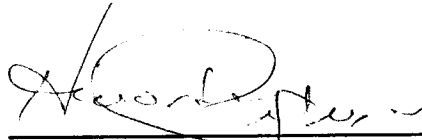


To the Graduate Council:

I am submitting herewith a dissertation written by Dee Misenheimer Lance entitled "The Criterion-Related Validity of a Test of Implicit Phonological Awareness." I have examined the final copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, with a major in Hearing and Speech Science.



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The Criterion-Related Validity of a
Test of Implicit Phonological Awareness

A Dissertation
Presented for the
Doctor of Philosophy
Degree
The University of Tennessee, Knoxville

Dee Misenheimer Lance
May 1996

Dedication

I would like to dedicate this work to my husband, Steven Lance. He has provided me with unconditional loving support throughout the pursuit of this degree. Without his unwavering strength to call upon, there were many times that the effort required to go on would have been difficult to muster.

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Abstract

The purpose of this investigation was to examine the criterion-related validity of the Test of Implicit Phonology (a modification of Lance, 1994) with valid measures of phonological awareness and reading ability. This test used a forced choice paradigm employing nonsense word pairs (e.g., /f kib/--/f rib/) of which one member violated the rules of phoneme combination in English and the other was permissible for phoneme combination in English.

Subjects selected for this study were 81 normally developing first-graders and second-graders who were tested using six different experimental measures and the Test of Implicit Phonology (TIP). The six tasks chosen to assess the criterion-related validity included: the Yopp-Singer phoneme segmentation task (Yopp, 1988); a phoneme deletion task (Bruce, 1964); a phoneme blending task (Catts, 1993); the word identification subtest and word attack subtest of the Woodcock Reading Mastery Tests-Revised (Woodcock, 1987); and the Phonological Screening-Multisyllabic

subtest of the Assessment of Phonological Processes-Revised (Hodson, 1986).

The results indicated that there was a positive significant correlation between the TIP and two of the phonological awareness tasks, both tasks of decoding and the multisyllabic word production task. Additionally, the first-grade children performed significantly lower than the second-grade children on the TIP, thus indicating that the TIP was also sensitive to developmental phonological awareness differences between the first- and second-grade children. It was concluded that the TIP has criterion-related validity as a phonological awareness assessment tool. With further inquiry this paradigm could prove to be a method of appraisal that is not confounded by reading and spelling instruction thus resulting in a more accurate assessment of implicit phonological awareness.

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Chapter I
Introduction and Review of Literature
Introduction

Defining Phonological Awareness

Phonological awareness and its link with reading ability has been researched heavily during the past few decades (for reviews see Adams, 1990; and Blachman, 1989). This phenomenon called phonological awareness has been defined several different ways. Swank and Catts (1994) describe phonological awareness as an "awareness or sensitivity to the sound structure of the language" (p. 10). Blachman (1989) suggests that "phonological awareness refers to the awareness of, and ability to manipulate, the phonological segments in words--specifically, the phonemes represented in an alphabetic orthography" (pp. 133-134). Stahl and Murray (1994) define phonological awareness as the "awareness of sounds in spoken (not written) words" (p. 221). In spite of the various definitions that express the meaning of phonological awareness, there is a basic similarity in these and others' definitions, the similarity being that phonological awareness is the

knowledge of, or sensitivity to the sound system--the phonology, of one's language (Blachman, 1989; Bradley & Bryant, 1985; Catts, 1993; Fletcher et al., 1994; Hakes, 1982; Mattingly, 1980; Stahl & Murray, 1994; Stanovich, 1988a; Swank & Catts, 1994; Wagner et al., 1987).

As with other phenomena in the social sciences, different labels have been used to describe this particular aspect of phonology: that is, phonological awareness. Wagner and his colleagues (1987) use the term "phonological processing," which is described as the "use of phonological information--the sounds of one's language--in processing written and oral information" (p. 355). Mattingly (1980), on the other hand, uses the term "linguistic awareness" and defines it as the knowledge about and access to the sound structure of one's language.

In this study, Stahl and Murray's (1994) definition will be adopted, and the term phonological awareness will be used to refer to the knowledge of the sound system, or phonology, of the language. This definition was chosen because some of the phonological awareness tasks used in this study will include units

that in some cases are larger than the isolated phoneme.

Phonological Awareness and Its Relationship With Reading Ability

Learning to read an alphabetic language requires one to make associations between the sounds of that language and the symbols chosen to represent them (Adams, 1990; Blachman, 1991; Chall, 1983; Liberman & Liberman, 1990; Liberman & Shankweiler, 1979; Mattingly, 1980; Stanovich, 1988a; Stark, Ansel, & Bond, 1988). Since the phonology of the English language is orthographically represented, a certain level of phonological awareness is required when learning to read (Liberman & Liberman, 1990).

Decoding ability is vital to the acquisition of reading skill and is considered by Chall (1983) to be the first stage of reading development. This stage is called the decoding stage and occurs between the ages of five and seven years. It is the period when a child learns the "phoneme-grapheme correspondence rules" (Chall, 1983, p. 28). Children who do not master this

stage of reading will not become facile readers (Liberman & Liberman, 1990).

Not everyone agrees with Liberman and Liberman (1990) and there is much debate among researchers about the exact nature of the relationship between phonological awareness and reading skill. Thus, it is important to highlight the three primary theories of literacy development. One is that reading instruction causes phonological awareness ability (Morais, Cary, Alegria, & Bertelson, 1979; Read, Zhang, Nie, & Ding, 1986). A second is that phonological awareness ability results in reading ability (Bradley & Bryant, 1983, 1985; Maclean, Bradley, & Bryant, 1987; Tunmer & Nesdale, 1985). The third is that reading instruction and phonological awareness have a relationship that is bidirectional (Blachman, 1994; Ehri, 1979; Mann & Liberman, 1984; Perfetti, Beck, Bell, & Hughes, 1981; Stahl & Murray, 1994; Stanovich, 1986).

The causal connection between phonological awareness and reading skill will not be resolved in the near future, but at this time most researchers agree that phonological awareness and reading ability are positively correlated. Therefore, children who

perform well on phonological awareness tasks demonstrate a corresponding level on reading tasks (Bradley & Bryant, 1983; Fletcher et al., 1994; Kamhi & Catts, 1986; Perfetti et al., 1987; Stahl & Murray, 1994; Vellutino & Scanlon, 1987). However, one issue that may confound the causal question is the many different tasks and levels used to assess phonological awareness.

Measuring the Different Levels of Phonological Awareness

Several different tasks have been used to assess phonological awareness ability, and these include rhyming tasks (Maclean et al., 1987; Stahl & Murray, 1994; Yopp, 1988), syllable counting tasks (Liberman, Shankweiler, Fischer, & Carter, 1974; Mann & Liberman, 1984), sound deletion tasks (Bruce, 1964; Catts, 1993; Liberman et al., 1974; Perfetti et al., 1987; Rosner & Simon, 1971), sound categorization tasks (Bradley & Bryant, 1983), and blending tasks (Catts, 1993; Perfetti et al., 1987; Swank & Catts, 1994; Yopp, 1988). Apparently, then, phonological awareness can be

assessed on different complexity or linguistic levels, depending on the paradigm.

In a factor analysis of phonological awareness and reading ability, Yopp (1988) discovered two different levels of phonological awareness. She described these levels as simple phonemic awareness and compound phonemic awareness. On the one hand, simple phonemic awareness is defined by tasks that require only one mental operation, such as the segmentation of a word or the isolation of individual phonemes. On the other hand, compound phonemic awareness requires that the subjects perform two mental operations. They are required to hold a "given sound in memory while performing a second operation" (Yopp, 1988, p. 107), such as deleting a sound from a word. Perfetti and associates (1987) classify various phonological awareness tasks according to the phonological level each task assesses (i.e., analysis or synthesis). In their study, synthesis is the blending together of the language's sounds into words, and analysis is the ability to take words apart into their component parts (i.e., syllables or sounds) (Perfetti, 1985; Perfetti et al., 1987). Generally, at least one test from each

level is needed to accurately measure phonological awareness (Perfetti et al., 1987; Yopp, 1988).

Implicit Versus Explicit Phonological Awareness

Both Yopp (1988) and Perfetti et al. (1987) describe phonological tasks that require their subjects to explicitly manipulate sounds in words. The subjects have to demonstrate an understanding of the phonemic components of words and then be able to maneuver those components at a cognizant level. Phonological awareness levels are also determined by the conscious level at which the phonological judgment is made, and these levels can be implicit or explicit. Perfetti (1985) proposes that phonological awareness may be only partly accessible, and also that such awareness may not necessarily be on a conscious level at all. Thus, the awareness level can be implicit in nature in addition to explicit, explicit phonological awareness being the ability to consciously manipulate the phonological system.

Most phonological awareness tasks require an explicit knowledge of the sound system. These tasks include sound and syllable segmentation, sound

blending, sound deletion, and sound isolation. For example, the Yopp-Singer segmentation task (Yopp, 1988) requires the division of the target word into its constituent syllables or sounds (e.g., /ʃi/ → /ʃ/+/i/). For the successful performance of this task, the child is required to separate the sounds in the word, hold each of the sounds of the word in memory, sequence the sounds, and articulate each of the sounds. This and other similar tasks require a conscious knowledge of a language's phonology.

Perfetti (1985) and Vellutino and Denckla (1991) argue that phonological awareness may not always be a product of the conscious manipulation of the sounds in words. Rather, it simply must be implicitly accessible to children through experience with their native language. "Hence implicit knowledge may be a more accurate characterization of what a child knows about language structure" (Perfetti, 1985, p. 212). One example of an implicit phonological awareness task is rhyming, for if preschoolers can recognize that two words rhyme, but they cannot tell why the words rhyme, they have demonstrated an implicit level of phonological awareness (Goswami & Bryant, 1990).

In a study designed to consider the predictive validity of four different tasks of phonological awareness, Swank and Catts (1994) employed tasks that assessed four different levels of phonological awareness including explicit, implicit, analysis, and synthesis. They utilized tasks that included sound deletion (analysis and explicit), sound categorization (implicit), sound blending (synthesis and explicit), and word segmentation (analysis and explicit). They found that the sound categorization task (the implicit awareness task) and the sound deletion task (the explicit analysis task) could differentiate between those subjects with good reading skills and those with poor reading skills. One of the limitations with this study, however, is that the tasks consisted of real words commonly used in the English language and familiar to young children. Therefore, based on the use of real words, the results may have been confounded by the subjects' word knowledge and, consequently, may not have accurately represented their phonological knowledge.

Nonsense Words Versus Real Words

Most of the tasks used to assess phonological knowledge have one element in common--the use of words that occur in the English language as the stimuli. Using real words to measure children's understanding of the sound system is one of the limitations with phonological awareness tasks. Therefore, the results may be confounded not only with word knowledge, but also with reading and spelling training (Mann & Liberman, 1984; Perfetti et al., 1987).

Several studies have used nonsense words in attempts to test phonological awareness on an explicit level. To this end, Wagner and his associates (1987) devised a nonsense word deletion task which included pronounceable nonsense words and required the subjects to delete a specific sound from each nonsense word. Perfetti and co-workers (1987) also used nonsense words for a synthesis task (sound blending) and an analysis task (tapping out the sounds in words), in addition to using real words for both of these levels.

Although some authors have used nonsense words to measure phonological knowledge, this was done on an explicit level. The use of nonsense words for the

assessment of phonological awareness on an implicit level, might provide a more accurate representation of phonological knowledge, and therefore will be employed in this investigation.

Phonologically Legal Versus Phonologically Illegal Words

Perfetti and colleagues (1987) indicated that the tasks now used to measure phonological awareness do not completely assess phonological competence. It may be therefore possible to assess phonological competence better by assessing children's ability to compare and differentiate nonsense words that are phonologically legal and nonsense words that are phonologically illegal. The term "phonologically legal" refers to the arrangement of sounds in a word consistent with the phonological rules of the language to which the word belongs. For example, the nonsense word /frib/ contains sound sequences that are permissible in English. Conversely, the term "phonologically illegal" refers to sound sequences that are in violation of the phonological rules of the language to which the word is a member. For example, in the nonsense word /fkib/ the

phoneme sequence of /ʃk/ violates the phonological rules of English and is illegal, meaning the sequence does not occur in English and is therefore not permissible.

Such a test has been used to differentiate between two groups of children with unintelligible speech, one group with developmental apraxia of speech and the other with functional articulation disorders (Kloss, 1983; Lance, 1994). This test of implicit phonological function, an earlier version of the Test of Implicit Phonology, employed nonsense word pairs, one member was phonologically legal and the other was phonologically illegal. The task was to determine which member of a nonsense word pair was more like a real word. Kloss (1983) and Lance (1994) found that the children classified as exhibiting a functional articulation disorder were less aware of the phonological rules for combining sounds together into words than were the children with normal articulation skills and the children with developmental apraxia of speech.

The Test of Implicit Phonology (a modification of Lance, 1994) has face validity as a test of phonological awareness although it has never been

thoroughly tested. The purpose of this investigation is to determine the criterion-related validity of the Test of Implicit Phonology based on correlational analyses with other valid tests of phonological awareness, with tests of reading ability, and with a task of multisyllabic word production.

Review of Literature for Phonological Awareness

Different Theories of Phonological Awareness

Development

The relationship between reading and phonological awareness has been demonstrated numerous times in the literature. Those children with reading impairments do not perform as well on tasks of phonological awareness as do children with normal reading ability (Bradley & Bryant, 1983; Fletcher et al., 1994; Kamhi & Catts, 1986; Mann & Liberman, 1984; Perfetti et al. 1987; Stahl & Murray, 1994; Vellutino & Scanlon, 1987). For example, Mann and Liberman (1984) performed a longitudinal study assessing children's ability to segment syllables and recall word strings. They found that the children in the study who exhibited normal

reading skills performed significantly better on both a syllable segmentation and a word string memory task than did the children with below-normal reading ability.

This study and others (for reviews see Adams, 1990; and Blachman, 1989) have supported the logical link between the awareness of the phonological structure of a language and the ability to map that structure onto the written form of that language (Goswami & Bryant, 1990). In order to learn to decode written language, children first must be able to identify the sounds in the language. After which they must associate the sounds with the symbols, and only then can they blend the sounds together into words (Goswami & Bryant, 1990; Liberman & Liberman, 1990; Shankweiler & Liberman, 1976).

The connection between reading and phonological awareness is not as straightforward as it might appear, for there are three different theories concerned with the nature of the association between phonological awareness and reading ability. The first theory is that reading instruction results in phonological awareness skill; the second theory is that phonological

awareness facilitates reading skill; and the third theory is that reading ability and phonological awareness ability are bidirectional. Although the proponents of each of these theories attempt to demonstrate cause-effect, this type of connection is difficult, at best, to demonstrate, and the empirical evidence used in support of each of the different theories falls short of this goal.

The Influence of Reading Instruction on Phonological Awareness

In an attempt to demonstrate that phonological awareness was the product of reading instruction, Morais, Cary, Alegria, and Bertelson (1979) compared the performance of two groups of Portuguese adults on two different tasks of phonological awareness. One group of adults was literate, having learned to read as adults in an adult literacy program, and the other group was illiterate. One of the tasks, sound deletion, required the subjects to delete a specified sound from words (real and nonsense) and then produce the remaining word. The other task, sound addition, consisted of adding a specified sound to words (real

and nonsense). The results of the study showed that the illiterate adults made significantly more mistakes than the literate adults on both of the phonological awareness tasks. Therefore, the authors concluded that phonological awareness was a by-product of reading instruction.

In spite of the apparent cause-effect relationship demonstrated by this study, the results should be interpreted cautiously. One cannot be certain that literacy was the only difference between the two groups of adults. For example, by their decision to seek literacy as adults, the individuals in the literate group might have reflected a greater propensity for reading or a greater motivation for learning.

Read, Zhang, Nie, and Ding (1986) replicated the study conducted by Morais et al. (1979) but selected their subject groups differently. Instead of choosing literate versus illiterate adults, they selected two groups of literate adults, one of which could read the orthographic (alphabetic) form of written Chinese, and the other of which could read only the logographic (the symbol indicating the whole word) form of written Chinese. The subjects were asked to perform a sound

addition task and sound deletion task involving nonsense and real words.

The results were very similar to those of the study performed by Morais et al. (1979). Those subjects who had been taught to read the orthographic form of Chinese made fewer errors than those who were taught to read the logographic form of Chinese. The errors were more pronounced for the nonsense words. Read et al. (1986) proposed that it was the alphabetic principle, not the fact that the subjects were literate, that differentiated these two groups of Chinese people.

Although Read et al.'s (1986) results provided support for the theory that reading instruction results in phonological awareness, there may have been confounding factors in the study. One factor was that the members of the orthographic group was younger than the logographic group. Another was that the orthographic group was more educated than the logographic group. An interesting point concerns the nonsense words, because in some instances it was possible to produce the correct phoneme sequence, but with a tonal quality that turned the nonsense word into

a real word. Producing the correct phonemic segments without the appropriate tonal quality resulted in 10 percent of the total errors for this study and in exaggerated differences between the two groups.

Proponents of this theory support the notion that phonological awareness is the consequence of learning to read an alphabetic language. On the one hand, this theory suggests that phonological awareness is simply an epiphenomenon of the reading acquisition process (Mann, 1986; Morais et al., 1979; Read et al., 1986). However, another theory concerning the relationship between phonological awareness and reading ability suggests that phonological awareness skill facilitates reading acquisition.

The Influence of Phonological Awareness on Reading Skill

The notion that phonological awareness and instruction in phonological awareness results in increased reading skill has been supported by several researchers (Bradley & Bryant, 1983, 1985; Maclean et al., 1987; Tunmer & Nesdale, 1985). These authors have suggested it is linguistic skill that supports reading

and spelling, and, in particular, a sound-symbol association is not required in order to acquire phonological awareness skill (Blachman, 1994; Lundberg, 1991; Mann & Liberman, 1984).

Bradley and Bryant (1983) performed a two-part longitudinal study for assessing the predictive ability of alliteration and rhyming skills on later reading skill. The first part was a correlational study investigating the relationship between sound categorization skill in the form of alliteration of beginning, medial, or final sounds and later reading ability. Four- and five-year-olds were initially tested using a sound alliteration task. For this task, the stimuli consisted of lists of three to four words, all but one sharing a common phoneme, and the subjects were required to identify the odd word. The scores for this task then were related to scores of reading and spelling ability over a four-year time period. The results of the first part of the study indicated that these two skills had a moderate positive correlation.

In the second part of this study, Bradley and Bryant (1983) employed a treatment phase to determine if instruction in alliteration and rhyme could

influence reading ability. As part of this study, 64 of their subjects were arbitrarily assigned into four matched groups. One of the groups was trained in alliteration and rhyme using pictures and objects. A second group was trained in alliteration and rhyme with an emphasis on the association of the alphabetic letters with sounds. The third group, the intervention control group, was taught to categorize words based on semantic classes. The fourth, also a control group, was not provided with any intervention. This instruction occurred over a two-year period and consisted of 40 individual sessions.

The authors found that the sound-letter correspondence training using alliteration and rhyme had a significant effect on reading and spelling ability. After the two years of training sessions, group two, which was trained specifically to use the alphabet for alliteration and rhyme, had reading and spelling scores that were significantly higher than the two control groups. Group one, which was taught alliteration and rhyme through the use of pictures, did not score significantly lower than group two or significantly higher than group three, the semantic

classes intervention control group, on the tests of reading and spelling. However, group one did score three months higher than group three on reading tasks and four months higher than group three on spelling. On tasks of reading and spelling, there was a significant difference between group one and group four, the nonintervention control group. The authors concluded that instruction in alliteration and rhyme tasks facilitates later reading and spelling ability.

Bradley and Bryant's (1983) study, nevertheless, demonstrated some weaknesses. One weakness was that although there was a difference between group one and group three on the spelling and reading tasks, the difference was not statistically significant. Furthermore, all of the children were school aged and received formal reading instruction during the course of the experiment. Therefore, it is difficult to conclude that rhyme and alliteration caused the increase in reading and spelling skill when it might have been the result of other literacy training. Consequently, care must be taken when interpreting this study in support of the theory that instruction in

alliteration and rhyming results in better reading and spelling ability.

In an attempt to control for possible educational influences, Maclean and her co-workers (1987) designed a longitudinal study using younger children who had not been enrolled in school. Their purpose was to determine if the rhyming ability of three-year-old children could predict later reading ability and performance on other phonological awareness tasks.

Maclean et al. (1987) found that early alliteration and rhyme detection ability was demonstrated in children as young as three years, and that early rhyming ability could predict the very early stages of decoding written words. These authors concluded that children as young as three years of age had phonological awareness ability in the form of alliteration and rhyming, and that this was sufficient evidence to support the theory that phonological awareness ability facilitates reading skill.

Although this study is used to support the theory that phonological awareness facilitates reading skill, the use of this study for such purposes involves one basic weakness: A longitudinal study is not sufficient

to assert causation. This study therefore lacks the properly controlled training component required to make causation claims.

Bradley and Bryant (1983), Maclean et al. (1987), and others advance the notion that phonological awareness skill facilitates reading ability, and that a sound-symbol association is not required for this skill. The theory that the acquisition of phonological awareness and reading ability are bidirectional is the third and final theory that warrants consideration.

A Reciprocal Effect of Phonological Awareness and Reading Instruction

The last major theory deals with the reciprocal relationship between phonological awareness and reading, wherein phonological awareness ability influences reading acquisition, and reading acquisition influences phonological awareness (Blachman, 1994; Ehri, 1979; Mann & Liberman, 1984; Perfetti et al., 1987; Stahl & Murray, 1994; Stanovich, 1986). In an early study, Bruce (1964) performed a cross-sectional study on children (chronological age = five yrs. to seven yrs.). He compared four groups of children's

performance on a sound deletion task across mental ages and methods of reading instruction. The subjects were placed in the following groups based on chronological age: (a) group one consisted of children aged five; (b) group two consisted of children aged six; (c) group three consisted of children aged seven; and (d) group four consisted of children aged eight. For the sound deletion task, the children were instructed to produce the remaining word after the deletion of a specific phoneme from the stimulus word (e.g., "What word is left if you take the /i/ away from party?"). The stimulus words were taken from a vocabulary count, compiled by Burroughs (1957, as cited in Bruce, 1964), for children between five years and six years six months, to ensure familiarity with the words used for the task. The Stanford-Binet Intelligence Scale (as cited in Bruce, 1964) was used to obtain intelligence quotients and mental ages for the subjects.

Bruce (1964) determined that for the sound deletion task, the higher the mental age the greater the number of correct items. He concluded that children with a mental age under the age of seven had difficulty performing the task. Another finding

concerned the type of reading instruction the children received. The children who had received direct-code, or phonics, instruction performed significantly better than those children who were taught to read using a published basal reader. He concluded that teaching method can significantly influence children's ability to correctly perform a sound deletion task.

Bruce's (1964) results support the notion that children who receive direct-code instruction perform better on phonological awareness tasks. The results of this study also indicate that the abstractness of this particular explicit phonological awareness task required a greater cognitive ability than a mental age of seven. Even though this study is used in the literature to support the reciprocity theory, a fundamental deficiency in the study was the lack of a comparison between the subjects' reading ability and their performance on sound deletion tasks.

In a longitudinal and treatment design study of first-grade children, Perfetti and colleagues (1987) followed 82 children, divided into three different groups, through the first grade. The first group, the basal readiness group, was started at the pre-basal

reader level because they lacked the pre-reading skills necessary to begin reading in the basal reader upon entering the first grade. The second group, the direct-code group, was taught to read through a direct-code method designed to teach letter-sound correspondence and sound blending. The third group, the rocket group, was placed in the beginning basal reader upon entering the first grade.

Three experimental measures were used to assess phonological awareness: A real word and a nonsense word sound blending task, a real word and a nonsense word tapping task, and a sound deletion task. For sound blending, the subjects were asked to produce a real word or nonsense word in response to a series of phonemes spoken by the examiner. The sound tapping task required the subjects to tap out the number of sounds in a real word or nonsense word spoken by the examiner. For the sound deletion task, the subjects had to produce the "word" that was left over after they had deleted a specified phoneme from the stimulus word. These skills were assessed four different times during the school year. The first testing session occurred within two weeks after the school term started and

before any reading instruction had begun. The second testing occurred between October to mid-November. Testing for the third session was performed in January, and the fourth testing session was in April. A mastery level of 75 percent correct was chosen for each of the tasks.

By the end of the school year, the time of the final testing session, all three groups had more of its members achieving mastery on the blending (synthesis) task than at the first testing session. During the last three testing sessions, the direct-code group performed significantly better than either the rockets or the basal readiness group on the sound blending task.

For the deletion task, the rocket group scored the highest on the first, third, and last testing sessions, with the direct-code group scoring next to the highest on those same sessions. For the second testing session of sound deletion ability the direct-code group scored the highest and the rocket group scored next to the highest. The basal readiness group performed significantly lower on all four of the testing sessions.

The tapping task was considered to be the most difficult of the three tasks because only 60 percent of the subjects reached mastery by the fourth testing session. Both the direct code and the rocket groups performed significantly better than the basal readiness group.

Performances on the experimental tasks of phonological awareness were correlated with reading curriculum progress and reading ability testing. The sound blending was the best predictor of word reading. The authors concluded that skill demonstrated on the synthesis task "enables later reading, regardless of instructional group" (p. 316). "Reading [ability], however, enables later deletion [ability], regardless of instructional group" (p. 317). The authors concluded that reading instruction and phonological awareness ability are bidirectional.

The controversy concerning the theories of the relationship between phonological awareness and reading skills continues. Although this situation has no easy resolution, the one issue on which most researchers will agree is that a relationship exists between phonological awareness and reading ability (Blachman,

1994; Bradley & Bryant, 1983; Bruce, 1964; Ehri, 1979; Mann & Liberman, 1984; Morais et al., 1979; Perfetti et al., 1987; Read et al., 1986; Stahl & Murray, 1994; Stanovich, 1986). Reading and phonological awareness are not isolated skills, and to some degree speech sound production is logically integrated with both of them.

Speech Production and Its Relationship to Phonological Awareness and Reading Ability

Speech sound production has been found to be related to reading ability. It has been suggested that a subgroup of children with articulation disorders exhibits a high occurrence of reading difficulties (Magnusson & Naucler, 1990). Liberman, Shankweiler, Blachman, Camp, and Werfelman (1980) state that if reading and speech are related, then reading ability, phonological understanding, and speech sound production are all connected at some level.

Catts (1986) compared the production ability of 20 reading-disordered children to that of 20 normally reading children. Three different levels of speech production were assessed: naming of pictured objects,

repetition of multisyllabic words, and repetition of phrases. Each of these tasks required the production of multisyllabic and/or complex phonetic sequences (i.e., consonant clusters and/or limited phonetic contrasts across syllables). Criterion measures included three subtests of the Woodcock Reading Mastery Tests (Woodcock, 1973): word identification, word attack, and passage comprehension. The reading-disordered children were also given the spelling subtest of the Wide Range Achievement Test (Jastak & Jastak, 1978).

The results indicated that the reading-disordered subjects made more speech production errors than the normally reading subjects on all of the tasks. There was a significant positive correlation between the reading-disordered children's mean error score on the speech production tasks and their performance on the reading subtests. The author concluded that reading-disordered children have more speech sound errors when producing phonemically complex utterances.

Kamhi and Catts (1986) performed a similar study comparing the abilities of reading-impaired children

and language-impaired children to receive and encode phonological information. They examined 36 children (chronological age = three yrs. two mos. to nine yrs. two mos.) in three different groups with 12 children in each group. The first group was classified as reading-impaired and did not have a history of speech and/or language impairment. The second group was classified as language-impaired. The third group was classified as normally developing, in that they had normal language and reading skills.

Six tasks of phonological processing were used in this study. The first task was a word repetition task using multisyllabic nonsense words containing 30 different words. Half of the items were created with clear phonetic contrasts across syllables, and the other half were created with minimal phonetic contrasts across syllables. The second task was sentence repetition, for which the subjects repeated 10 short phrases containing complex phonetic sequences (e.g., The spy fled to Greece). Sentence and word division was the third task, in which the subjects were presented with eight sentences, eight bisyllabic words, and eight monosyllabic words, and were then asked to

break them into shorter units. The next task was sound deletion, requiring the subjects to produce a word after they had deleted a specified sound from the word. The fifth task of phonological awareness was a segmentation task. For this the children had to tap out the number of sounds in certain words. A sixth task, morpheme judgement, was also performed. For this the children were asked to make a judgment about the correctness of sentences, some of which contained morphological errors.

For the word repetition tasks, the normally developing children used fewer phonological processes than did either the language-impaired group or the reading-impaired group. The reading-impaired group produced fewer phonological processes than did the language-impaired group. On the sentence imitation tasks, the normally developing children produced significantly fewer phonological processes than did either the reading-impaired group or the language-impaired group.

The authors also completed a correlation analysis, finding that language abilities were correlated with both the speech production measures and the morpheme

judgment task. Additionally, the authors demonstrated that reading ability was correlated with deletion, segmentation, and the morpheme judgment tasks. They also concluded that the deletion task was the best predictor of reading ability. As a result, they concluded that the reading-impaired group and the language-impaired group had similar deficits in the areas of phonological awareness and morphological awareness, although the groups remained heterogenous.

That speech production should in some instances be a reflection of the phonological awareness ability in children has been demonstrated. This additional component, of the already complex constellation of phonological awareness skills, demonstrates that this phenomenon is comprised of several different levels.

Different Levels of Phonological Knowledge

Phonological awareness is not a single ability, but instead is a clustering of different cognitive abilities that are centered around the child's developing cognizance of the segmental organization of spoken language (Perfetti et al., 1987). There are several known levels of phonological awareness,

including the analysis, synthesis, explicit, and implicit levels.

In the studies already mentioned, the authors have used different levels in their assessment of phonological awareness. Morais et al. (1979) and Read et al. (1986) used sound addition and sound deletion tasks. On further analysis, they employed two explicit measures, including one of synthesis (i.e., sound addition) and one of analysis (i.e., sound deletion). Bruce (1964), with his sound deletion task, measured phonological awareness on the explicit and the analysis levels. Perfetti et al. (1987) used two analysis tasks (i.e., deletion and tapping) and one of synthesis (i.e., blending), all of which measured phonological awareness on an explicit level. Regardless of whether the task is one of synthesis or one of analysis it is going to be an explicit task. Because of the nature of these two levels, both require conscious manipulation of sounds as they pertain to words.

Bradley and Bryant (1983), on the other hand, used an implicit phonological awareness task of sound alliteration, a task that required four- and five-year-old children to determine which one word out of three

or four words did not contain the shared common phoneme. This task was moderately positively correlated with later reading ability. Likewise, Maclean and associates (1987) also evaluated phonological awareness on an implicit level using alliteration and rhyme.

Again, phonological awareness has been assessed on the explicit level using tasks of analysis and synthesis. Implicit phonological awareness has been assessed through alliteration and rhyming tasks. In comparison to the amount of literature on the explicit level, the literature on the implicit level and the different measures of implicit phonological awareness is sparse. Additionally, to my knowledge there has not been an implicit phonological awareness task that has been demonstrated to be valid assessment tool.

In an attempt to determine the validity of phonological awareness tasks and classify these same tasks according to phonological awareness level, Yopp (1988) used 10 different tasks that assessed four different levels: analysis, synthesis, explicit, and implicit. This study utilized 96 kindergarten children, whose ages ranged from five years four months

to six years eight months, with a mean age of 5 years 10 months. All of the children had been exposed to a reading readiness program that provided them with sound-symbol association instruction and limited sight word training.

Ten different experimental tasks were administered to the subjects and included the following: (a) one speech sound discrimination task; (b) one phoneme blending task; (c) one phoneme counting task; (d) two phoneme deletion tasks, one developed by Bruce (1964) and one developed by Rosner (1975, as cited in Yopp, 1988); (e) one rhyming task, (f) two phoneme segmentation tasks, one developed by Goldstein (1974, as cited in Yopp, 1988) and one developed by Yopp (1988) called the Yopp-Singer phoneme segmentation task; (g) one sound isolation task; and (h) one phoneme reversal task. The tenth task, used to determine predictive validity, was a learning task developed by Yopp (1988) to assess "each child's ability to use sound-symbol correspondences to decode printed artificial words" (p. 167).

In the results of a correlational analysis, Yopp (1988) found all the tasks to be at least moderately

positively correlated to each other. The learning task was used to measure predictive validity, and the tasks having the greatest predictive validity were the Goldstein phoneme segmentation task (1974, as cited in Yopp, 1988), the Yopp-Singer phoneme segmentation task (Yopp, 1988), and a phoneme deletion task (Bruce, 1964). Of the nine phonological awareness tasks administered, only three tasks had an intra-subject reliability coefficient of at least .90. These included the phoneme blending task (Roswell & Chall, 1959, as cited in Yopp, 1988), the Bruce phoneme deletion task, and the Yopp-Singer phoneme segmentation task. Thus, the two tasks with the highest predictive validity and adequate intra-subject reliability were the Bruce phoneme deletion task and the Yopp-Singer segmentation task.

Yopp also performed a factor analysis and concluded that the tasks she used fell into one of two factors. These factors were described as simple phonemic awareness and compound phonemic awareness. Simple phonemic awareness was defined as a task that involved only one mental operation, such as the segmentation of a word or the isolation of individual

phonemes. Compound phonemic awareness entailed the performance of two mental operations: they must hold a "given sound in memory while performing a second operation" (Yopp, 1988, p. 175). She concluded that a combination of simple phonemic awareness and compound phonemic awareness tasks has "greater predictive value for early reading acquisition than does any test alone" (p. 175).

Yopp's pivotal study provided both new information regarding two new levels of phonological awareness, and also validity and reliability information on different tasks of phonological awareness. As a result of this study, valid and reliable measures are now available, although the two valid and reliable tasks in her study were tasks of explicit phonological awareness.

Stahl and Murray (1994) indicated that Yopp's study may have missed an important level of phonological awareness, linguistic complexity. Linguistic complexity was defined as the "ability to recognize a rime, manipulate onset and rime, manipulate vowel and coda, manipulate phonemes within a cluster onset, manipulate phonemes within a cluster coda" (Stahl & Murray, 1994, p. 222). Onset and rime refer

to intrasyllabic structure, "units that can be smaller than a syllable, but larger than a single phoneme" (Treiman & Zukowski, 1991, p. 69). The onset consists of the phoneme(s) of a syllable prior to the vowel and the rime consists of the vowel and if applicable the final consonant(s), or coda (e.g., for the word /step/, /st/ is the onset and /ɛp/ is the rime) (Treiman & Zukowski, 1991).

In Stahl and Murray's (1994) attempt to separate linguistic complexity (onset vs. rime) from other levels of phonological awareness tasks, they tested 113 kindergartners and first-graders on four traditional phonological awareness tasks: blending, isolation, segmentation, and deletion. