gradually proceeded toward the use of these parts in more complete wholes. For instance, the child was taught one hundred unrelated reading words; then he was given a book and expected to read with understanding the selections it contained. This technique proved ineffective because many children continued the habit of seeing and naming one word at a time without effectively comprehending the meaning of the whole selection.
>
> . . . .
>
> Today teachers know that children can learn more easily and effectively if they begin with the whole and later go to the parts. The child learns to read a sentence or thought at a time and later learns to recognize each word as a part of the sentence. This type of recognition would be similar to learning to recognize a picture of a rabbit when the child sees the whole picture. When he later sees a picture of the rabbit's head, it will have meaning for him because he recognizes it as a part of a known whole. . . . In the same way the child begins by learning to write a whole word or thought. Later each letter has an identity and is more easily learned because the child has learned it first in connection with meaning.[16]

This would appear to be a basic tenet of modern teaching, i.e., start with a whole, then take it apart (analysis), then recombine it (synthesis). In phonic instruction in the schools, however, what may be happening is that the child is taught by

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[15]Van Riper, <u>Teaching Your Child</u>. . ., p. 88.

[16]Ida Morrison and Ida Perry, <u>Kindergarten -- Primary Education: Teaching Procedures</u> (New York: The Ronald Press Company, 1961), pp. 22-23.

seeing and listening to a word whole, the word is then broken down (analysis) by the teacher, and then the student recombines these letters and/or speech sounds into the word whole (synthesis). In other words, in the first two or three grades, the analysis is done primarily by the teacher and the synthesis by the students. This may account for the fact that in the present study vocal phonic synthesis mean scores at each age level tested were significantly higher than the vocal phonic analysis mean scores. This is further born out when one looks at the differences between the vocal phonic synthesis and analysis means at each of the age groups studied. The largest difference between vocal phonic synthesis and analysis means was at the 7-0/7-5 age level, after one year of phonic training, and the differences were less at each of the next two age levels (7-6/7-11 and 8-0/8-5). We might expect that most of the analysis was done by the first grade teachers and less by the second and third grade teachers. In other words, after a year of phonic training the children in the second and third grades were becoming more independent in their use of phonic tools. The more independent reading that they did would necessitate more analysis and then synthesis in attacking new words.

Conclusions

On the basis of the results obtained in this study, the following conclusions can be stated:

1. There is a difference in the vocal phonic synthesis ability of children at the selected age levels. A significant

difference exists between the 6-0/6-5 and 6-6/6-11 age groups. These age groups also differ significantly from the 7-0/7-5, 7-6/7-11, and 8-0/8-5 age groups. The 7-0/7-5, 7-6/7-11, and 8-0/8-5 age groups do not differ significantly from each other in vocal phonic synthesis.

2. There is a difference in the vocal phonic analysis ability of children at the selected age levels. The significant differences at successive age levels are between the 6-6/6-11 and 7-0/7-5 age levels, the 7-0/7-5 and 7-6/7-11 age levels, and the 7-6/7-11 and 8-0/8-5 age levels in vocal phonic analysis ability.

3. There is a difference between the vocal phonic synthesis and vocal phonic analysis abilities of children at selected age levels. Significant differences were found between all the age levels studied (6-0/6-5 through 8-0/8-5).

4. The largest difference in mean scores for both vocal phonic synthesis and analysis occurred between the 6-6/6-11 and 7-0/7-5 age levels.

5. No significant difference was found between males and females in either vocal phonic synthesis or analysis ability at any of the selected age levels studied.

6. Vocal phonic synthesis and analysis ability appears to follow, in certain respects, that of sound discrimination and articulation. Vocal phonic synthesis decelerates in growth after the age of seven years as does sound discrimination and articulatory ability. The critical period for speech sound

discrimination and the reduction of articulation errors is between the ages of six and seven; this is also true for both vocal phonic synthesis and analysis.

Suggested Areas for Further Research

1. Further investigation of children younger than 6-0 and older than 8-5 could prove interesting, since neither a base nor a ceiling was reached on either the vocal phonic synthesis or analysis tests.

2. Due to the sharp increase in both vocal phonic synthesis and analysis at the 7-0/7-5 age level, a month by month study of the first graders could prove interesting.

3. Because it was observed that some third grade children seem to be hindered by the nonphonetic elements of some of the words, a possible study could be carried out to find out what relationship exists, if any, between spelling and vocal phonic analysis ability.

