

TYPICAL SPEECH AND LANGUAGE SKILLS OF HEAD START CHILDREN

A Dissertation by

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The following faculty members have examined the final copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirement for the degree of Doctor of Philosophy with a major in Communication Sciences and Disorders.

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DEDICATION

To my beloved children,
Tyler and Laura,
who always gave me their unconditional love and unwavering support

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“If we knew what we were doing, it wouldn’t be called Research.” –A. Einstein

As I reflect on my doctorate journey, no truer words could have been spoken than Albert Einstein’s observation that research is an adventure into unknown territory. It is a stimulating and challenging journey that is very exciting but intense. This excitement comes from “sitting on the edge of your seat” and not knowing where research will lead us. This educational adventure began as an intense desire in a young girls’ heart to teach her brothers and sisters the wonderment of what she had learned each day in school. It kept growing until that day the desire was realized when the opportunity to enter doctorate study at Wichita State University became a reality.

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ABSTRACT

The primary purpose of this study was to evaluate the speech and language abilities of typically developing Head Start children ages, 3 years; 8 months to 5 years; 7 months. Three goals were addressed during this study. The first was to determine communication characteristics of typical Head Start children at three different age levels. The second was to determine whether differences between genders and among age groups were significant. The third was to determine which variables (i.e., phonological deviations, percentages of consonants correct, mean length of utterances, receptive vocabulary, age, gender) significantly predict the children's percentages of intelligible words in connected-speech samples.

Results indicated that there was considerable variability in the skill levels of the typically developing children for all of the areas assessed. ANOVA results indicated differences were not significant between boys and girls or among the three different age groups. Results of a stepwise multiple regression analysis indicated that two variables predicted percentages of intelligible words in connected-speech samples: (a) percentages of consonants correct accounted for the greatest amount of variance followed by (b) mean length of utterances. Correlation results indicated that all variables (i.e., phonological deviations, percentages of consonants correct, mean length of utterances, receptive vocabulary, age), except gender, were significantly correlated with percentages of intelligible words.

Data analysis revealed a possible plateau of intelligibility and expressive language skills at the older age group levels. These findings may be important to SLPs and Head Start staff when considering speech/language program development and curriculum structure.

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LIST OF ACRONYMS

ACRONYM	FULL NAME
ACI	Articulation Competence Index
ANOVA	Analysis of Variance
ASHA	American Speech-Language Hearing Association
CS	Connected Speech
FACES	Family and Child Experiences Survey
HAPP-3	Hodson Assessment of Phonological Patterns-Third Edition
IDEA	Individuals with Disabilities Education Act
LEA	Local Education Agencies
LLE	Limited Literacy Instruction
MLU	Mean Length of Utterance
NCLB	No Child Left Behind Act
PCC	Percentage of Consonants Correct
PDA	Phonological Deviation Average
PIW	Percentage of Intelligible Words
PPVT-4	Peabody Picture Vocabulary Test-Fourth Edition
RDI	Relative Distortion Index
SLP	Speech-Language Pathologist
SPSS	Statistical Product and Service Solutions
TOMPD	Total of Major Phonological Deviations
WSU	Wichita State University

CHAPTER 1

INTRODUCTION

The ability to communicate effectively with others is a critical skill that often is taken for granted. Adequate communication skills are essential for individuals to succeed in their interactions with others. These skills develop slowly through our communicative relationships with others, and our speech habits and knowledge of language are shaped by, and become, the products of everyday interactions with parents, teachers, friends, and peers (Colorado Department of Education, 2010). Strong language skills are necessary for academic success in all areas of education. Their foundational role in literacy development, however, has often been ignored (Snow & Paez, 2004). In addition to providing a base for literacy, language skills also integrate reading, writing, speaking, and listening skills (Colorado Department of Education, 2010). Literacy skills determine whether a child will experience academic success or academic failure. Therefore, it is crucial for individuals to have appropriate receptive and expressive language skills, not only for communication purposes, but also for future academic success.

Academic success begins with the ability to communicate effectively with others. Children develop a variety of individual skills in all of the areas of speech and language (i.e., phonology, semantics, grammar, pragmatics), and these are combined, along with other associated factors (e.g., rate of speech, intonation, dialect), and integrated when communicating messages to others. This communicative exchange exists within a speaker/listener dyad (Kent, Miolo, & Bloedel, 1994) and manifests itself orally as an acoustic-phonetic event that is referred to as “speech intelligibility.” This exchange has been defined by Nicolosi, Harryman, and Kresheck (1989) as the degree of clarity with which one’s utterances are understood by others. Intelligibility has been used as an index of overall speech acceptability by professionals in the

speech-language pathology field for years (e.g., Beukelman & Yorkston, 1979, 1980; Connolly, 1986; Metz, Samar, Schiavetti, Sitler, & Whitehead, 1985; Metz, Schiavetti, & Sitler, 1980).

Children who have speech intelligibility issues frequently have deficits in academic skills as well (Bird, Bishop, & Freeman, 1995). They frequently have poor beginning reading skills, which can negatively affect them in far-reaching ways (Webster & Plante, 1992). For example, when children with major speech/language issues attempt to gain information from academic coursework, they may have difficulty with decoding words, and thus, cannot gain content-related information. According to The No Child Left Behind Act (NCLB, 2001), students who often become high school dropouts, did not achieve grade-level reading during the elementary years. Limited reading skills may widen the gap between social levels and perpetuate poverty (Payne, 2003). Moreover, low exposure to words limits a child's literate world in areas such as the understanding and development of rich vocabulary (Hart & Risley, 1995). Diminished reading skills contribute to a vicious cycle including a lessened ability to express ideas.

Academic difficulties also have been linked to decreased language opportunities in the home. Reading experts agree that academic difficulties can be tied to limited-literacy experiences (LLE) (Snow, Burns, & Griffin, 1998; Snow & Paez, 2004). Moreover, low achievement has been linked to poverty (e.g., lack of financial, emotional, physical, and support resources) (Payne, 2003). Children who come from low-income homes may have less access to academic resources, and they may start school with language-delayed abilities that significantly lag behind their economically advantaged peers (Coats Human Services Reauthorization Act, 1998). Additionally, many of these children continue to perform well below their more advantaged peers in reading upon entering school (NCLB, 2001) and commonly struggle throughout their academic years (Stanovich, 1999).

Literacy Support: Head Start

The United States government has been focusing on the promotion of literacy skills for several decades. This focus has included: (a) investigating factors that affect literacy development, (b) passing literacy legislation (e.g., NCLB, 2001), and (c) developing programs to improve literacy skills of our children (e.g., Head Start). The U.S. Department of Education (2001) reported that 46% of kindergarten children have one or more of the following risk factors in developing reading skills: (a) poverty, (b) non-English speakers, (c) expressive phonological impairment, and (d) specific language impairment. In addition, educators have found that the majority of children who came from high-poverty homes and had completed elementary school, scored below a basal reading level (Donahue, Finnegan, Lutkus, Allen, & Campbell, 2001). Despite various policies and programs that have been put into place, the educational system continues to wrestle with enhancing literacy skills. Society's future growth is dependent on developing effective learning environments for our children so that they may learn to read and develop their full potentials.

One of the programs that have been developed in the United States to combat the risk factor of poverty and to promote literacy in children is the national preschool program developed in 1965 called Head Start (Zigler & Styfco, 2004). It is a comprehensive school readiness program that helps promote the enhancement of a child's social, emotional, and cognitive development through the provision of various services. The Head Start organization also requires inclusion of children with handicaps (P. L. 94-424). It includes eleven eligible disability categories, and, of these, more than 80% of the children with special needs have a speech and/or language impairment (U.S. Department of Health and Human Services, 2011a).

The program's goal is to comprehensively prepare impoverished children for school so they are able to achieve academic success. Head Start places special emphasis on helping children develop their reading and math skills (U.S. Department of Health and Human Services, 2010b). Although Head Start has reported improvement in children's scores while attending Head Start, early gains in the areas of language, literacy, and math have not been sustained as children move into their early school years (U.S. Department of Health and Human Services, 2010a).

Factors That May Affect Head Start Reading Success

One possible factor that may contribute to the continuing lag of Head Start children behind their peers may be their lower receptive vocabulary skills. Hart and Risley (1995) proposed that children who are not engaged in adequate language interactions with their parents are going to have low levels of vocabulary and conceptual development. Moreover, these low vocabulary and concept levels may negatively affect children's later reading skills and academic achievement. Hart and Risley reported that there is a large difference in the number of vocabulary words spoken in professional homes in contrast to the number of vocabulary words spoken in homes receiving welfare. Head Start reported that receptive vocabulary skills of children attending Head Start are substantially below the national average (87.2%) (U.S. Department of Health and Human Services, 2011a). More specifically, The Head Start Impact Study of 2000-2012 compared the average receptive vocabulary scores of Head Start children in 2003 to scores obtained by the general population. They found that the 3-year-old age group scored at the 32st percentile, whereas the 4-year-old age group scored at the 31st percentile.

Because Head Start children come from low-income homes and often have LLE, reduced expressive language skills (e.g., expressive vocabulary) also are common (U.S. Department of

Health and Human Services, 2011a). This, in turn, negatively affects reading success. Broadly speaking, adequate reading skills require: (a) a solid foundation in oral language, (b) an awareness of the sound structure of language, and (c) exposure to and experiences with the written word (Paulson, Jepson, & van der Pol, 2004; Snow, Burns, & Griffin, 1998; Torgesen, 2005). Good overall language skills are essential for literacy growth to occur. It also is widely recognized and well documented that children with specific language impairment are at risk for literacy acquisition difficulties in areas such as reading and spelling (Bird, Bishop, & Freeman, 1995; Bishop & Adams, 1990; Clarke-Klein & Hodson, 1995; Gillon, 2004; Nathan, Stackhouse, Goulandris, & Snowling, 2004).

Children at Head Start who have speech intelligibility problems may also have reading difficulties because of the direct connection to phonological awareness skills. It is well known that children with delayed expressive phonology (i.e., poor speech intelligibility) have poorer phonemic perception and phonological awareness skills than their typically developing peers (e.g., Gillon, 2004; Rvachew, Ohberg, Grawburg, & Heyding, 2003). Furthermore, even after speech impairments are resolved; these children often are at risk for long-term difficulties when using phonological information for reading and spelling (Nathan et. al., 2004). Bishop and Adams (1990) stated in their Critical Age Hypothesis that children need to be intelligible by age 5 ½ years or they are likely to have difficulty with reading skills. Also, if Head Start children have reduced speech intelligibility, their vocabulary and language development may be delayed because of reduced beginning literacy skills (e.g., deficit phonological perception). Head Start children need additional support to better improve their school readiness skills.

Statement of the Need

A critical need exists to help children from homes with impaired speech/language systems and limited literacy experiences to better prepare for future academic success. Efforts such as national preschool programs (e.g., Head Start) have been created in an attempt to help children from low-income homes “catch up” with their economically advantaged peers. Also, legislation such as No Child Left Behind has been implemented to enhance literacy skills (NCLB, 2001). Gains that Head Start children obtain have not helped them catch up (U.S. Department of Health and Human Services, 2010a).

The future academic success of Head Start children is dependent on adequate literacy skills. The development of adequate reading skills is dependent on adequate speech-language skills. These children need an effective foundation of speech/language development not only to communicate successfully, but also to reduce their risk for literacy difficulties in the future (Bishop & Adams, 1990). It is critical that we identify any speech/language issues that Head Start children commonly have to insure that supports might be implemented to help these children obtain optimal benefits from their future educational environment.

Data concerning speech/language skills of Head Start children are generally lacking. Treatment at Head Start has been extremely variable (Madison & Hays, 1981). Typically these children enter kindergarten with many deficiencies in the areas that are fundamental for success. Specific speech/language/intelligibility need areas have not been identified due to limited research. Practitioners have struggled with decisions involving what is typical for this population and how to best provide services (personal communications); Head Start speech/language guidelines are vague. Specific Head Start speech/language program needs have not been identified due to lack of information. Representative speech-language samples from Head Start

children may yield information to help the Head Start staff better define their speech/language and intelligibility criteria, and thus, improve the specificity of their communication eligibility guidelines. Also, the samples may provide important information to consider when Head Start staff design daily curriculum needs (i.e., group activities vs. individualized activities). In addition, this information may also help practitioners to make more informed decisions about: the inclusion of high treatment need areas (i.e., receptive vocabulary, phonological patterns), and the identification of any specific program needs (i.e., integration of services at particular age levels). In summary, this information may help educators develop more appropriate curriculum supports in order to help these children succeed in school.

It is important to gain information about the communication characteristics of Head Start children in order to better support their needs related to school success. Intelligibility levels, speech production skills, vocabulary skills, and morphology are all important communication skills which have been linked to literacy skills. Identification of the skill levels of Head Start children and the variables that are most important to intelligibility may better identify any specific speech/language need areas.

Studies that have been conducted in the area of typical speech/language development (including intelligibility) and also measures that have been used to assess these skills are reported in the next chapter. Chapter III provides details about a study designed to assess speech/language skills of Head Start children. Results of this study are presented in Chapter IV. The findings are explained in Chapter V.

CHAPTER II

REVIEW OF LITERATURE

Head Start, a national preschool program dedicated to preparing the country's neediest children achieve academic success, has been in existence for over four decades. Although Head Start has prioritized helping children develop their literacy skills, children who entered the program in the fall of 2006 still fell behind their peers in the areas of language, literacy, and math when they reached kindergarten (U.S. Department of Health and Human Services, 2010b). Various risk factors may contribute to this lag including: (a) limited language experiences (Snow, Burns, & Griffin, 1998; Snow & Paez, 2004), (b) low vocabulary skills, (Hart & Risley, 1995), (c) poverty (Payne, 2003; U.S. Department of Education, 2001), (d) expressive phonological impairment (Gillon, 2000, 2002, 2004; Rvachew, Ohberg, Grawburg, & Heydig, 2003; Webster & Plante, 1992), and (e) specific language impairment (Bird, Bishop, & Freeman, 1995; Bishop & Adams, 1990; Clarke-Klein & Hodson, 1995; Nathan, Stackhouse, Goulandris, & Snowling, 2004; U.S. Department of Education, 2001). Typical speech and language data need to be obtained from Head Start children; it is essential for designing more effective methods and programming to better support Head Start children's future academic growth.

This literature review begins with a discussion of the typical development of children's speech/language skills including: (a) phonology (sound system development), (b) semantics (receptive and expressive development of words and word relationships), (c) grammar (syntax and morphology), and pragmatics (social use). The second section includes speech intelligibility (understandability of speech) and the related concept of severity of involvement including: (a) the importance of these concepts, (b) their definitions, (c) associated factors, and (d) typical development of intelligibility. The third section discusses measures that are used to evaluate

speech/language skills including: (a) speech sound measures, (b) language measures, and (c) intelligibility/severity measures. The fourth section includes an overview of Head Start including: (a) research regarding the effectiveness of the program, (b) information on performance standards and eligibility criteria for speech/language impairment, and (c) the management of services to children. The fifth section provides a discussion of the problems that are related to Head Start research. This review ends with a section on Head Start speech/language needs including a statement of the problem and the purpose of this study.

Typical Development of Children's Speech/Language Skills

Human communication is a social skill that begins at birth with an immersion of sounds and develops into a dynamic tool for influencing the behavior of others (McLaughlin, 2006). It is often divided into the components of: (a) phonology (sound system of language), (b) semantics (its meaning), (c) grammar (structure of a language), and (d) pragmatics (its social use). The first three components combine together and are used socially, in a variety of ways, to communicate with others. If the communicative attempt is verbal, the transmission of an intended message from a speaker to a listener exists on a continuum of effectiveness. This clarity of a communication has often been referred to as the intelligibility of an utterance. Attempts to measure speech intelligibility have been numerous, and investigators have used a variety of methods to assess it. Although no best method has been agreed upon, researchers do agree that the measurement of speech intelligibility is needed to identify the effectiveness of speech interaction.

Phonology

The language component of phonology is an important foundational skill which has evolved extensively over the years. It developed out of a need to explain how children acquired

linguistic structures and out of a growing interest in normal and disordered phonological development (Ingram, 1976). An interest in typical and disordered phonology is evidenced by the diary studies of 1877-1929, the large sample studies of 1930 to 1957, and the linguistic studies of 1958 to the present. The large cross-sectional sample studies from 1930 to 1957 yielded normative acquisition data which many speech-language pathologists still use today (e.g., Poole, 1934; Templin, 1957). Clinicians use these “norms” to make decisions about which individual speech sounds are “developmentally appropriate” at which age levels.

There are problems with using these phoneme acquisition norms. For example, great variability exists between the methods used in these studies (e.g., the criterion levels of the phonemes, the allophonic considerations). As a result of these procedural differences, a consensus has not been reached on exactly which sounds are developed at which age levels. For example, /r/ and /s/ are acquired by age 4 years according to Templin (1957). In contrast, Smit, Hand, Freilinger, Bernthal, and Bird (1990) reported that /r/ and /s/ are acquired by age 8 years. Hodson (2007) has compiled phonological data from various studies and has reported that /s/ clusters appear by age 3 years and /r/ by 6 years. As a result of these differences in normative data, it is extremely difficult for speech-language pathologists to determine whether a child is “developmentally” on target. Even though an order of individual phonemes has not been agreed upon, most researchers have found that phoneme categories of nasals, stops, and glides are mastered earliest in a child’s speech development, and phoneme categories of fricatives, affricates, and liquids are acquired later (Hodson, 2010).

In addition to research on individual phonemes and sound category classes, some phonologists have investigated developmental data for broad phonological patterns of children’s speech errors (e.g., Dyson & Paden, 1983; Haelsig & Madison, 1986; Preisser, Hodson, &

Paden, 1988; Porter & Hodson, 2001). The information from several of these developmental studies has been aggregated by Hodson (1997) to provide “flags” to guide speech-language pathologists when deciding if a particular child’s performance is typical when compared to their peers (Hodson, 2010). Her findings included: (a) 3-year-olds produce /s/ clusters (/s/ maybe distorted but not omitted) and velars; (b) omissions are rare by age 4 years, and their speech is “adult-like”; and (c) most children have mastered liquids /l/ and /r/ between ages 5 and 6 years. Presently, when SLPs name a type of speech sound disorder, they often use different labels according to the number of errors a child produces. A mild/moderate impairment is often referred to as an “articulation” disorder, whereas, a severe impairment is commonly called a “phonological” disorder or “apraxia” (Hodson, 2011).

Semantics

Another important component of language is semantics or the study of meaning. Preschoolers’ semantic development is tied closely to their development in other areas (e.g., motor, social, cognitive) and their awareness that words have lexical meaning gradually develops (McLaughlin, 2006). Preschoolers’ vocabularies grow at tremendously rapid rates. By 3 years of age, vocabularies of typical preschoolers consist of approximately 900-1,000 words. By the time children begin kindergarten at age 5 years, they often have vocabularies of approximately 2,100 to 2,200 words (Owens, 2007). Carey (1978) has estimated that preschoolers learn 9 new words per day, and by the time they are 6 years old, they may have as many as 14,000 words.

Because Hart and Risley (1995) recognized the importance of rich language interactions and vocabulary for later success in school, they investigated the vocabulary words spoken in different family environments. They compared the vocabulary words spoken in professional homes to the number of vocabulary words spoken in welfare homes. Hart and Risley recorded 1

full hour of every word spoken at home between parents and children in 42 families for 2½ years. Specifically, they found that by age 3, the spoken vocabularies recorded for the children from the professional families were considerably larger than those recorded for the parents in the welfare families. Between the two different groups, there was an average difference of almost 1,500 words spoken per hour. Hart and Risley completed follow-up studies at age 9 years that showed that the differences in the children's language experiences were very much linked to large differences in child outcomes. They concluded that children who have quality verbal interactions are more likely to acquire the vocabulary, oral language, and emergent literacy concepts needed to support school success.

Grammar

Tied closely to vocabulary development is the language component of grammar or structural development. Between the ages of 2 and 5 years, preschoolers begin using grammatical morphemes (smallest elements of language that carry meaning), basic sentence types, and, later, advanced grammatical constructions. Roger Brown (1973) and his colleagues completed a longitudinal study of three preschool-age children. They recorded and transcribed 2 hours of spontaneous speech samples of the children in their homes each month over several years. Brown identified language development aspects that seemed to characterize different levels and then categorized the results that were obtained into five stages. Brown believed that in contrast to chronological age, the length of a child's utterances would be a better indicator of a child's grammatical development stage. Furthermore, Brown found that counting a child's morphemes in their sentences (instead of just words) resulted in an even more sensitive measure of grammatical development. This measure of a child's average utterance length in morphemes became known as Mean Length of Utterance (MLU). In addition to Brown's stages, he also

focused on the appearance and order of mastery of 14 grammatical morphemes that are acquired at various developmental stages as a child continues his or her grammatical development.

Pragmatics

An additional component of language is pragmatics or the practical use of language in a social interaction. Speech sounds, vocabulary, and grammar components are meshed together in a variety of ways and then used pragmatically in a social situation. Pragmatics involves the speaker's use of language as a tool to achieve certain intended goals. McLaughlin (2006) has observed that compared to the other linguistic components of language (e.g., semantics, grammar), pragmatics comes the closest to being at the heart of communication.

The social functions of pragmatics are extensive and complex. The functions can vary as widely as from talking to ourselves for reassurance to using alternative words and sentence forms in a discussion to achieve a certain intended result. Because the language area of pragmatics is very extensive, this investigation is limited to a small section of this realm. It will focus on the communicative use of speech in a social situation, more specifically, the clarity or speech intelligibility of an utterance.

Speech Intelligibility and Severity

The components of phonology, semantics, grammar, and pragmatics are all important parts of a child's speech-language skills; however, what is of greatest importance is the understandability of this combined skill set and whether a listener receives the intended message of the speaker. Speech intelligibility determines whether true communication has been achieved.

Historically, most of the literature on speech intelligibility and severity has been focused on individuals with neurological impairments, individuals with hearing impairments, and adults who use esophageal speech. Published data regarding intelligibility of children with both normal

phonologies and disordered phonologies have been limited. More recently, however, greater attention has been centered on treatment approaches for children with unintelligible speech (McLeod, 2006) and, consequently, more attempts have been undertaken to identify reliable quantification measures to assess a child's speech (e.g., Flipsen, Hammer, & Yost, 2005). The concepts of speech intelligibility or unintelligibility with associated severity levels are at the core of these quantification measures. Because these concepts are so closely interrelated, researchers have often presented these entities together.

The exact relationship between intelligibility and severity has been debated. Shriberg and Kwiatkowski (1982) claimed that intelligibility is one of three constructs of severity (i.e., intelligibility, disability, handicap). Kent, Miolo, and Bloedel (1994) contended that intelligibility and severity are correlated but they are distinct and separable. Gordon-Brannan and Hodson (2000) proposed that intelligibility and severity overlap. Smit (2004) stated that intelligibility and severity are not the same elements. Although the exact relationship cannot be agreed upon, most researchers do agree that a close relationship does exist between them (e.g., Gordon-Brannan & Hodson; Kent, et al.; Shriberg & Kwiatkowski; Smit). For the purpose of this study, speech intelligibility and severity will be considered as overlapping concepts that are tied closely together.

Importance of Speech Intelligibility

Speech intelligibility has been used as an index of overall speech acceptability for over three decades (e.g., Bernthal & Bankson, 1998; Beukelman & Yorkston, 1979, 1980; Connolly, 1986; Metz, Samar, Schiavetti, Sitler, & Whitehead, 1985; Metz, Schiavetti, & Sitler, 1980; Monsen, 1981; Weiss, Gordon, & Lillywhite, 1987). A study by Beukelman and Yorkston (1979) is one of the earliest studies to show the use of intelligibility scores as an index of overall

communication function. The speech intelligibility of nine speakers with dysarthria was judged by 108 listeners in which single words and paragraphs were read. Normally hearing listeners answered questions about the content of the paragraphs that they heard. The information transfer from the speakers to the listeners had a high correlation with the intelligibility scores. Thus, this study substantiated the use of intelligibility as a useful technique to measure speech sound abilities.

In addition, intelligibility has specific clinical implications for assessment and treatment. Decisions involving intelligibility include: (a) use as a tool to determine if intervention is needed, (b) use as an intervention goal to improve communication skills, (c) use as a measurement to evaluate the effectiveness of intervention strategies, and (d) use as an assessment to make appropriate placements (Ansel, McNeil, Hunker, & Bless, 1983; Bernthal & Bankson, 1993; Monsen, 1983; Schmidt, 1984; Yorkston, Strand, & Kennedy, 1996).

One example of a study that exemplifies the importance of intelligibility in clinical assessment was completed by Hodson and Paden (1981). These researchers investigated phonological process patterns of 60 unintelligible children, 3 to 8 years, and the error patterns of 60 normally developing 4-year-olds. The Assessment of Phonological Processes (Hodson, 1980) was administered individually to the children, and all utterances were transcribed phonetically. The results revealed five processes that were demonstrated by all 60 of the children with unintelligible speech. They included: (a) cluster reduction, (b) stridency deletion, (c) stopping, (d) liquid deviation, and (e) assimilation. Processes demonstrated by the most severe subjects included: (a) velar deviations, (b) backing, (c) final consonant deletion, (d) syllable reduction, (e) (f) prevocalic voicing, and (g) glottal replacement. The processes demonstrated by the 4-year-olds with intelligible speech included: (a) devoicing of word-final obstruents, (b) production of

anterior strident phonemes to replace the non-strident interdentalals, (c) liquid deviations, (d) tongue protrusions, (e) depalatalization, (f) assimilations, and (g) metathesis. These researchers provided data showing how types of phonological processes distinguish between the speech of intelligible and unintelligible children. This study demonstrated why intelligibility is important as a clinical tool in assessment.

The importance of speech intelligibility has been discussed by many researchers. For example, Kent, Miolo, and Bloedel (1992) explained that intelligibility is “the behavior standard of communication” (p. 329). Connolly (1986) stated “among the factors necessary for successful oral communication, intelligibility . . . is clearly one of the most fundamental” (p. 371). Subtelny (1977) reported that intelligibility is the most practical single index to apply when assessing competence in oral communication. Also, Bernthal and Bankson (1998) called intelligibility the “most important factor when determining the need for intervention and for evaluating the effectiveness of intervention strategies” (p. 271). Therefore, most researchers agree that intelligibility is the most important factor in successful communication, assessment, and intervention.

Importance of Severity

The importance of severity has also been noted by many researchers (e.g., Flipsen, Hammer, & Yost, 2005; Hodson, 1992; Khan & Lewis, 1986; McCabe & Bradley, 1975; Rafaat, Rvachew, & Russell, 1995; Shriberg & Kwiatkowski, 1982). For example, results of a study by Rafaat, Rvachew, and Russell (1995) showed the importance of severity ratings. Fourteen experienced SLPs rated the severity of phonological impairment for 45 preschoolers, ages 30 to 65 months. They assessed: (a) the severity of impairment after administering a single-word articulation test, (b) the severity of impairment after listening to a 5- minute sample of the child’s

conversation, and (c) an overall severity of impairment based on both factors. The results indicated that the inter-judge reliability between SLPs was in 80% agreement for the older children (4;5 and above), but the judgments were at 40% agreement for the younger children (3;5 and younger). Their conclusion was that the children with age-appropriate phonological skills could not be distinguished from children with a mild delay; consequently, the SLP needed education regarding normative phonological data for young children. This study demonstrated that severity of involvement is an important tool in the area of speech sound disorders.

The clinical value of quantifying severity levels also has been identified by various investigators (e.g., Flipsen, Hammer, & Yost, 2005; Garrett & Moran, 1992; Hodson, 1992; Rafaat, Rvachew, & Russell, 1995; Shriberg, 1993; Shriberg & Kwiatkowski, 1982). For example, Flipsen (in Bowen, 2009) stated that the use of severity ratings may involve placing some children with milder problems on waiting lists (in some countries), whereas children with higher degrees of involvement may be given higher priority for speech intervention. Furthermore, Flipsen reported that some SLPs group children according to severity levels to improve their efficiency in services, and also, some insurance companies determine the amount of service they will pay for according to the severity of a speech sound disorder. Bernthal, Bankson, and Flipsen (2009) stated that the severity of a disorder is a high priority factor in case selection decisions by SLPs. Rafaat et al. (1995) added that severity ratings are essential to achieving reliability across SLPs. In addition, Bowen (2009) observed that SLPs use ratings to quantify severity for their own information and to inform parents about the degree of their child's speech disability. Thus, severity ratings are important for: (a) prioritizing caseloads, (b) efficiency of services, (c) documentation for insurance companies, (d) reliability across SLPs, (e)

for quantification of documentation data, and (f) for informing parents about a child's phonological disability.

In summary, information about the importance of intelligibility and severity for clinical assessment and treatment is extensive. These tools help identify speech/language issues, provide measurement for ongoing assessment, and document progress; they are effective devices for helping guide professionals in designing appropriate treatment methods.

Definition of Speech Intelligibility

Various researchers have attempted to define intelligibility although its elusive nature makes it difficult to be described precisely. Smit (2004) defined intelligibility as “the capacity to communicate with others in a way that they can understand” (p. 40). In contrast, some definitions are more complex such as Kent et al. (1994), who defined intelligibility as “the functional common denominator of verbal behavior” (p. 81).

Connolly (1986) described intelligibility with a broad, linguistic view. He claimed that intelligibility is a special case of a broader concept called “indeterminability.” He explained that an utterance is indeterminable if the listener is not able to recover correctly the intended meaning of a message. Connolly also stated that intelligibility is not an all-or-nothing phenomenon, but instead, a matter of degree.

Kent (1992) described a very different view of intelligibility. He hypothesized that intelligibility is a part of a more general concern called communicative competence. It is multilayered and has many different dimensions, including: (a) auditory, (b) perceptual, (c) linguistic, (d) acoustic, and (e) physiological factors. Kent added that we study intelligibility through many different methods. These methods are developed out of the theories that we ascribe to in our belief systems.

Kent et al. (1994) described intelligibility in a very realistic manner, “The idea that a single intelligibility score can be ascribed to a given individual apart from listener and listening situation is somewhat a fiction. It is probably closer to the truth that a particular talker has a range of intelligibility potentials, depending on listener familiarity, nature of the linguistic message, physical setting, motivation, effort level, and so on” (p. 81).

It appears that the concept of intelligibility is dependent on a particular individual’s “glasses.” It is understandable that researchers have not reached a consensus on a definition. Individuals all see intelligibility from a different view, and all have a different purpose for trying to quantify it (Kent, Weismer, Sufit, Rosenbek, Martin, & Brooks, 1990). Although a consensus has not been reached on the definition, the reality is, there is still a clinical need to develop an assessment of intelligibility to quantify phonological information (Kent et al., 1994). For the purposes of this study intelligibility is defined as *the percentage of identifiable words (PIW) that an unfamiliar listener can recognize in a connected-speech sample.*

Definition of Severity

Severity has been defined by Smit (2004) as “the degree to which speech is deviant or disordered” (p. 43). She added that the degree of deviancy can be measured in a couple of ways; through a global measure or a number derived from the transcription of speech samples. Similarly, Shriberg and Kwiatkowski (1982) defined severity as the degree of impairment or disability in a client, whereas Flipsen et al. (2005) defined it as a categorization about how “significant” the speech problem is. Flipsen added that categorization is used in conjunction with labels such as mild, moderate, or severe.

Shriberg and Kwiatkowski (1982) hypothesized a model of severity which contains three independent constructs. The constructs are disability, intelligibility, and handicap. They

explained that *disability* refers to the degree of deviation from the norm, *intelligibility* refers to an estimate of the percentage of intelligible words in a continuous speech sample, and *handicap* outlines the degree to which the disability impedes effective functioning. Shriberg and Kwiatkowski also noted that because the appraisal of “handicap” requires more functional information than we usually have, severity of involvement usually refers to a focus on the disability (i.e., lack of speech-sound skills of the speaker).

There seems to be closer agreement concerning the definition of severity in comparison to intelligibility. The main difference of opinion appears to be what the scope of a severity definition should include (e.g., just speech skills of a speaker versus a larger domain). Although the articulatory/phonological aspects of a speaker may account for 20% of the variance in a speaker (Shriberg, 1986), there is still another 80% unaccounted for; therefore, perhaps the view of severity of involvement does need to go beyond the focus of specific speech sound skills and should include some functional aspects as well. Camarata (1995, 2010) has an interesting naturalistic intervention approach that includes both speech intelligibility and speech accuracy. When professionals see changes in the skills of their clients, they often do not know the extent of transfer of these skills to spontaneous conversation (i.e., extent of “handicap”). Studies of generalization to conversational settings have been limited. For the purposes of this study we will define severity as *the categorization about how significant a problem is (e.g., mild, moderate, severe, profound), not limited to speech sound accuracy alone.*

Associated Factors

Associated factors that influence intelligibility and severity are extensive. Various researchers have reported a multitude of influences such as: (a) *articulation/phonological* (e.g., number and types of sound errors), (b) *consistency/inconsistency of sound errors*, (c) *frequency*

of occurrence of error sounds, (d) phonological deviation patterns used, (e) suprasegmental (e.g., rate, inflection, open and closed juncture, stress patterns, pauses, voice quality, loudness, resonance, and fluency); (f) *contextual* (e.g., utterance length and fluency, word position, intelligibility of adjacent words; semantic context); (g) *linguistic* (e.g., phonological complexity, syllabic structure, grammatical form); (h) *pragmatic* (e.g., the social environment, the message content; available cues); (i) *acoustic* (e.g., the characteristics of the transmission media); and (j) *methodological* (e.g., listener familiarity, stimulus material type) (e.g., Bernthal & Bankson, 1993; Boothroyd, 1985; Dongilli, 1994; Flipsen, 1995; Forrest & Morrisette, 1999; Garcia & Cannito, 1996; Garrett & Saint-Pierre, 1980; Hodson & Paden, 1981; McGarr, 1983; McGarr & Osberger, 1978; Schiavetti, Sitler, Metz, & Houde, 1984; Shriberg & Kwiatkowski, 1982; Stimley & Hambrecht, 1999; Weiss, 1982; Vihman & Greenlee, 1987; Weston & Shriberg, 1992; Yorkston & Beukelman, 1978). These numerous influences have contributed to the vagueness of the constructs of intelligibility and severity and, thus, make it difficult to quantify the speech of children with speech sound disorders. Researchers need to consider these influences when choosing the most valid measures to use and when minimizing confounding variables during investigations.

As already stated, many articulatory/phonological factors influence speech intelligibility. One of the major influences includes the types of sound errors that a child produces. As reviewed earlier (p. 15), Hodson and Paden (1981) provided data showing how types of phonological processes distinguish between the speech of intelligible and unintelligible children. This study indicated that there are specific patterns or strategies in a child's unintelligible speech that differs from the speech of a typically developing child, not only in number, but also in types used.

Error patterns can also be identified by feature groups of phonemes. For example, Forrest and Morrisette (1999) completed a study involving children who were diagnosed with and treated for phonological disorders and compared their errors to the errors of children suspected of having childhood apraxia of speech (CAS). The results indicated that the feature patterns of both groups were the same. Specifically, all the children maintained the feature of voicing most frequently, followed by manner of production, and place of articulation was evidenced the least.

In addition to the types of error patterns, the nature of those errors is also of major importance. For example, deleting a sound, compared to distorting a sound, results in less intelligibility (Hodson, 2004, 2007; Hodson & Paden, 1991). Also, the more frequent the error sounds occur in a language, the more unintelligible the speaker (Fudala & Reynolds, 1986). In addition, the more consistently the target sounds are produced in error, the more probable the listener's speech will be perceived as "defective" (Bernthal, Bankson, & Flipsen, 2009).

Thus, it appears that children with unintelligible speech have some distinguishable characteristics. Besides the major difficulty with sound and syllable omissions (Hodson, 2004, 2007; Hodson & Paden, 1991), these children may retain voicing (Forrest & Morrisette, 1999) and may even overuse voicing as evidenced by extending it to the prevocalic position in words (Hodson & Paden, 1981). The manner of articulation also is commonly retained (Forrest & Morrisette, 1999), although the characteristic of stridency may be especially difficult as evidenced by cluster reductions of "s" and stridency deletions (Hodson & Paden, 1981). Place of articulation seems to be the most unstable (Forrest & Morrisette, 1999) and is evidenced by numerous phonological deviations such as: (a) velar deviations, (b) backing, (c) assimilation, and (d) glottal replacement (Hodson & Paden, 1981). These characteristics need to be kept in mind

when determining whether a disorder exists and when measuring the intelligibility effects of intervention.

Even though variances of speech sound/pattern productions appear to be a major influence in speech intelligibility, as stated earlier, many other factors also affect the clarity of speech. Shriberg and Kwiatkowski (1982) recognized the influence of suprasegmental factors early. In addition to presenting data for using percentage of consonants correct (PCC) as a measure of severity, they also investigated the variables of voice (pitch, loudness, quality) and rhythm (phrasing, stress, rate) in children with disordered speech. Their results substantiated the validity of the PCC as a severity tool, but also, the suprasegmental variables of phrasing, stress, and rate also played an important role in some of the children's severity ratings. Shriberg and Kwiatkowski found that the suprasegmental factor of phrasing had the greatest influence on intelligibility. Studies involving suprasegmental factors have continued (e.g., Shriberg, 1993; Shriberg, Kwiatkowski, Best, Hengst, & Terselic-Weber, 1986).

Because studies involving articulatory/phonological variance and suprasegmental variance did not fully explain unintelligibility, Weston and Shriberg (1992) investigated contextual and linguistic factors. These researchers completed two studies to identify specific contextual and linguistic correlates. For study one, listeners' glosses were obtained from a database of conversational speech-language transcripts involving 2,476 words taken from 19 continuous-speech samples that had been collected previously from 4- and 5-year-old children (Shriberg, 1990). For study two, the same samples were used to cross-validate and expand the word-level findings of study one with different listeners and different listening conditions. The results obtained by Weston and Shriberg (1992) indicated regularities associated with unintelligible words. These intelligibility outcomes included: utterance length and fluency, word

position, intelligibility of adjacent words, phonological complexity, syllabic structure, and grammatical form. These findings revealed that, in addition to articulatory/phonological and suprasegmental factors, many types of contextual and linguistic factors also affect intelligibility.

The method used in a study also affects the intelligibility outcomes that are obtained. For example, Flipsen (1995) found that if a listener was familiar with a speaker (such as a mother with her child), higher intelligibility ratings were obtained. Flipsen's participants in his study included four speech-delayed children, ages 4 to 7 years. The children were audio-taped four times over a 12-18 months period using imitation of single words. The results indicated that the mothers were significantly better than all other listeners at identifying the words spoken by their children, and the mother advantage was greatest for the two youngest children. Flipsen concluded that speaker-listener familiarity was an important factor associated with intelligibility; especially when the listener was the child's mother.

Another associated factor that affects the results is the use of different stimulus materials (words, sentences, paragraph reading, and continuous speech). The effect of stimulus types on the intelligibility of children with disordered phonologies has been studied only minimally. Gordon-Brannan and Hodson (2000) compared five different intelligibility/severity measures with varying stimulus types: (a) percentage of words in conversation, (b) percentage for imitated single words, (c) percentage of imitated words in sentences, (d) listener ratings, and (e) the average of percentages of occurrence of phonological deviations (PDA). Their results indicated that all five measures of the intelligibility/severity measures were highly intercorrelated. Consequently, it appears that all five stimulus measures that were examined may be valid choices for researchers to use in intelligibility studies depending on the purpose of their studies.

Typical Development of Intelligibility

Studies of typical intelligibility development have been limited in number, and the methods used to assess intelligibility have varied greatly. In addition, the overlap in age ranges has been somewhat limited. Some of the studies have similarities in outcomes, whereas others have large differences between them. It appears that these differences depend on the age level of the child tested and the particular person reporting the results. Table 1 provides results of current intelligibility studies, ages of the children assessed, reporters of the intelligibility information, and the percentages of intelligibility that were obtained.

Table 1 *Intelligibility Study Results*

STUDY	AGE RANGE	REPORTER	OUTCOME
Weiss (1982)	2;0	30 listeners (25 inexperienced and 5 experienced)	26-50%
	3;0		71-80%
	4;0		100%
Vihman & Greenlee (1987)	3;0	unfamiliar listeners	mean of 73% (range of 50-80%)
Coplan & Gleason (1988)	1;10	parent	50%
	3;1		75%
	3;11		100%
Gordon-Brannan & Hodson (2000)	4;0	unfamiliar listeners	mean of 93% (range of 73-100%)
Roulstone, Loader, Northstone, Beveridge, & others (2002)	2;1	parent	87.3%
Flipsen (2006)	3;0	transcriber of speech samples	mean of 95%
	4;0		mean of 96%
	5;0		mean of 98%
	6;0		mean of 99%
	7;0		mean of 99%

One primary source of these contrasts is that there are differences regarding who is reporting the intelligibility results. For example, the results obtained from the study by Coplan and Gleason (1988) is often cited as intelligibility guidelines in typical developmental references for children although the results were actually obtained by parent report, and children were not actually tested. The main issue with parent report studies is that parents often understand their children better than unfamiliar listeners do; and, consequently, parents often report higher intelligibility scores for their children (Flipsen, 1995). Another example is evident in the Flipsen (2006) report; a transcriber was used to calculate the speech intelligibility samples. As expected when a reporter has repeated access to the samples, the intelligibility outcome for 3-year-old children was high compared to the other studies.

Another source of these contrasts appears to depend on the age of the children who were tested. Two of the three studies assessing 2-year-old children's intelligibility levels were by parent report, and the third study does not identify who the reporter was. Of those three studies, the intelligibility percentages varied widely; therefore either the parent reports were either highly inconsistent or the 2-year-old children varied greatly in their intelligibility levels. The studies assessing 3- and 4-year-old children's intelligibility levels included both parent and unfamiliar listener reports. These studies were more similar in their results.

After examining the results of these studies, it appears that the widest contrast in results occurs at the 2-year-old age level. The 3- and 4-year-old age level results are most consistent. It appears that it is very important for investigators to keep in mind who has reported the results so one might consider the possibility that outcomes might be inflated. Unfamiliar listeners were used in the present study to eliminate the possibility of inflated intelligibility percentages.

Measures of Speech/Language Skills

The speech and language assessment instruments that are available for SLPs to use include a vast array of choices. Because the list of available options is so large, this brief discussion will be limited to the instruments that are used in this study. Descriptions are provided of a phonological assessment tool, a receptive vocabulary instrument, and an expressive grammatical assessment.

Speech Sound Measures

The measures for speech sound assessment have historically been “articulation” tests that focused on evaluating one phoneme at a time (e.g., Goldman-Fristoe Test of Articulation; Goldman & Fristoe, 2000). These assessment tools have involved filling in blanks with children’s errors without the use of word transcriptions for these errors (Hodson, 1998). All errors of the assessment (whether substitution errors, distortion errors, or omission errors) are given the same weight when these assessments are scored. Hodson (2010) found that omission errors have more weight than other types of errors when determining the severity of a child’s speech sound disorder. Instead of single phoneme assessment procedures, phonologically based assessment tools identify patterns of deviations that can be targeted during remediation (Hodson & Paden, 1991).

An example of a phonologically based assessment tool is the Hodson Assessment of Phonological Patterns – Third Edition (HAPP-3; Hodson, 2004). Single-word productions are obtained through spontaneous object/picture naming tasks in addition to a few questions. This assessment contains 50 words. Omissions and consonant category deficiencies, as well as substitutions are analyzed. Categories of omissions include: (a) syllables, (b) consonant clusters/sequences, and (c) singleton consonants in all word positions. Consonant categories evaluated include: (a) nasals, (b) glides, (c) liquids, (d) stridents, (e) velars, and (f) other anterior

nonstridents. Consonant category deficiencies are coded whenever omissions or non-category substitutions (e.g., non-strident /t/ for strident /s/) occur for the targeted consonants. Severity levels of mild, moderate, severe, or profound are derived from the Total Occurrences of Major Phonological Deviations (TOMPD).

Language Measures

The study by Hart and Risley (1995) that was discussed earlier pointed out the importance of children's language experiences for the development of vocabulary skills and basic concepts. A tool that has been used extensively to measure receptive language skills is the Peabody Picture Vocabulary Test-Fourth Edition (PPVT-4) (Dunn & Dunn, 2007). This instrument involves color pictures depicting specific vocabulary words. Speakers point to one of the four vocabulary choices on each page in response to hearing the investigator name a particular vocabulary word. The total number of correct responses is converted to a number of different statistical interpretations (e.g., age and grade equivalents, percentiles). PPVT-4 scores have been included in Head Start documents to report any growth of children's vocabulary skills from one year to the next (U.S. Department of Health and Human Services, 2010b).

Child language development also includes the major component of expressive grammar skills. Brown (1973) conducted a longitudinal study involving the recording and analysis of the language development of three preschool-age children over several years. He reported his landmark study of children's development of grammatical morphemes in his book, *A First Language: The Early Stages*. Brown's work has become a reference point for much of the future research in child language (McLaughlin, 2006). One of Brown's greatest contributions is the procedure he developed to compute a child's average utterance length in morphemes or mean length of utterances (MLU). The procedure includes: (a) segmenting a speech sample into utterances, (b) using the first 50 consecutive intelligible utterances, (c) counting the number of

morphemes in each utterance using the specified counting rules, (d) adding up the total number of morphemes in the sample, and (e) dividing by the total number of utterances. The MLU, which is the end result, corresponds to a child's stage of language development. Moreover, he also identified order of mastery of 14 grammatical morphemes that are acquired within these stages of development.

Intelligibility/Severity Measures

Connolly (1986) identified a number of possible factors that may be important to a researcher's clinical evaluation of intelligibility. His factors included a variety of specific possibilities involving: phonological contrasts, linguistic environments, interaction of message variables, communication context, familiarity of speech, and target differences. Kent et al. (1994) and others have agreed that any or all of these factors are of potential interest to investigators when analyzing a client's intelligibility. Kent and his colleagues stated that the design of effective intelligibility assessments requires focusing on the various clinical factors that are most important to a researcher's purpose. The present study was most interested in the ability of the listener to identify words produced by the speaker. Kent et al. added that good articulation and/or phonology are needed for intelligible speech production; however, articulation tests and phonological evaluations are not assessments of speech intelligibility.

General Categorization

Gordon-Brannan and Hodson (2000) categorized intelligibility assessments and observed three general approaches that have been used: (a) open-set word identification, (b) closed set word identification, and (c) rating scale procedures. In addition to these general category types, Gordon-Brannan and Hodson added that there are assessment instruments that include methods for estimating intelligibility (e.g., Fudula & Reynolds, 1986).

Open-set word identification is a general approach that was identified by Gordon-Brannan and Hodson (2000) as a procedure based on transcription of words that are spoken. These measures involve calculating the percentage of words understood from a variety of different sample types (e.g., conversation, sentences). The examiner orthographically transcribes the words, and intelligibility percentages are based on the examiner's identification of the words spoken by the subject. Some examples of open-set word measures include: a speech intelligibility sentence test for speakers with hearing impairments by Monsen (1978), the Conversational Speech Method by Shriberg and Kwiatkowski (1982), the Weiss Intelligibility Test by Weiss (1982), and the Assessment of Intelligibility of Dysarthric Speech by Yorkston and Beukelman (1981). The present study used the open-set word identification method of calculating the percentage of words understood from a conversational connected-speech sample.

The only published open-set word identification test that was designed specifically for children (and adolescents) with speech sound disorders is The Weiss Intelligibility Test (Weiss, 1982). This assessment was structured to quantify overall intelligibility. The two subtests are: (a) Intelligibility of Isolated Words and (b) Intelligibility of Contextual Speech. During administration of the first portion, the speaker produces 25 words, and the listener transcribes them. During the second portion, a 200-word continuous-speech sample is transcribed or the listener can simply tally the words understood and not understood. The average of the two subtests is an overall intelligibility score, and the score is converted to one of five categories on a severity scale. Weiss also provides an option for subjective assessment of 23 factors that may affect the intelligibility of a child's speech. This investigator believes that numerous factors can affect the intelligibility of speech utterances.

Open-set identification measures, especially conversational samples, have been described as representative of a client's everyday speech and are important for carrying out effective and efficient treatment (Masterson, Bernhardt, & Hofheinz, 2005). These measures may give a broader base for additional evaluations during the assessment process (e.g. morphosyntax).

The second general approach that was described by Gordon-Brannan and Hodson (2000) is closed-set word identification. These intelligibility measures involve listener identification of words spoken from a closed set of choices or a multiple-choice format. The intelligibility percentages are based on the amount of listener selections that are correct. Many assessment options also exist in the closed-set word identification approach. The current study collected conversational speech samples to more accurately reflect the children's everyday speech.

The other general approach discussed by Gordon-Brannan and Hodson (2000), involves the use of rating scales. These measures involve listeners making judgments about a speaker's intelligibility and specific values on a scale are determined from these judgments. Intelligibility rating scales are primarily of two different types; equal-appearing interval scales and direct magnitude scales. Equal-interval scaling procedures involve listeners assigning numbers to a speech sample on linear continuums; direct-magnitude scales involve placing stimulus samples on a continuous scale in relation to a standard stimulus. The standard can be assigned by an investigator or assigned subjectively without a standard. The latter, no use of a standard, is the procedure often used by many SLPs (Gordon-Brannan & Hodson, 2000).

Schiavetti (1992) recommended that scaling procedures not be used to assess intelligibility for a couple of reasons. The first reason is that the construct validity of equal interval scaling is lacking. Schiavetti explained that intelligibility information placed on a rating scale actually involves "category" scaling. For example, "not intelligible," "somewhat

intelligible,” and “completely intelligible” really represent an ordinal series of categories not equal intervals. A second reason is the lack of criterion validity of interval-scaled speech intelligibility compared to the direct metric of the speaker-listener match (i.e., word-identification tests have much greater criterion validity). Schiavetti (1992) concluded that “equal appearing interval scaling is inappropriate for the measurement of speech intelligibility” (p. 24). The present study used the measure of percentage of words understood because a judgment of category is not required; but rather, direct speaker-listener analysis of intended words is utilized.

Weston and Shriberg (1992) reported that many factors need to be considered when investigating the variance in children’s intelligibility. Specifically, they reported that structural and linguistic variables are extremely important. The intelligibility estimation derived from this research is based on single words. The validity of single word assessments (e.g., Weston & Shriberg, 1992) and the merits of single word assessments have been debated for several decades (Masterson, Bernhardt, & Hofheinz, 2005). In the current study, both connected speech measures and single-word assessments were completed.

Specific Intelligibility Measures

Even though there is widespread agreement about the importance of intelligibility, there is no consensus yet regarding appropriate procedures for measuring it (Bernthal & Bankson, 1998). Kent et al. (1994) observed that even if two people with speech impairment have exactly the same intelligibility score, they may have dissimilar speech production patterns associated with their speech delays. Kent et al. (1994) reported that “the process of assessing intelligibility is fraught with procedural and interpretative complications” (p. 81).

The choices available for measuring the intelligibility of children’s speech include a large selection of various methods and techniques. Methods have included: (a) percentage of

intelligible words (PIW) in a conversational sample, (b) gross estimation of percentage of words in a sample, (c) gross estimation of utterances understood in a sample, (d) percentage of words understood in reading a paragraph, in sentences, in carrier phrases, and word lists, (e) percentage of phonological processes used in words, and (f) the weighted value of incorrect phonemes on an articulation test (Gordon-Brannon & Hodson, 2000). There are also a great variety of techniques that have been used. The particular technique depended on the specific clinical population that was investigated and the reason for the assessment (e.g., Beukelman & Yorkston, 1979, 1980; Boothroyd, 1985; Dongilli, 1994; Flipsen, 2006; Fudala & Reynolds, 1986; Fujimoto, Madison & Larrigan, 1991; Hodge & Daniels, 2007; Hodson & Paden, 1981; Hustad & Beukelman, 2001; Ingram, 2002; Jamieson, Parsa, & Price, 2002; Kent et al., 1989; Kent et al., 1990; Kent et al., 1994; Klein & Flint, 2006; Laures & Weismer, 1999; McLeod, Harrison, & McCormack, 2012; Metz et al., 1985; Metz, Schiavetti, Samar, & Sitler, 1990; Monsen, 1978, 1981, 1983; Parkhurst & Levitt, 1978; Platt, Andrews, Young, & Neilsen, 1978; Samar & Metz, 1988; Sitler, Schiavetti, & Metz, 1983; Tikofsky, 1970; Weiner, 1981; Williams, 2000; Wolf, Presley, & Mesaris, 2003; Yorkston & Beukelman, 1978, 1981).

Despite the many available methods and techniques to assess intelligibility, it has been reported by numerous researchers that most practicing clinicians rely on subjective impressions to estimate intelligibility (Gordon-Brannon & Hodson, 2000; Kent et al., 1992, 1994). Gordon-Brannon and Hodson (2000) listed a number of reasons for this occurrence. The first reason or problem that clinicians face is the fact that transcribing and scoring intelligible and unintelligible words requires much more time than making a gross estimation of intelligibility. They stated that practicing clinicians are usually unable or unwilling to spend the time completing this type of assessment. Other problems that these investigators presented are: (a) a speech clinician's

orthographic transcription may not accurately reflect what the child intended to say, (b) it is difficult to specify one definitive intelligibility measure that includes all speaking situations for individual clients, and (c) normative data for speech intelligibility for children have been limited.

Another commonly used method that many practicing clinicians use to measure intelligibility is listener rating scales (Bernthal, Bankson, & Flipsen, 2009; Kent, 1992; Smit, 2004). According to Smit (2004) these scales can be defined (e.g., a rating of 1 to 6) or occur in categorical form (e.g., “I notice some speech errors,” “The speech is understandable some of the time,” “I never understand the speech”). Kent (1992) noted that the use of listener ratings is a “common clinical procedure” (p. 2) and that the popularity is probably due to the relative ease of assessment. Kent pointed out that ease of use is not the only property that should be considered, and that, at a minimum, a professional needs to consider validity and reliability. Gordon-Brannan and Hodson (2000) added that rating scales may be a less time-consuming alternative; however, they have not been validated for children with phonological impairments. Flipsen et al. (2005) supported these statements; the researchers found that rating scales lack validity.

Calculating the percentage of intelligible words from a conversational-speech sample is currently the “gold standard” for assessing severity. It was described by Shriberg and Kwiatkowski (1982) as part of the total assessment of the severity of involvement of 32 children with delayed speech. According to Shriberg and Kwiatkowski, intelligibility is just one of the three constructs of the “cover term” (p. 257) *severity of involvement*. The percentage of intelligible words data were obtained by having 14 students from communication disorders courses listen to tapes and transcribe the words understood in an utterance-by-utterance fashion. Other factors of severity were also tested, and then, all of the factors were rank-ordered for importance in overall severity of involvement. The results of this study indicated that out of the

factors of intelligibility, age, articulation, language, and suprasegmentals, *intelligibility* was ranked as the most important factor. Therefore, the method of calculating the percentage of intelligible words in a conversational speech sample was demonstrated to be a valid measure of assessing a child's speech.

Although this "best" method of determining intelligibility has been accepted by many researchers as a valid measure of intelligibility (e.g., Gordon-Brannan & Hodson, 2000; Kent et al., 1994), other researchers have questioned it. For example, Klein and Flint (2006) expressed concerns associated with reliability and validity. They contended that it may not always be possible to determine the number of words that are understood due to the unintelligibility of a child's words.

Specific Severity Measures

Severity of involvement has been firmly identified as a major consideration in many clinical treatment decisions. In direct contrast to this fact, Flipsen et al. (2005) stated that "there does not yet appear to be a clear consensus as to the most valid approach to determining severity in speech-sound disorders" (p. 298). Furthermore, researchers have different views on what the most important issues are in assessing severity. For example, Flipsen et al. (2005) have limited their concerns to a scope of the speech sound skills of the listener. They proposed that the issue of severity requires the consideration of three different parameters of measurement. Those parameters include: what factors need to be evaluated, how the various category boundaries should be defined, and how age differences can be accounted for. In contrast to the view of Flipsen et al. (2005); Shriberg and Kwiatkowski (1982) have a much broader approach to severity (as described in the speech intelligibility section).

As mentioned earlier, Smit (2004) identified at least two ways that we might determine severity: (a) through global subjective measures and (b) through numbers derived from transcriptions of speech. An example of a global subjective measure is a severity rating scale that many state departments of education use to qualify children for services. One such example is the Iowa Severity Rating Scale (Barker, Baldes, Jenkinson, Wilson, & Freilinger, 1982; Jeffrey & Freilinger, 1986). Barker et al. (1982) explained that this scale “assists the clinician in case selection and suggests the intensity of the service delivery model” (p.156).

Another variation of the global rating scale is an impressionistic rating scale. It has been described by Flipsen et al. (2005) and Bernthal et al. (2009) as a well-known approach in which the determination of severity is made through the use of impressionistic judgments about the degree of the severity (mild to severe). The numerical judgments are placed on an ordinal continuum matching the degree of severity. Flipsen et al. (2005) contended that impressionistic rating scales are problematic, and they raise at least three important issues: (a) a question of their reliability, (b) a lack of a gold standard against which relative performance is to be judged, and (c) a lack of construct validity (clinicians may use inappropriate factors to make severity judgments). Flipsen et al. (2005) added that this type of severity rating, which seems to be the choice of clinicians, may be due to the fact that clinicians are “left free to base his or her judgments on whatever factors he or she feels are important” (p. 298).

Flipsen et al. (2005) have assessed the validity of impressionistic severity ratings in their study. Ten experienced SLPs rated the severity of involvement of conversational-speech samples of 17 children with speech delay of unknown origin, ages 2;11 to 5;3. These ratings were then correlated with a large variety of segmental and whole-word measures of articulatory competence; some were established measures and others were alternative measures. The results

of this study demonstrated that although a small group of 6 SLPs were largely in agreement, most of the severity ratings were highly variable. This small group of clinicians paid attention to number, type, and consistency of errors, as well as both segmental and whole-word errors. These researchers concluded that ratings based on impressionistic judgments are not valid; these results support the need for more objective severity measures.

The other major type of severity measure identified by Smit (2004) involves measures that come from transcriptions of speech samples. Flipsen et al. (2005) called these measures “tools for determining severity” (p. 299). As more attention is given to the quantification and validation process of intervention for evidence-based practice, more types of measures are being developed (e.g., Fudala & Reynolds, 1986; Haynes & Steed, 1987; Hodson, 1986, 2004; Johnson, Weston, & Bain, 2004; Pamplona, Ysunza, Patino, Ramirez, Drucker, & Mazon, 2005; Secord & Donohue, 2002; Shriberg, Austin, Lewis, McSweeney, & Wilson, 1997a, 1997b; Shriberg & Kwiatkowski, 1982).

The most cited measure of severity is the Percentage of Consonants Correct developed by Shriberg and Kwiatkowski (1980, 1982). The PCC was designed to be a valid metric to quantify the severity of a speech disorder. As mentioned earlier, these researchers investigated the severity of involvement of 32 children with speech delays. Fifty-two SLPs listened to one minute audiotaped-continuous-speech samples and assigned severity ratings from “3” (mild) to “7” (severe) on a 9-point scale. The number of correct consonants were identified in the samples and divided by the total number of intended consonants and multiplied by 100. The PCC percentages were compared to the ratings to obtain levels of severity involvement. The PCC values index four levels of severity of involvement. They include: “Mild (85-100%),” “mild-moderate (65-85%),” “moderate-severe (50-65%),” and “severe (less than 50%).” Shriberg and Kwiatkowski

(1982) derived these levels of severity of involvement from comparing the PCC percentages of 32 speech-delayed children with severity ratings assigned to them by 53 SLPs. They concluded that the PCC metric could serve as a reliable and valid measure of assessing severity of involvement.

Another well known severity measure, and also an extension of the PCC, is the Articulation Competence Index (ACI; Shriberg, 1993). It was designed to identify those individuals whose speech contains many distortions. Shriberg conducted a normative study of children, ages 3;0 to 5;11; some of whom had typically developing speech (N = 199) to those who had speech sound disorders (N = 117). The results indicated that the mean ACI scores of the children without speech difficulties were under 50%, and the mean scores of the children with speech disorders were 70% or higher. The ACI is calculated by: (a) identifying the PCC of the speech sample, (b) adding the Relative Distortion Index (RDI), (number of distortion errors divided by the total number of speech errors multiplied by 100), and (c) dividing the sum of the PCC and RDI by 2. Thus, according to the percentages obtained, the ACI was found to be an appropriate tool for identifying children with speech distortions.

Because the PCC was developed in 1982, Shriberg et al. (1997a) have developed additional extensions to the PCC (in addition to the above ACI) to attempt to capture some specific “needs.” The metrics are: (a) Percentage of Consonants in the Inventory; (b) the Percentage of Consonants Correct-Adjusted; (c) the Percentage of Consonants Correct-Revised; (d) the Percentage of Vowels Correct; (e) the Percentage of Vowels Correct-Revised; (f) the Percentage of Phonemes Correct; (g) the Percentage of Phonemes Correct-Revised, and (h) the Intelligibility Index. All of these metrics were developed to address valid concerns and questions that investigators have asked about the original PCC. Lifespan reference data for all of the

measures are available (Austin & Shriberg, 1996); however, these investigators have added that “researchers requiring well-standardized normative data on any of the 10 measures should attempt to collect demographically appropriate samples for specific needs.”

Additionally, there are instruments that analyze phonological deviations that also assign severity levels. For example, the Hodson Assessment of Phonological Patterns-Third Edition (Hodson, 2004) and its companion, the Hodson Computerized Analysis of Phonological Patterns (Hodson, 2004), utilizes the single word responses of 50 words to obtain severity levels based on clients’ productions of the words. The severity levels *mild*, *moderate*, *severe*, or *profound*, are derived from the TOMPD. This variable was used in the current study to identify any phonological deviations that may be exhibited in the Head Start children’s speech and to assess the level of severity of those deviations.

Head Start Overview

Head Start was originally created in 1965 (Zigler & Styfco, 2004) as a “catch up” summer school program for low-income children. It was designed to teach children what they needed to know for kindergarten. It began as an 8-week program (as part of President Lyndon Johnson’s *War on Poverty*) and was expanded by Congress into a year-round program the next year. Presently, Head Start is a program within the Administration for Children and Families in the United States Department of Health and Human Services. Head Start was designed to promote school readiness skills in the areas of social and cognitive development of children through educational, health, nutritional, social, and other services. It was designed specifically to provide a supportive environment for low-income children ages 3 to 5 years.

Effectiveness of the Head Start Program

Reports on the long-term effectiveness of Head Start over the last four decades have been mixed. The question of its effectiveness has been debated since shortly after the program's inception (e.g., Cicarelli, 1969). Some educators have claimed that the program's initial impact fades out very quickly ("Head Start Fade") possibly as early as the second and third grades (Lee & Loeb, 1995; Vinovskis, 2005). Ludwig and Philips (2007) reported that the skepticism about the program has persisted into present day times and is evidenced by the existence of reports such as policy briefs that echo a theme of ineffectiveness.

Some investigators have reported that the effectiveness of Head Start has been significant (e.g., Currie & Thomas, 1995; Garces, Thomas, & Currie, 2002). For example, Garces et al. (2002) used data from the Panel Survey of Income Dynamics to review outcomes for 4,000 adults who had attended Head Start. They found that these individuals were significantly more likely to complete high school, attend college, and have higher earnings in their early adult years.

Because no consensus had been reached regarding Head Start's effectiveness, Congress mandated a study in 1998 called the "Head Start Impact Study" (U.S. Department of Health and Human Services, 2005) which involved 5,000 3- and 4-year-old Head Start children. The study measured the effectiveness of Head Start compared to a variety of other community and educational intervention programs. The children were assigned to either Head Start or other parent-selected community resources for 1 year. The control group consisted of 60% of the total participants who were placed in other preschool settings. The Head Start Impact Study reported the First Year Findings in June, 2005 (U.S. Department of Health and Human Services, 2005). The results indicated consistent, small-to-moderate advantages for 3-year-old children for pre-reading, pre-vocabulary, and parent reports of children's literacy skills. No significant results

were reported for oral comprehension, phonological awareness, or early math skills for the 3- or 4-year-old children. Fewer positive benefits were reported for the 4-year-old Head Start participants. The results of this study led to a national reevaluation of the program. The Head Start Act was reauthorized to specifically involve highly qualified teachers to implement emergent literacy instruction (Coats Human Services Reauthorization Act of 1998). In addition, this initiative recommended direct, age-appropriate instruction in language and literacy; however, this recommendation was not supported with the implementation of universal standards or curricula to facilitate this process. Therefore, each Head Start decided on individual curricula.

Performance Standards and Speech/Language Eligibility Criteria

Head Start operates under a set of regulations called “Performance Standards.” They specify detailed information concerning various parts of the program (e.g., services to children with disabilities). The performance standards for children with disabilities section has subparts including: (a) the purpose and scope of a disabilities service plan, (b) recruitment and enrollment information, (c) assessment guidelines, and (d) eligibility criteria for eleven disability areas (U.S. Department of Health and Human Services, 2011a). In 1972, Congress mandated that Head Start make a minimum of 10% of its enrollment openings available to children with disabilities. In addition, Head Start was mandated to recruit and enroll children with disabilities who are most in need of service. The largest number of children within a Head Start disability category was speech/language impairment (U.S. Department of Health and Human Services, 2011a), with more than 80% of the children with special needs in this group. Available Head Start eligibility criteria for speech/language impairments are listed below:

1308.9 Eligibility criteria: speech or language impairments

(a) A speech or language impairment means a communication disorder such as stuttering, impaired articulation, a language impairment, or a voice impairment, which adversely affects a child's learning.

(b) A child is classified as having a speech or language impairment whose speech is unintelligible much of the time, or who has been professionally diagnosed as having speech impairments which require intervention or who is professionally diagnosed as having a delay in development in his or her primary language which requires intervention.

(c) A language disorder may be receptive or expressive. A language disorder may be characterized by difficulty in understanding and producing language, including word meanings (semantics), the components of words (morphology), the components of sentences (syntax), or the conventions of conversation (pragmatics).

(d) A speech disorder occurs in the production of speech sounds (articulation), the loudness, pitch or quality of voice (voicing), or the rhythm of speech (fluency).

(e) A child should not be classified as having a speech or language impairment whose speech or language differences may be attributed to:

- (1) Cultural, ethnic, bilingual, or dialectical differences or being non-English speaking; or
- (2) Disorders of a temporary nature due to conditions such as a dental problem; or
- (3) Delays in developing the ability to articulate only the most difficult consonants or blends of sounds within the broad general range for the child's age.

To summarize the above information, Head Start has defined “speech impairment” as impaired articulation, unintelligible speech “much of the time,” a diagnosis of speech impairment, or a delay in development. A major problem with these definitions is that they are underspecified, and the degree of impairment for eligibility has not been stated. Therefore, there are no exact guidelines to determine which children will or will not receive services.

“Impaired articulation” is an extremely vague picture of a child’s speech. A child may have one error or many errors that consist of omissions, substitutions, and/or distortions. This definition does not clarify how many errors there are, what is in error, or how intelligible a child actually is. Also, the definition implies that an articulation test be used to determine the diagnosis of “impaired articulation.” Ertmer (2010) and others have provided evidence that single-word articulation test scores rarely account for more than 25% of the variance in a child’s speech.

Flipsen (2010) has agreed that the ability to understand a child's speech cannot be measured adequately with an articulation test.

Being unintelligible "much of the time" is also an extremely vague criteria definition. It can include a wide range of impairment. For example, "much of the time" may encompass any percentage level from approximately 50% to nearly 100%. As discussed earlier, the studies on typical speech intelligibility development have indicated that a 3-year-old child should be approximately 75% intelligible and a 4-year-old child approximately 100% intelligible; therefore, the age of the child and the intelligibility percentage needs to be known to help determine whether a particular child needs to receive intervention.

The term "speech impairment" is more vague than the first two definitions. It can refer to actual speech sound production errors, intelligibility issues, and/or severity levels. Flipsen (2010) stated that intelligibility and the accuracy of speech sound productions are not the same thing. He stated that "being intelligible" also means: (a) choosing the best vocabulary words to convey intentions, (b) formulating syntax correctly, (c) knowing the correct sounds to use, (d) using appropriate prosody, (e) staying on topic, and (f) physically producing the message fluently. The definition of speech impairment can lead a person down a variety of paths.

Another problem that clouds the "definition situation" is the fact that phoneme acquisition data have varied so greatly from one study to another. As a result of these differences in normative data, SLPs have a very difficult time determining whether a child qualifies for intervention services.

In addition to the definition problem, because the degree of speech impairment has not been specified by Head Start, a major difficulty that professionals face is whether a child's speech is "severe enough" to qualify for treatment. This dilemma becomes clear when clinicians

ask themselves various questions. These questions might include: How many errors make a child “speech-impaired?” What kinds of errors does a child need to have in order to qualify for services? Or How unintelligible does a child need to be in order to qualify for service, 50% or maybe 75%? Without specific Head Start guidelines, the decision to have a child enter treatment is difficult. Historically, criteria for the specific implementation of special services by Head Start have been lacking (Madison & Hays, 1981). This fact has made it difficult for professionals to determine case load selections and delivery of services.

The nature of Head Start’s responsibilities for providing services to children with disabilities has shifted since the passage of The Individuals with Disabilities Education Improvement Act of 2004 (IDEA). Under IDEA, the State Education Agency is required to make available to all eligible children with disabilities a free appropriate public education in the least restrictive environment matching their individual needs. As a result, Local Education Agencies (LEA) (e.g., public schools) are ultimately the major responsible channel for the identification, evaluation, and provision of an appropriate education for children in need of special education and related services. Furthermore, Head Start programs must depend on LEA SLPs for specific speech/language impairment criteria, case load priorities, and service delivery options. Because of the large number of children and families that receive services, Head Start decided to implement a vehicle to gather data on the quality and practices of its programs. Consequently, the Family and Child Experiences Survey (FACES) (U.S. Department of Health and Human Services, 2001) was developed to provide vital information about the characteristics, experiences, and outcomes of Head Start children.

Problems Related to Head Start Research

Historically, Head Start research in the area of speech/language skills has been minimal, and reporting of typical language skills has not been inclusive. For example, progress in language skills at Head Start has been documented by annual reports, earlier, using one receptive vocabulary development test (i.e., PPVT), and now additionally, using an expressive vocabulary test (i.e., The Expressive One-Word Picture Vocabulary Test; Brownell, 2000). This documentation process has only focused on a very small aspect of language (e.g., vocabulary). It needs to include a more comprehensive picture of children's overall speech and language skills (e.g., phonology, semantics, grammar, pragmatics, and speech intelligibility). In addition, most of their annual reports are not sufficient because they are not based on empirical research.

Recently, Hammer, Farkas, and Maczuga (2010) completed a study pertaining to speech and language skills at Head Start. The study investigated a variety of factors (e.g., speech and language skills) and evaluated the relationship of these factors to reading outcomes. More specifically, Hammer et al. (2010) used FACES 1997 (U.S. Department Health and Human Services, 2001) tracking data to investigate the impact of child and family characteristics, speech-language impairment, and the home literacy environment on the language and literacy outcomes of children from low-income backgrounds. Their variables included: (a) various child and family characteristics such as age, gender, and ethnicity, (b) parent report of speech-language impairment, (c) frequency of home literacy activities, and (d) children's scores on vocabulary, letter-word identification, and early reading assessments. Their results indicated that children's reading abilities in kindergarten were predicted by ethnicity, presence or absence of speech-language impairment, and home literacy environment, as well as children's vocabulary, and letter-word identification abilities in Head Start. They concluded that the home literacy

environment and the presence of appropriate speech-language skills in preschool are primary contributors to the development of children's early reading skills.

Therefore, Hammer et al. (2010) concluded that speech-language skills are a major variable in reading success; however, they used a parent report of speech impairment and did not evaluate the presence of these impairments. For example, parents were asked "Does your child have special needs?" and "How would you describe your child's special need or needs?" A study that evaluates typical speech/language development in the Head Start population rather than using parent report is needed.

Head Start's Speech/Language Research Needs

The lack of specific speech and language guidelines and implementation procedures for Head Start has been recognized for a long time (Madison & Hays, 1981), and this need has continued to the present day (U.S. Department of Health and Human Services, 2011a). To help Head Start support their mission of academic success for children who have come from economically disadvantaged homes and limited-literacy environments, speech/language data for typical children need to be gathered to gain a clearer picture of the specific needs of this population.

Presently, the data concerning speech/language skills of Head Start children are generally lacking. Because information is not currently available, treatment at Head Start has been highly variable. Some current research information has been obtained pertaining to how speech and language skills of Head Start children may be related to their reading outcomes, but the speech/language information was gained through parent report and not through acquisition of child data. Also, in addition to vocabulary skills, a more expansive information base of Head

Start children's speech/language skills is needed to gain a more complete picture of skill levels (e.g., speech sound skills, expressive grammar skills).

Statement of the Problem

Speech and language skills are the base upon which future academic skills develop (e.g., reading and spelling). Without this solid base of all the elements needed for effective communication (e.g., phonological development, receptive vocabulary, oral language, speech intelligibility), literacy skills are not likely to develop adequately. When all of these elements combine, the clarity of a message or the speech intelligibility of an utterance determines whether effective interaction occurs and whether a child can depend on these skills to help him or her develop an adequate future knowledge base. Given the limited scope of current Head Start research, an evaluation of Head Start children's communication skills needs to be completed so that specific gaps can be identified. Attainment of effective speech-language development provides the foundation for future academic growth.

Purpose of the Study

The purpose of this study is to evaluate Head Start children's speech and language skills including: (a) speech productions during an object-naming task, (b) intelligibility in connected-speech samples, (c) mean length of utterances, (d) percentages of consonants correct, and (e) receptive vocabulary. This comprehensive assessment of Head Start children's speech/language skills may identify areas of need for supporting academic and literacy success. The performance variables in question one were chosen for investigation because they are all essential speech and language variables that are foundational to communicative/academic success. The percentage of intelligible word levels for different age groups and different genders was investigated in question two because the information may yield more specific details about where intelligibility

needs exist. The last question was investigated to specifically identify the factors that contribute the most to the intelligibility of Head Start children's speech.

Research Questions:

- 1) What are the ranges, means, and standard deviations for the following?
 - Intelligibility (PIW)
 - Phonological Deviations (TOMPD)
 - Receptive Vocabulary (PPVT-4)
 - Mean Length of Utterances (MLU)
 - Percentages of Consonants Correct (PCC)
- 2) Are PIW differences significant among the following groups?
 - a) 3-, 4-, and 5-year-old children
 - b) Boys vs. Girls
- 3) Which of the following variables account for significant variance in predicting the percentage of intelligible words in connected-speech samples?
 - a) Total Occurrences of Major Phonological Deviations
 - b) Percentages of Consonants Correct
 - c) Mean Length of Utterances
 - d) Receptive Vocabulary
 - e) Age
 - f) Gender

CHAPTER III

METHOD

This study was designed to evaluate speech and language abilities of Head Start preschool children. The primary purpose was to determine communication characteristics of typically developing Head Start children. The second purpose was to determine whether differences exist between genders and across three age groups. The third purpose was to determine which variables significantly predict the intelligibility of conversational speech of Head Start children.

The criterion measure that was used in this study was the percentage of intelligible words (PIW) in connected-speech (CS) samples. Additional performance variables included single-word severity measures, receptive vocabulary, and mean length of utterance measures of language. The six potential predictor variables included: (a) Total Occurrences of Major Phonological Deviations from the Hodson Assessment of Phonological Patterns -Third Edition (HAPP-3) (Hodson, 2004), (b) Percentage of Consonants Correct (Shriberg & Kwiatkowski, 1982), (c) Peabody Picture Vocabulary Test - Fourth Edition (Dunn, L. & Dunn, D., 2007), (d) Mean Length of Utterance (Brown, 1973), (e) age, and (f) gender.

Participants

Sixty-two children began the assessment procedures. Four children did not complete the entire battery of assessments. One child was excluded because her speech was highly unintelligible. Fifty-seven African-American preschool children between the ages of 3;8 (years; months) and 5;7, who were enrolled in Head Start, participated in and completed this investigation. Head Start staff came from a diversity of cultural backgrounds. Information about the study was distributed to caregivers by Head Start staff in order to obtain informed consent

(See Appendix A). In addition, caregivers were given questionnaires to provide information regarding the children's speech, language, and hearing histories (See Appendix B). Criteria for inclusion were: (a) monolingual English-speaking homes, (b) no known organic anomalies related to speech and hearing mechanisms, and (c) passing a pure-tone audiometric screening procedure (500, 1000, 2000, 4000 Hz based on Head Start records).

In order to analyze age and gender group differences, the children were divided into three groupings by age (3;8-3;11; 4;0-4;11; 5;0-5;7). Twenty-eight of the 57 children were boys, and 29 were girls. The specific numbers for each age and gender groupings of the Head Start children were: four, 3-year-old boys; thirteen, 4-year-old boys; eleven, 5-year-old boys; a Total of 28; seven, 3-year-old girls; sixteen, 4-year-old girls; and six, 5-year-old girls; a Total of 29.

Procedures

Parent/caregiver reports and investigator observations were used to identify any recruits who had apparent neurological, motor, or physical impairments that may have affected speech productions. No children were identified with these difficulties. The testing for each child took place over two different sessions or approximately 30 minutes per child.

Noise Considerations

Noise levels in the testing rooms were checked using a Quest Technologies Model 2700 Impulse Sound Level Meter coupled to a 1/2-inch field mike and to a Quest Technologies 0B-300 ½ octave filter set. Deliyski, Evans, and Shaw (2005) reported that reliable speech recording results can be obtained if a SNR is below 42 dB. The average signal-to-noise (SNR) ratio in the storage area was less than 42db the majority of the time although occasional peaks occurred up to 52db. The SNR ratios in the nurse's and the administrator's offices also averaged below 42db with only occasional SNR up to 48db. If a noise did occur at the same time that a child named an

object, the child was asked to repeat the word. In addition, placement of a microphone affects the intensity of a recorded signal and the SNR ratio (Svec & Granqvist, 2010). Therefore, the investigator and speaker were seated at a cloth-covered table (to reduce reverberation noise) with the microphone placed on a stand approximately 30 cm from the child's mouth. Digital audio recordings were made of each speaker's single-word and CS samples. A Marantz PM660 Professional Digital Recorder and a Shure PG81 condenser microphone were used for recording speech samples.

Vocabulary Assessments

The vocabulary assessments were completed using the PPVT-4 (Dunn, L. & Dunn, D., 2007). This norm-referenced instrument, which is designed to assess a child's understanding of single-word vocabulary items, was administered individually. It consisted of a colored easel test with four vocabulary pictures on each page. It was administered according to the test manual by a Communication Sciences and Disorders (CSD) graduate student who completed training in giving the test. Children pointed to one of four pictures in response to hearing the examiner name a word.

The reliability and validity of the PPVT-4 is extensive. This assessment was normed in the United States on 28 different age groups from 2;6 to 81+ and for 13 grade groups by grade and semester from kindergarten through 12th grade. Split-half reliability and coefficient alpha for two forms were calculated for each of these groupings. Split-half reliability coefficients across ages ranged from .91 to .97 with a mean of .94 across both forms. Coefficient alpha across ages ranged from .93 to .98 with a mean of .97 for Form A (which was used in the present study). Split-half reliability coefficients across grade levels and semesters ranged from .87 to .97, with a

mean of .94 across forms. Coefficient alpha across grade levels and semesters ranged from .92 to .98 with means of .97 and .96 for Form A and B respectively.

In addition, construct validity is supported by correlations with other tests. The correlation of the PPVT-4 with the earlier 3rd edition ranged from .81 to .91, with a median of .84. The correlation of the PPVT-4 with the Expressive Vocabulary Test- Second Edition (Williams, 2007) ranged from .80 to .84 with a mean of .82.

Vocabulary skills are an important component of language that is tied closely to motor, social, and cognitive development. An assessment that examines vocabulary skills of children is an important variable because it helps indicate the approximate receptive language levels of children.

Speech Sample Assessments

Single-word speech samples and CS samples were obtained. Reliability of the speech assessments will follow the descriptions and procedures. The single-word speech samples were based on object-naming productions from the HAPP-3 (Hodson, 2004). The CS samples were obtained while children manipulated and talked about objects.

The HAPP-3 was administered by the investigator, a doctoral student in CSD, who has had previous experience using this instrument. Omissions and consonant category deficiencies, as well as substitutions, were analyzed. HAPP-3 productions were transcribed online by the examiner and recorded digitally for inter-judge reliability. In addition, digital segments were reviewed to obtain consensus when discrepancies between transcribers occurred, before analyzing deviations.

Normative data for the HAPP-3 were obtained for 886 children residing in 22 states and the District of Columbia. The sample's characteristics (i.e., geographic area, race) are representative of the national elementary-age population.

Two types of internal consistency reliability were reported. The reliability of the 50 coefficient alphas for the 50 stimulus words ranged from .95 to .97 across all ages (3 to 7 years), with an average coefficient of .96. The coefficient alpha for the 11 patterns of Phonological Deviations ranged from .87 to .99 across all ages with an average coefficient of .95. In addition, the correlation coefficient for test-retest reliability was .99, and the inter-scoring reliability coefficient was .98.

Two types of validity were reported: content-description validity and construct-identification validity. Three examples of content-description validity included: first, rationales for the formats, items of the screening tests, and Comprehensive Phonological Evaluations; second, item analysis procedures; and third, differential item functioning analysis to show absence of bias. The coefficients for item discrimination ranged from .47 to .68. The differential item functioning analysis indicated that any potentially biased items represented less than 1% of the test items on the HAPP-3. Construct-identification validity demonstrated the relationship of age differentiation to test performance ($r = .41$), and group differentiation was demonstrated by standard ability scores from 75 to 98.

Because the HAPP-3 assesses the phonological deviation patterns of a child's speech, it identifies the number and types of speech errors that a child produces. The Total of Major Phonological Deviations (TOMPD) score evidences these errors and is an important predictor variable. It indicates the current functioning of Head Start children's speech sound production skills.

To obtain the CS samples, each child and the examiner played with a set of 36 objects selected to sample productions of representative consonant singletons and clusters. These objects were selected from a list of developmentally appropriate words from Paul (1995) and Fenson, Dale, Reznick, Thal, Bates, and Hartung (1993). The examiner showed a participant one object at a time and commented about the object (e.g., “*Look at this*” or “*It’s a silly snake*”). If the child did not spontaneously respond to items, the examiner asked questions (e.g., “*I wonder what the girl is doing?*”). The percentages of intelligible words were obtained from 100-word CS samples (Casby, 2011).

Calculations from Single-word Speech Samples

The research assistant, a graduate student experienced in phonetic transcription, independently transcribed all of the phonological deviations for each child from the digital recordings. These transcriptions were compared to the examiner’s live transcriptions to obtain inter-judge reliability. Whenever discrepancies occurred between the examiner and the assistant; those digital segments were replayed until consensus was reached. After agreement was obtained, scores for Omissions, Consonant Category Deficiencies, and TOMPD were calculated by using the Hodson Computerized Analysis of Phonological Patterns (Hodson, 2003).

The Percentage of Consonants Correct (PCC; Shriberg & Kwiatkowski, 1982) was calculated from HAPP-3 single-word speech samples. First, the number of consonant targets was obtained for each sample; then, the total number of consonants produced correctly by each child was tallied. This total number of correct consonants was divided by the total consonants in the sample to obtain the PCC for each child. A graduate Communication Sciences and Disorders student experienced in PCC analysis completed the calculations.

Reliability and item-level analyses were obtained for the four data sets in Shriberg and Kwiatkowski's investigation: the PCC, the Severity of Involvement ratings, the Percentage of Intelligible Words, and Suprasegmental ratings. All measures were taken together and analyzed via correlation, partial correlation, and multiple correlation models to identify significant components of variance for severity of involvement.

For the PCC measure, intrajudge reliability was completed by rescoreing all 30 tapes 5 weeks after the original scoring. The Pearson correlation coefficient between ratings was .97. Average differences in percentages for each child were 2.1 percentage points, with a standard deviation of 1.73 and a range of no difference to differences of five percentage points. Only a PCC analysis was completed in the present study.

The PCC identifies the number of consonants that a child produces correctly and assigns a level of severity of involvement. It is a commonly used severity measure. This assessment is an important predictor variable for indicating the percentage of children's correct consonant productions in a sample.

Calculations from Connected-Speech Samples

The MLU (Brown, 1973) was calculated from each of the CS samples. First, the morphemes in each individual utterance were determined. Next, the total morphemes for each utterance were added together for the entire sample. This total morpheme score was divided by the total number of utterances within each sample to obtain each participant's MLU.

The language component of grammar or structural development can be identified by looking at the number and type of grammatical morphemes in children's expressive language. The MLU procedure is an important predictor variable because it indicates the current developmental stages of children's expressive language development.

Listeners

Three speech-language pathology graduate students in the Wichita State University Communication Sciences and Disorders department, who had completed some coursework in Phonetics, participated as the unfamiliar listeners. All three students passed a 20db audiometric screening at the frequencies 250 Hz through 8000 Hz (ANSI, 1997). They listened to the samples at the same time. The digital recordings were presented via individual headphones so that background noise was kept to a minimum. Materials used to obtain the CS samples were shown to the listeners prior to the listening task to familiarize them with the context of the testing.

The 57 digitally recorded 100-word CS samples were recorded as individual data files and were presented in random order over a one-day period. Each listener independently wrote words that were understood. The intelligibility percentage scores were calculated by dividing the total number of words identified by each listener by the total number of words actually spoken by the child. The overall intelligibility score for each child was obtained by calculating the average of the scores from the three listeners.

Types of reliability that were completed will be described below; however, the results will be provided in Chapter IV. The results will include: (a) inter-judge reliability for phonetic transcription, (b) inter-judge reliability for connected-speech samples, and (c) intra-judge reliability for connected-speech samples.

Inter-judge Reliability: Phonetic Transcription

The examiner and the research assistant completed independent phonetic transcriptions for the HAPP-3 productions. A point-by-point agreement index was calculated to compare their transcription results.

Inter-judge Reliability: Connected-Speech Samples

The PIW coding for the three listeners was examined for reliability. Pearson correlation was used to determine the listeners' consistency (inter-judge reliability). Coefficients were obtained.

Intra-judge Reliability: Connected-Speech Samples

Ten of the 57 samples were selected randomly and repeated at the end. These additional 10 samples were used for evaluating intra-judge reliability for each of the three listeners. The students listened to 67 CS samples without knowing that 10 samples were repeated. Pearson correlation was used to determine intra-judge reliability for the three listeners.

Data Analysis

All statistical analyses were performed using IBM SPSS Statistics 20 – Gradpak. Ranges, means, and standard deviations were obtained for PIW, TOMPD, PCC, MLU, and PPVT.

Stepwise regression analysis was used to determine which variables accounted for significant variance. The regression analysis involved entering all combinations of the predictor variables, with one predictor being entered at a time.

CHAPTER IV

RESULTS

The purpose of this investigation was to evaluate speech and language abilities of typically developing preschool children attending Head Start. Three questions were addressed in these analyses. First, what are the communication characteristics of typically developing Head Start children? Second, are there differences in intelligibility between genders (i.e., boys vs. girls) and among different age groups (i.e., 3-, 4-, and 5-year-olds)? Third, which variables (phonological deviations, percentage of consonants correct, mean length of utterances, receptive vocabulary, age, gender) predict percentages of intelligible words in connected-speech samples?

Reliability of Coding

To obtain inter-judge reliability for phonetic transcription a point-by-point agreement index was calculated. $A / (A + D)$ (number of consonants where there were initial disagreements) times 100 = percent of agreement. The reliability between the examiner and the research assistant was 95%.

Coding for the three listeners was also examined for reliability. To analyze the consistency among listeners (inter-judge reliability) and within listeners (intra-judge reliability), the Pearson correlation was used. Coefficients among the three listeners ranged from .87 to .93. The Pearson correlation coefficients for individual listeners (i.e., intra-judge) were: Listener 1 = .97; Listener 2 = .98; and Listener 3 = .86.

Performance Variables

Descriptive statistics for all variables are shown in Table 2, and averages per age group are shown in Table 3. A substantial range was present in all variables as noted in the standard deviations and ranges of the data. Raw scores were reported for the receptive vocabulary variable

rather than standard scores so individual differences would not be “masked.” Standard scores do not illustrate the actual increases in raw scores as children get older.

Table 2 *Means, Standard Deviations, and Ranges for Performance Variables (N=57)*

Measure	Mean	SD	Range
Percentage of Intelligible Words	82.31	10.80	53 - 98
Phonological Deviations	21.07	21.54	0 - 93
Percentage of Consonants Correct	80.68	14.90	36 - 99
Mean Length of Utterance	4.92	1.17	2.89 – 9.36
Receptive Vocabulary	63.35	21.86	28 - 121
Age	55.35	7.19	44 - 70

Note. Percentage of Intelligible Words (PIW) = the mean of words understood by 3 listeners for all participants; Phonological Deviations (TOMPD) = the phonological deviations score mean; Percentage of Consonants Correct (PCC) = the mean of consonants produced correctly; Mean Length of Utterance (MLU) = the mean length of morphemes per utterance; Receptive Vocabulary (PPVT) = the raw receptive vocabulary score mean; Age = the age mean in months.

Table 3 *Head Start Children’s Means Per Age Group*

Assessment	3 years (N=11)	4 years (N=29)	5 years (N=17)
PIW	75%	84%	84%
TOMPD	40	18	13
PCC	68%	82%	86%
MLU	4.34	5.01	5.15
PPVT	48	60	82

Demographic Variables

The second research question was: are there differences between genders (i.e., boys vs. girls) and among three age groups for percentages of intelligible words? Participants were divided into three age groups (3;8-3;11; 4;0 – 4;11; 5;0 – 5;7). A 2 (gender) x 3 (age groups) analysis of variance (ANOVA) indicated that differences between boys and girls and between age groups were not significant, nor was interaction significant (see Table 4 and Table 5).

Table 4 *Percentage of Intelligible Words for Gender*

Age Group	Boys			Girls		
	<i>n</i>	Mean	SD	<i>n</i>	Mean	SD
3;8 – 3;11	4	73.25	15.63	7	76.57	13.28
4;0 – 4;11	12	80.42	12.33	16	86.94	6.76
5;0 – 5;7	12	83.92	9.70	6	83.33	8.62

Table 5 *Percentage of Intelligible Words for Age Group*

Age Group	<i>n</i>	Mean	SD
3;8 - 3;11	11	74.91	14.45
4;0 - 4;11	28	83.68	9.54
5;0 - 5;7	18	83.62	9.16

Predictor Variables and Intelligibility

The third research question was: Which variables predict identification of intelligible words in connected-speech samples by unfamiliar listeners? A stepwise multiple regression analysis was used. Two variables predicted percentage of intelligible words in the following order: (1) percentage of consonants correct and (2) mean length of utterances. Percentage of

consonants correct entered first, accounting for 40% of the variance: $F(1,55) = 36.56$, $p < .001$; $b = .46$, $R^2 = .40$. Mean length of utterances entered second, accounting for an additional 13% of the variance: $F(1,54) = 14.41$, $p < .001$; $b = 3.64$, $R^2 = .13$. These two measures accounted for 53% of the variance for the criterion variable, percentage of intelligible words (see Table 6).

Table 6 *Stepwise Regression Analysis Results for Significant Predictors of Intelligible Words*

Variable	R^2 Change	b Weight	F	p
Percentage of Consonants Correct	.40	.46	36.56	.00
Mean Length of Utterance	.13	3.64	14.41	.00

All zero-order correlations were significant at .05 except gender (see Table 7).

Table 7 *Correlation Matrix for All Variables*

	1	2	3	4	5	6
1. Percentage of Intelligible Words	--	-.57	.63	.60	.46	.26
2. Total Occurrences of Major Phonological Deviations		--	-.94	-.45	-.38	-.43
3. Percentage of Consonants Correct			--	.44	.44	.45
4. Mean Length of Utterance				--	.52	.24
5. Receptive Vocabulary					--	.48
6. Age						--

The results from Chapter IV will be summarized and discussed in Chapter V. Also, the meaning of these data will be interpreted, and future research investigations will be suggested.

CHAPTER V

SUMMARY AND DISCUSSION

This investigation was designed to evaluate speech and language abilities of Head Start preschool children. The findings are summarized and discussed in this chapter. In addition, possible implications, limitations of the study, and future research needs are addressed.

Summary of Study

The primary purpose of this investigation was to determine the communication characteristics of typically developing Head Start children's speech-language skills. A second purpose was to determine whether there were differences between genders and across age groups. The third purpose was to determine which variables (phonological deviations, percentage of consonants correct, vocabulary, mean length of utterance, age, gender) significantly predict the intelligibility of Head Start children's conversational speech.

Fifty-seven African-American preschoolers between the ages of 3;8 (years; months) and 5;7, who were enrolled in Head Start, participated in this investigation. The children were divided into three age groupings (3;8-3;11; 4;0-4;11; 5;0-5;7). Of the 57 children, 28 were boys and 29 were girls. Testing for each child took place over a period of two different sessions during the spring of the year.

Single-word speech samples and continuous-speech (CS) samples were obtained in an empty Head Start room. All assessments were administered individually. The single-word speech samples were based on object-naming productions and pictures from the HAPP-3 (Hodson, 2004). The CS samples were obtained while children manipulated and talked about these objects. Digital audio recordings were made of each speaker's single-word and CS samples. Phonological deviation scores were obtained from the HAPP-3 assessment data, and portions of the digital audio recordings of the CS samples were used to obtain the PIW. Three unfamiliar listeners

wrote down all the words that they understood from the samples, and PIW were calculated. PCC scores (Shriberg & Kwiatkowski, 1982) were calculated from the HAPP-3 productions, and MLU scores (Brown, 1973) were calculated from the same portions of the audio recording samples that were used for calculating the PIW scores. The PPVT-4 (Dunn & Dunn, 2007) was used to provide receptive vocabulary scores.

Summary of Results

The first question pertained to evaluating communication characteristics of typically developing Head Start children's speech-language skills. Means, standard deviations, and ranges were obtained for Head Start children's speech-language skills.

The communicative characteristics of Head Start children in this study had considerable variability in all areas that were assessed. Means for the three age groups and overall are provided below.

Percentage of Intelligible Words (PIW). Age group means were 75% for 3-year-olds, 84% for 4-year-olds and also for the 5-year-olds. The overall PIW mean was 82%. The 3-year-old PIW (75%) matched the intelligibility level suggested by Coplan and Gleason (1988). The 4- and 5-year-old children's intelligibility levels of 84% were lower than expected. At age 4 years, Gordon-Brannan and Hodson (2000) reported a 93% intelligibility mean, Coplan and Gleason (1988) reported a 100% from parent reports, and Flipsen (2006) reported 96% intelligibility from transcriber analyses. At age 5 years, Flipsen reported a 98% intelligibility level. This intelligibility percentage "plateau," which is not consistent with other research findings, may indicate a "slowing" of speech/language and intelligibility gains as Head Start children become older.

Percentage of Consonants Correct (PCC). The PCC age group mean for the 3-year olds was 68%, for the 4-year-olds, it was 82%, and for the 5-year-olds, 86%. The PCC overall mean (80%) was within the “mild-moderate” (65-85%) range (see Shriberg & Kwiatkowski, 1982), with an overall range of “Mild” (85-100%) to “Severe” (less than 50%). The number of consonants produced correctly increased as children became older which would be expected. According to Shriberg and Kwiatkowski (1982), the PCC indicated at least a “Mild” number of incorrect consonants in every age group level.

Total Occurrences of Major Phonological Deviations (TOMPD). The TOMPD age group mean for 3-year olds was 40, 18 for the 4-year olds, and 13 for the 5-year olds. The TOMPD overall mean (21.07) was within a Severity Rating of “Mild,” with a range from no deviations to “moderate” deviations (see Hodson, 2004). The largest numbers of errors occurred for Consonant Sequences/Cluster Reductions and for Liquid and Strident Deficiencies. Two of the three phonological deviation categories (e.g., Consonant Sequences/Cluster Reductions, Strident Deficiencies) were consistent with deviation categories produced by unintelligible preschoolers and one phonological deviation category (e.g., Liquids) was typical of both unintelligible and typical preschoolers (Hodson & Paden, 1981).

Mean Length of Utterances (MLU). The MLU for 3-year-olds (4.34) was equivalent to Brown’s stage V (41-46 months; MLU of 3.75-4.5); the MLU for 4-year olds (5.01) was slightly above Brown’s stage V (41-46 months; 3.75-4.5), and the 5-year-old’s MLU (5.15) was just above Brown’s stage V (41-46 months; 3.75-4.5). The MLU overall mean (4.92) was above Language Development Stage V (3.75-4.5; 41-46 months) (Brown, 1973), with a range of Stage III (2.5-3.0; 31-34 months) to above Stage V. Increases in MLU per age group slowed down as children became older.

Peabody Picture Vocabulary Test-4 (PPVT). The PPVT average standard score for the 3-year olds was 92, 90 for the 4-year-olds, and 94 for the 5-year olds. The overall raw score mean of 63 was equivalent to a standard score of 98 at age 4 years. The range of receptive vocabulary scores was 28 to 121(equivalent to standard scores of 67 to 124). Standard scores for children in the three age groups were within an average range.

There was substantial variability for all of the assessments. Further inspection of specific age group information identified several aspects of performances by Head Start children that are of some concern. In particular, the performances of the 5-year-old children in this study who would soon be entering kindergarten were below expectations for percentages of intelligible words, percentages of consonants correct, and mean length of utterances.

A 2 x 3 analysis of variance was used to determine if differences between genders and among age groups were significant for the criterion variable, percentage of intelligible words. Differences between boys and girls, and also among the three age groups, were not significant. Other investigators have reported nonsignificant differences for gender (Cairns & Williams, 1972; Hodson & Paden, 1978), but generally age differences have been significant (Weiss, 1982; Flipsen, 2006).

Results of stepwise multiple regression analyses indicated that the predictor variable accounting for the largest amount of variance for percentages of intelligible words was PCC (40%), followed by the variable MLU (13%). The number of consonantal errors and morphological utterance length were the greatest predictors of intelligibility in this study. In addition, it is important to note that all of the variables in this study except gender were significantly correlated with intelligible words except gender.

The MLUs of the individual age groups were associated with specific developmental language stages (Brown, 1973). As already mentioned, the 3-year-old's MLU (4.34) was equivalent to Brown's stage V (41-46 months, MLU of 3.75-4.5), the 4-year-old's MLU (5.01) was slightly above Brown's stage V (41-46 months; 3.75-4.5), and the 5-year-old's MLU (5.15) was slightly above Brown's stage V (41-46 months; 3.75-4.5). The developmental language stages of the three age groups differed in regards to chronological age results. Most of the individual MLUs and associated language stages for the 3-year olds were at or above their chronological age level stages; however, more of the individual 4- and 5-year-old children received MLUs with associated developmental language stages below what would be expected for their chronological age levels. Ten of the 4-year olds had MLUs below expectations, at stage V or below; chronologically, they should be higher. Nine of the 5-year-olds had MLUs near Stage V or below, when, chronologically, the children's ages were as much as 21 months above Stage V. Only three 5-year olds had MLUs above 6.0 (complex sentences are expected by this age level). This finding may indicate a slowing of sentence length and complexity development as some Head Start children become older.

Discussion

Historically, Head Start children's speech-language needs have not been investigated adequately. Speech-language skills are the foundation for intelligible, effective communication with others and for future academic success (Colorado Department of Education, 2010). Although the Federal government has funded the national preschool program of Head Start for over four decades to promote school readiness, the data that are available to identify typical speech and language skills are limited to vocabulary skills (U.S. Department of Health and Human Services, 2011a).

Recently, Head Start added an expressive vocabulary test (i.e., Expressive One-Word Picture Vocabulary Test; Brownell, 2000) to assess overall expressive language skills. FACES reported that the children who entered Head Start in the fall of 2009 obtained an overall expressive vocabulary score of 81.6 (U.S. Department of Health and Human Services, 2011a). This score is more than one standard deviation below the normative mean of 100. This report of reduced expressive vocabulary skills in low-income homes is consistent with the research by Hart and Risley (1995). It is important because SLPs who serve the Head Start population need to be aware that, according to national reports by U.S. Department of Health and Human Services, most Head Start children do have reduced expressive vocabularies and past research has supported the notion that reduced expressive language skills negatively affects reading skills. A solid foundation in oral language is needed for adequate reading skills to develop (Paulson, Kelly, Jepson, & van der Pol, 2004; Snow, Burns, & Griffin, 1998; Torgesen, 2005). This report is consistent with the notion that reading skills are at risk in the Head Start population. SLPs might use this information to consider building vocabulary and expressive language support into their speech/language programming; it may help support Head Start children's academic success.

Because effective speech-language skills are needed for successful communicative and academic success, further investigations of variables that may be related to intelligibility and overall speech-language skills are essential to help support Head Start children's success. Speech and language skills are foundational to literacy skill development, and appropriate literacy skills are the tools needed for academic and professional success. Results from this study (e.g., possible plateau of intelligibility, slowing of language development) and Head Start reports (e.g., below average receptive and expressive vocabulary) need to be considered when investigating possible Head Start support. SLPs who serve Head Start children need inclusive information

about Head Start children's specific needs in order to make informed decisions, and, if indicated, to provide optimal effective intervention. More specifically, information gained from speech/language intelligibility studies might be used to: (a) more clearly define Head Start speech and language criteria for eligibility considerations, (b) design effective speech/language program structures, and (c) provide valuable information about Head Start curriculum needs to better support academic success.

Communication Effectiveness

All children combine and integrate the components of phonology, semantics, grammar, and pragmatics along with other associated factors (i.e., rate of speech, intonation, dialect) when communicating with others. The effectiveness or speech intelligibility of their communicative exchanges is determined by the adequacy and coordination of these skills. In this study, all of the performance variables except gender (i.e., percentage of intelligible words, phonological deviations, percentage of consonants correct, mean length of utterance, receptive vocabulary, and age) were significantly correlated with speech intelligibility. The finding from this study indicated that the intelligibility of Head Start children's speech was related to several factors. All of these factors are important to consider when investigating intelligibility difficulties and when considering appropriate interventions. Also, the possible plateau in intelligibility development of the Head Start children needs further study. A plateau of intelligibility may indicate a slowing of Head Start speech/language/intelligibility skills.

Speech sound production skills, an important component of intelligibility, varied considerably among the Head Start children in this study. The individual consonants produced correctly varied from very few errors to a number of errors, and phonological deviations varied from no deviations to a moderate number of deviations. In Table 4.1, the descriptive statistics for

Phonological Deviations were: an average mean of 21.07, an average standard deviation of 21.54, and a range of 0 to 93. The high standard deviation number is indicative of the great individual variability in the children's deviation scores in this study.

The regression analysis indicated that the largest predictor of intelligibility of Head Start children's speech was PCC; although all of the variables in this study (except gender) were significantly associated with intelligibility. The PCC measure, which weights all errors such as omissions and substitutions equally, is dependent upon the number of errors rather than types. This study indicated that the number of consonantal errors best predicted the children's speech intelligibility.

The types of specific error patterns in a child's speech also contribute to intelligibility (Hodson, 2010). It is not surprising, therefore, that phonological deviations were significantly correlated with intelligibility. Alternatively, however, these assessments are designed to diagnose and obtain information from children with highly unintelligible speech rather than typically developing speech. Errors such as omissions are weighted more heavily in this assessment (HAPP-3; Hodson, 2004). The highest phonological deviation categories for all three age groups were: Consonant Sequences/Cluster reductions, Liquid deficiencies, and Strident deficiencies. Interestingly, Hodson and Paden (1981) reported that phonological deviations typical of unintelligible children include cluster reduction, liquid deviations, and stridency deletion. They also reported, however, that phonological deviations of typically developing children also include liquid deviations. This finding may indicate that these Head Start children have some phonological deviation patterns that are more commonly seen in unintelligible children.

Semantic knowledge is another important variable that supports the ability to be understood by others (Weston & Shriberg, 1992). The use of specific vocabulary can improve a

listener's understanding of an intended message or reduces it if the vocabulary is too vague. The Head Start children in this study demonstrated considerable individual differences in vocabulary skill levels (i.e., standard scores of 67-124), although, the standard scores of all three age groups (92, 90, 94) were within the average range. The vocabulary scores for this study are higher than the national overall level of 87.2 reported by Head Start (U.S. Department of Health and Human Services, 2011a).

Brown's (1973) MLU provides valuable information not only about the length and grammatical complexity of utterances, but about intelligibility as well. In this study, Head Start children's MLUs predicted an additional 13% of the percentages of intelligible words in their connected speech. These findings are consistent with numerous investigators who have linked suprasegmentals and syntactic structures to intelligibility (Shriberg & Kwiatkowski, 1982). The data obtained in this study indicated that individual Head Start children's connected speech varied from two-word utterances to complex sentences; however, as children became older, overall scores of some of the children in the older age groups did not improve as much as expected compared to the younger children. This finding may indicate a "slowing" of expressive language development, which, in turn, may also slow the development of intelligibility.

Intelligibility of the Head Start children also correlated with actual chronological ages. This correlation is consistent with a number of intelligibility investigations that have shown that there is a developmental progression for intelligibility (Weiss, 1982; Coplan & Gleason, 1988; Flipsen, 2006). Although percentages of intelligible words were significantly correlated with actual ages, differences for age groupings were not significant. This may indicate that although age is important to intelligibility, the overall trend in this study was a possible plateau of intelligibility development.

Academic Success

As mentioned previously, children with speech intelligibility issues often have deficits in academic skills as well. More specifically, these children often have poorer literacy skills which are evidenced in their poorer reading skills. It is likely that these poor reading skills, along with limited language experiences, contribute to a limited semantic knowledge base and the reduced ability to express ideas. Consequently, the overall foundation of speech and language skills is compromised, and future academic success appears to be at greater risk.

Formal Head Start reports have used the measure of receptive vocabulary over the years to demonstrate changes in overall language growth, and now have added an expressive vocabulary measure. Head Start reported that children have improved their receptive vocabulary scores but they still have not caught up with their peers (U.S. Department of Health and Human Services, 2010a). More inclusive speech and language information (i.e., percentage of intelligible words, percentage of consonants correct, phonological skills, mean length of utterances) is needed to identify the specific speech and language skill levels of Head Start children. Identification of any speech and language deficits is important, not only to help support communicative effectiveness, but also for developing a solid base upon which literacy skills can grow. This study has identified some possible speech/language need areas for academic success (i.e., overall speech intelligibility, phonology, language development). Need areas have also been reported by Head Start (i.e., receptive and expressive vocabulary skills). Adequacy in all of these areas of communication is critical to build a solid foundation for reading success.

Implications

This investigation provided important information related to intelligibility and the speech/language skills of Head Start children. The findings of this study support the notion of the

complexity of speech intelligibility. The percentage of consonants correct and mean length of utterances accounted for the greatest variance in predicting speech intelligibility; however, all predictor variables (except gender) were significantly correlated with the understandability of speech. These results indicate that many factors need to be considered and identified when reporting intelligibility, (i.e., phonological patterns of speech, vocabulary levels, and ages).

The specific data from the receptive and expressive language components provided interesting information about the characteristics/growth of language for older age groups. With increasing age group levels, the receptive vocabulary differences in scores between children within each age group widened as children became older and the growth in developmental language levels slowed down. As discussed earlier, both vocabulary skills and oral language skills are critical to the development of literacy skills. These results suggest that language support is crucial, especially in the early years, for building an adequate foundation for literacy for children who struggle with inadequate language skills.

Because receptive vocabulary and expressive language are foundational skills for future academic learning, it is extremely critical to consider how to best support Head Start children's academic skills. Traditionally, many Head Start programs have used the model that children learn best through play and indirect learning without direct instruction. Head Start has recently revised their Head Start Child Outcomes Framework (renamed The Head Start Child Development and Early Learning Framework) in 2010, with the intention that the framework more clearly serves as a "beacon" to guide Head Start program implementation (U.S. Department of Health and Human Services, 2011b). Their goal is to increase "intentional" instruction and scaffold learning throughout the day in an integrated way without "compartmentalizing learning activities"; however, specific curricula are still left up to

individual Head Start centers, and program structures needed to implement intentional instruction changes have not been identified or described in their report. This information indicates that the implementation of a more direct and systematic approach to support receptive and expressive language skill development is needed in the Head Start setting.

Limitations of Study

One limitation of this study involves the listeners who were used. All three unfamiliar listeners who identified words in the connected-speech samples were Caucasian, whereas all the children in the study were African-American children. There are some typical speech/language differences between Standard American English (SAE) and African-American English (AAE) (Craig, Thompson, Washington, & Potter, 2003).

For example, there are some phonological differences between SAE and AAE. African-American children may have some specific phonetic differences (Stockman, 2008). They may include some post-vocalic consonant omissions, some syllable reductions, /t/ or /f/ for “th” sounds, omission of word final /l/ and /r/, omission of initial /w/, vowel lengthening, and vowel nasalization (Gordon-Brannan & Weiss, 2007). Some AAE phonological differences were evidenced on the HAPP-3 assessment (i.e., /f/ for “th” on the word *mouth* and omission of final /d/ on the word *slide*); however, it was noted on the record form that these were dialectal differences.

Children who use AAE also have many language differences. This study, however, did not examine specific grammar structures of the children’s utterances; rather, it examined morphemes and utterance lengths. The MLUs that were obtained may have been influenced by AAE differences (i.e., zero copula/auxiliaries; zero prepositions; Craig et al., 2003) because some of the language differences involve omission of some grammatical structures.

These phonological and language differences might also affect the intelligibility results. It is possible that African-American listeners would yield different intelligibility percentages. The 4- and 5-year-old children in this study had intelligibility levels of 84% which was below what would be expected according to the current developmental intelligibility data. It would be interesting to replicate this study, but use African-American listeners instead to determine if different intelligibility results would be obtained.

Another limitation of this study involves the time of year (spring semester) the investigation was conducted. Because of this fact, a limited number of 3-year olds were available late in the school year. It would be important to include more 3-year olds in a replication.

Future Research Needs

Effective intelligibility skills are the key for appropriate communication interactions and school readiness; however, few published studies have been completed on typical intelligibility of children. Normative data on the developmental expectations of intelligibility have been limited (Hustad, Schueler, Schultz, & DuHadway, 2012). These studies have not only been limited in number, but the methods for obtaining intelligibility information have varied greatly making comparisons difficult (i.e., parent interviews, Coplan & Gleason, 1988; analysis of children's speech, Gordon-Brannan & Hodson, 2000). Although there are many variables that affect intelligibility, and it is difficult to measure, intelligibility is still a valuable research tool for reporting valid changes in children's speech performances. Additional research is needed that investigates and reports intelligibility data so that investigators can gain important, ecologically valid, information for informed decision-making.

Treatment studies need to be conducted that fully integrate speech/language programs within Head Start curricula so that evidence can be obtained regarding the growth of children's

speech/language skills in an integrated program compared to a “pullout” program. Also, if positive changes in their speech/language skills are documented, future investigations are needed to compare Head Start children’s speech/language skills to their academic growth.

The data in this study indicate that Head Start children appear to have greater speech/language needs than the regular preschool population (e.g., intelligibility, expressive language). More specifically, the areas of concern included a possible slowing of intelligibility gains and also expressive language skills at the older age group levels. These areas are important to SLPs who serve Head Start children and to Head Start staff when considering typical speech/language skill levels, speech/language program development (e.g., age level treatment), and curriculum structure (i.e., individualized support systems vs. group instruction). More research is needed, however, to confirm these needs and to study possible developmental trends of slowing of skills.

Head Start also has reported need areas (i.e., receptive vocabulary, expressive vocabulary) which also supports the view that Head Start children’s speech/language skills are not adequate for literacy success. Research that defines these need areas more completely is needed to provide normative data for the Head Start population. As need areas are identified and defined and as more normative information is obtained, SLPs may be able to more effectively design intervention programs to help support and enhance the growth of school readiness skills in Head Start children.

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APPENDICES

APPENDIX A

Definitions

Academic Success – having to do with the use of literary skills for achievement in school

Articulation – the production of speech sounds

Expressive Language Impairment – characterized by language based errors

Expressive Phonological Impairment – characterized by phonologically based errors

Grammar – expressive language development

Head Start – a national preschool program developed to combat poverty and to promote literacy and school readiness in children through a variety of different services.

Limited Literacy Experiences – lack of access to academic resources

Literacy – includes listening, speaking, reading, and writing

Mean Length of Utterance – the number of meaningful units of language within a sentence

Percentage of Intelligible Words – the percentage of words that are understood by a listener

Percentage of Consonants Correct – a severity metric used to quantify the severity of a speech disorder which involves counting the number of consonants produced correctly in a particular connected-speech sample and dividing by the total number of intended consonants and multiplying by 100.

Performance Standards – the set of regulations that Head Start operates under.

Phonology – the study of the development of the sound system of a language

Phonological Deviations – speech sound production changes that differ from the standard

Pragmatics – the social use of language

Semantics – the study of meaning or receptive language

Severity – degree to which speech is deviant or disordered

Speech Intelligibility – the understandability of an intended message between a speaker and a listener

APPENDIX B

Parent Letter

Spring 2011

Dear Head Start Families,

Your Head Start location has been chosen to participate in a research study on speech and language development.

The study will be conducted by a student from the WSU Department of Communication Sciences and Disorders. All information will remain confidential.

Attached to this letter is a permission to participate in the study and a brief questionnaire for you to fill out. Head Start students will participate in a brief evaluation of speech sounds and language skills. This will take place at school.

You may contact me, Amber Willis, Mental Health/Disabilities Manager for Child Start Inc. at 682-1853, and I will be glad to answer any questions you may have.

Sincerely,

Amber R. Willis
Mental Health/Disabilities Manager
Child Start Inc.

APPENDIX C

Consent Form

WICHITA STATE UNIVERSITY Department of Communication Sciences and Disorders

Assessing Children's Productions of Speech Sounds and Patterns

PURPOSE: Your child is invited to participate in a study investigating children's speech sound productions. We hope to learn more about speech abilities of children in Head Start Centers. The study is being conducted by the Department of Communication Sciences and Disorders at Wichita State University.

PARTICIPANT SELECTION: Your child has been invited to be a participant in this study because he/she currently attends Head Start. It is anticipated that there will be 60 children in this study.

EXPLANATION OF PROCEDURES: If you decide to allow your child to participate, information about speech productions and receptive vocabulary will be obtained. Your child will be tested in one of the Head Start rooms using a digital audio-tape recorder. Objects and pictures will be used for completing tasks. Testing will last approximately 40 minutes.

DISCOMFORT/RISKS: There are no anticipated risks associated with participating in this study.

BENEFITS: Results of this study may be useful to help professionals design more effective methods for children who have speech disorders.

CONFIDENTIALITY: Results of your child's assessment will be available upon request. Records of the study will be kept locked in the university faculty member's office. If reports are presented at conferences or published, no names or identifying information will be used.

REFUSAL/WITHDRAWAL: Participation in this study is entirely voluntary. Your decision whether or not to allow your child to participate will not affect your current or future relations with Wichita State University or Head Start. If you agree to have your child participate, you may withdraw your child at any time without penalty.

COMPENSATION or TREATMENT: Wichita State University does not provide medical treatment or other forms of reimbursement to persons injured as a result of or in connection with participation in research activities conducted by Wichita State University or its faculty, staff, or

students. If you believe that your child has been injured as a result of participating in the research covered by the consent form, you can contact the WSU Office of Research Administration, Wichita, KS 67260-0067, (316) 978-3285.

CONTACT: If you have any questions about this research, you can contact: Dr. Barbara Hodson, Professor, 978-6342, Carol Ellis, Doctoral Student, Communication Sciences and Disorders, Wichita State University, 978-3240, or Head Start. If you have any questions pertaining to your child’s rights as a research participant, you can contact the WSU Office of Research Administration (316) 978-3285.

HEARING: We need to learn about hearing testing results obtained by Head Start staff. Signing below indicates that you have given permission for us to obtain information about your child’s hearing.

You are under no obligation to allow your child to participate in this study. Your signature indicates that you have read the information provided above and have voluntarily decided to allow your child to participate. You will be given a copy of this consent form to keep.

Signature of Parent or Legal Guardian

Date

Witness Signature

Date

APPENDIX D

Questionnaire

Speech-Language-Hearing Questionnaire

Child's Name: _____ Birthdate: _____

Parent (s)/Caregiver: _____

Relationship of person completing the questionnaire: _____

1. Please provide information about speech development:

When did your child say his/her first word? _____

What was the first word? _____

When did your child begin to put 2 words together? _____

Do family members have difficulty understanding your child's speech?

yes ___ no ___

Do people outside the family have difficulty understanding your child's speech?

yes ___ no ___

2. Has your child had a history of ear infections as indicated by the following:

complained of ear aches yes ___ no ___

had ear aches or infections yes ___ no ___

If so, how many times? _____

When was the last time? _____

had medical treatment for ear infections yes ___ no ___

If so, how many times? _____

When? _____

had ventilation tubes inserted yes ___ no ___

If so, when? _____

Are tubes currently in one or both ears? _____

3. Has your child ever received speech-language therapy services?

If so, how long? _____

4. Is there any other information about your child's speech, language, or

hearing that we should know? _____

Please return to Barbara Hodson and Carol Ellis, Wichita State University.

APPENDIX E

PPVT-4 Directions

Training

Establishing rapport with the child prior to testing is suggested. Begin with Training Item A1 (at the beginning of the **Testkit Form A**). Say: **I have some pictures to show you.** Point to each of the four pictures on the page, and say, **Look at the pictures on this page.** Say, **Put your finger on boy.**

If correct, Say, **Good! Let's try another one.** Say, **Put your finger on chair.** If the child responds correctly to Item A1 and A2 correctly without help, say: **Good!** Then proceed to Item 1 and begin testing.

If incorrect, say, **You may not be sure, but put your finger on the one you think is right.** If the child still responds incorrectly or doesn't respond, demonstrate the correct response by pointing to the boy and saying, **This is boy. Now try again. Put your finger on boy.** Help the child as needed until he/she responds correctly. Then say: **Good! Let's try another one. Put your finger on chair.**

If the child does not answer A1 and A2 training items correctly, then administer Training Items A3 and A4 (puppy and bike) in the same way, teaching as needed. If the child answers two out of the four training items correctly, go to Item 1 and begin testing.

Administration of test items

Once training is completed, and you are ready to test, say, **Now we'll do some more. You can point to the picture or say the number of, the picture that shows the meaning of the word.**

Begin testing with the start item, which is the first item in the appropriate set of test items that correlates with the child's chronological age. **Say: Put your finger on _____.** When the child understands the task, you may discontinue the prompts. You may say: **You are doing well** or other encouraging words, but do not give contingencies for responding. You may repeat a word if asked or if the child seems unsure of their answer. You may also encourage them to guess.

Scoring

Record the number of the vocabulary item that corresponds to the colored picture that the child points to. Write DK for don't know, NR for no response. Establish the basal and ceiling.

Basal and Ceiling

Basal is 1 or no errors in a Set. Go back to previous set if a child misses 2 or more in set. **Ceiling** is 8 or more errors in same Set. Complete a set even if you have reached 8 errors

APPENDIX F

HAPP-3 Directions

Before Testing

A child's utterances should be audio recorded with a high-quality recorder. An external microphone should be placed approximately 30 cms from the child's mouth. A terry cloth towel should be placed on the table to reduce the noise of the objects being handled on the hard table surface. When a child's utterances are highly unintelligible, the examiner is encouraged to name each object after the child's individual utterances. All materials should be organized and laid out before administration. For example, the objects and pictures that correspond to each of the 10 words in each column should be put in separate containers. (Except the objects in columns 4 and 5 may be put together due to a small number of objects.)

Administration

The child is seated comfortably with a corner of the table between the examiner and the child. The examiner says **"Here are some toys. I want you to choose a toy, say its name, and then place it on the bag."** The child chooses a toy (or picture according to his or her individual preference, then names it, and places it on top of the container (to be put away after completion of the evaluation session.)

If the child does not say the name of the object, the examiner names the object before asking the child to name it again.

If a child is young, the examiner should name all of the objects in the bag first and have the child point to each object as it is named. Then the child should be asked to name the objects.

When the child names an object but the response is not the desired word, the examiner should use prompts to elicit the target response. For example, one prompt would be **"Tell me another name for that."** (Other prompts for individual words are listed in the examiner's manual.)

Scoring

All 50 stimulus words are elicited and recorded onto the Transcriptions of Stimulus Words section of the Comprehensive Phonological Evaluation Record Form. The examiner transcribes the child's speech deviations as the child names the objects/pictures. The Transcriptions of Stimulus Words section is separated into numbered boxes for each of the stimulus words. If the word is correct, a "C" or a check mark is placed after the orthographic form of the word on the top of the box. Target transcriptions are provided. If the child produces errors, IPA symbols which represent those errors are recorded above the specific targeted sounds for those words.

APPENDIX G

Connected-Speech Sample Directions

Before Testing

Connected-Speech samples should be audio recorded with a high-quality recorder and an external microphone should be placed approximately 30cms from the child's mouth. A terry cloth towel should cover the table to reduce the noise from handling of the toys on a hard table surface. The connected speech samples are elicited by having each child and the examiner "play" with a set of 36 objects selected to sample productions of representative consonant singletons and clusters. The objects are selected from a list of developmentally appropriate words from Paul (1995) and Fenson, Dale, Reznick, Thal, Bates, and Hartung (1993).

Administration

The examiner shows a child one object at a time and comments about the object. For example, the examiner says, "**Look at this**" or "**It's a silly snake.**" If a child does not spontaneously respond to items, the examiner asks questions such as "**I wonder what the girl is doing?**"

Scoring

The percentages of intelligible words for each child are obtained from the 100-word Connected-Speech samples taken from a portion of these full samples.

Objects

- | | |
|-----------------------------|--|
| (1) /m/ mouse | (22) unvoiced /th/ bathtub, (23) tooth |
| (2) /n/ knife | (24) voiced /th/ mother |
| (3) /ng/ pudding | (25) /sh/ shoe |
| (4) /w/ watch | (26) /ch/ chicken |
| (5) /y/ yogurt | (27) /j/ jar |
| (6) /p/ puppy, (7) pillow | (28) /l/ lamb |
| (8) /b/ ball, (9) bed | (29) /r/ rock, (30) chair |
| (10) /t/ table | (31) /st/ stick |
| (11) /d/ duck | (32) /sp/ spoon |
| (12) /k/ cat | (33) /sn/ snake |
| (13) /g/ game, (14) gum | (34) /ks/ box |
| (15) /h/ house | (35) /tr/ tree |
| (16) /f/ fish | (36) /rl/ girl |
| (17) /v/ stove, (18) oven | |
| (19) /s/ soap | |
| (20) /z/ zipper, (21) zebra | |

APPENDIX H

Phonological Deviations of Head Start 3-Year Olds

Percentage Means for 3-year-olds (N=11)

Phonological Deviations	Deviation Percentage Means	Percentage Correct Means	SD
Segment Omissions			
Syllables	3	97	3.13
Consonant C*(C) s	30	70	26.72
Prevocalic Singletons	1	99	3.32
Intervocalic Singletons	1	99	2.83
Postvocalic Singletons	6	94	5.24
Consonant Category Deficiencies			
<u>Sonorants</u>			
Liquids	34	66	25.74
Nasals	3	97	6.10
Glides	21	79	20.71
<u>Obstruents</u>			
Stridents	23	77	21.64
Velars	11	89	10.44
Other NonStridents (e.g., Backing)	12	88	6.84

*C = Consonants(s)

Phonological Deviations of Head Start 4-Year Olds

Percentage Means for 4-year-olds (N=29)

Phonological Deviations	Deviation Percentage Means	Percentage Correct Means	SD
Segment Omissions			
Syllables	1	99	2.80
Consonant C*(C) s	12	88	12.32
Prevocalic Singletons	0	100	0.00
Intervocalic Singletons	0	100	1.80
Postvocalic Singletons	3	97	3.42
Consonant Category			
Deficiencies			
<u>Sonorants</u>			
Liquids	17	83	25.80
Nasals	2	98	4.16
Glides	9	91	9.90
<u>Obstruents</u>			
Stridents	10	90	16.68
Velars	6	94	7.11
Other NonStridents (e.g., Backing)	8	92	5.28

*C = Consonants(s)

Phonological Deviations of Head Start 5-Year Olds

Percentage Means for 5-year-olds (N=17)

Phonological Deviations	Deviation Percentage Means	Percentage Correct Means	SD
Segment Omissions			
Syllables	0	100	0.00
Consonant C*(C) s	11	89	11.76
Prevocalic Singletons	0	100	.97
Intervocalic Singletons	0	100	0.00
Postvocalic Singletons	1	99	1.87
Consonant Category			
Deficiencies			
<u>Sonorants</u>			
Liquids	8	92	14.67
Nasals	0	100	1.21
Glides	7	93	9.19
<u>Obstruents</u>			
Stridents	9	91	13.06
Velars	5	95	6.30
Other NonStridents (e.g., Backing)	7	93	4.18

*C = Consonants(s)

APPENDIX I

Raw Data

	gend	age	grup	piw	ppvt	mlu	pcc	tompd	mthb	yrofb	nw
1	2	44	1	82	71	5	94	4	7	2007	108
2	1	53	2	87	57	7	90	5	11	2006	102
3	2	65	3	80	90	4	96	2	10	2005	108
4	1	44	1	53	49	4	39	80	7	2007	120
5	2	52	2	95	72	6	97	4	11	2006	112
6	2	44	1	68	52	3	71	44	7	2007	118
7	2	59	2	84	51	4	78	30	8	2007	106
8	2	59	2	89	80	5	92	9	5	2006	110
9	1	57	2	96	66	7	88	11	7	2006	108
10	1	45	1	73	35	4	80	23	6	2007	104
11	2	44	1	91	48	7	76	32	7	2007	117
12	2	67	3	69	58	4	88	15	9	2005	128
13	1	64	3	96	121	9	99	2	11	2005	117
14	2	58	2	89	67	5	95	2	5	2006	106
15	1	62	3	76	41	5	62	51	1	2006	119
16	1	62	3	72	66	4	81	26	1	2006	119
17	1	62	3	87	47	4	87	8	6	2006	116
18	1	62	3	80	100	7	89	8	1	2006	118
19	2	54	2	93	66	6	91	9	10	2006	109
20	2	54	2	98	87	7	96	0	10	2006	117
21	1	53	2	89	38	4	81	17	10	2006	111
22	2	70	3	94	73	4	87	16	2	2006	114
23	2	52	2	81	53	6	82	20	12	2006	117
24	1	49	2	67	62	3	41	85	2	2007	112
25	2	48	2	85	35	3	84	20	3	2007	111
26	1	49	2	94	56	5	90	8	3	2007	117
27	2	46	1	85	72	5	73	25	5	2007	109
28	2	56	2	90	64	5	90	8	7	2006	118
29	1	61	3	96	104	5	95	0	3	2006	112
30	1	60	3	84	75	5	93	5	4	2006	112
31	2	58	2	75	87	5	86	16	5	2006	111
32	2	44	1	71	28	3	36	93	8	2007	110
33	2	48	2	81	63	4	84	23	4	2007	108

	gend	age	grup	piw	ppvt	mlu	pcc	tomprd	mthb	yrofb	nw
34	1	44	1	91	45	5	86	14	8	2007	109
35	2	59	2	93	93	5	94	2	5	2006	110
36	2	56	2	93	80	7	92	1	8	2006	109
37	2	47	1	86	57	5	64	64	5	2007	115
38	1	55	2	82	35	6	76	25	9	2006	131
39	1	64	3	81	60	5	74	18	12	2005	123
40	1	58	2	73	46	5	83	13	6	2006	116
41	1	55	2	55	37	3	73	27	9	2006	111
42	2	61	3	89	64	6	90	4	3	2006	117
43	1	50	2	72	77	5	57	30	2	2007	114
44	1	50	2	74	33	5	80	24	2	2007	111
45	2	58	2	76	35	4	87	19	6	2006	110
46	2	66	3	86	95	6	93	4	10	2005	122
47	2	52	2	87	60	5	89	12	12	2006	107
48	1	45	1	76	31	5	59	36	7	2007	104
49	1	56	2	91	65	5	87	10	8	2006	110
50	2	56	2	82	102	5	52	71	9	2006	107
51	2	66	3	82	65	5	84	14	10	2005	117
52	1	65	3	94	114	5	94	6	11	2005	117
53	1	56	2	85	48	4	62	21	8	2006	105
54	1	63	3	94	84	5	96	2	1	2006	111
55	1	60	3	80	58	5	73	24	4	2006	118
56	1	62	3	67	47	4	73	38	2	2006	122
57	2	46	1	53	46	4	70	21	6	2007	116