4. The intelligence factor should prove to be an interesting variable. For example, how would subnormals differ from normals or those with superior intelligence differ from normals?

5. Functional articulatory cases could be compared with the norms from this data.

6. The brain-injured child could also be compared with normals in vocal phonic synthesis and analysis ability.

7. Those children who are now being taught under the "Montessori Method" could be compared to the children in the selected age levels of this study.

8. Children in school systems where phonics is not used as a direct method of learning to read could be compared with the population used in the present study.

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APPENDIX

APPENDIX A

Name____________________ Age____ Sex____ Grade____ PPVT____

Synthesis (order_____)			Analysis (order_____)		
1. boy	____	____	1. pie	____	____
2. cow	____	____	2. bee	____	____
3. ice	____	____	3. tie	____	____
4. knee	____	____	4. egg	____	____
5. toe	____	____	5. ear	____	____
6. neck	____	____	6. church	____	____
7. fish	____	____	7. pig	____	____
8. boat	____	____	8. cat	____	____
9. dog	____	____	9. game	____	____
10. suit	____	____	10. feet	____	____
11. glass	____	____	11. paper	____	____
12. smoke	____	____	12. flag	____	____
13. penny	____	____	13. paint	____	____
14. dress	____	____	14. ladder	____	____
15. floor	____	____	15. truck	____	____
16. parade	____	____	16. plant	____	____
17. Sunday	____	____	17. candy	____	____
18. rabbit	____	____	18. circus	____	____
19. cracker	____	____	19. woman	____	____
20. window	____	____	20. lettuce	____	____
21. fifteen	____	____	21. banana	____	____
22. potato	____	____	22. soldiers	____	____
23. napkin	____	____	23. ice cream	____	____
24. fireman	____	____	24. reindeer	____	____
25. airplane	____	____	25. bluebird	____	____
26. elephant	____	____	26. umbrella	____	____
27. animals	____	____	27. butterfly	____	____
28. woodpecker	____	____	28. telephone	____	____
29. pumpkin	____	____	29. yesterday	____	____
30. children	____	____	30. Christmas	____	____

Total Raw Score __________ Total Raw Score __________

APPENDIX B

TABLE 12.--Percentile ranks for vocal phonic synthesis raw scores at each age level investigated (n=60).

	AGE LEVELS				
Scores	6-0/6-5	6-6/6-11	7-0/7-5	7-6/7-11	8-0/8-5
58-59			100	100	100
56-57			97	97	97
54-55			92	93	92
52-53			90	87	87
50-51			83	82	80
48-49			75	67	78
46-47			67	63	73
44-45			58	62	60
42-43			55	55	60
40-41			48	52	48
38-39			37	42	40
36-37			30	40	30
34-35			22	30	20
32-33		100	20	25	10
30-31		97	17	22	10
28-29	100	95	7	15	8
26-27	98	93	3	13	5
24-25	97	93	2	7	2
22-23	93	90	2	5	
20-21	92	83	2	2	
18-19	88	77		2	
16-17	85	72			
14-15	80	67			
12-13	73	60			
10-11	67	55			
8-9	58	38			
6-7	48	32			
4-5	32	25			
2-3	20	17			
0-1	10	10			

APPENDIX C

TABLE 13.--Percentile ranks for vocal phonic analysis raw scores at each age level investigated (n=60).

	AGE LEVELS				
Scores	6-0/6-5	6-6/6-11	7-0/7-5	7-6/7-11	8-0/8-5
58-59				100	100
56-57				98	95
54-55			100	98	88
52-53			95	97	83
50-51			92	95	80
48-49			88	92	75
46-47			88	88	72
44-45			85	83	65
42-43			83	78	62
40-41			83	77	55
38-39			82	70	50
36-37			82	62	43
34-35			82	55	43
32-33			82	53	43
30-31			75	53	40
28-29			75	47	38
26-27			68	47	32
24-25	100		63	37	30
22-23	98		47	37	25
20-21	98	100	33	32	12
18-19	98	98	18	20	5
16-17	97	95	10	7	2
14-15	95	90	7	3	2
12-13	93	85	3	2	2
10-11	90	83	3	2	2
8-9	90	82			
6-7	83	73			
4-5	75	68			
2-3	67	57			
0-1	63	48			

63

605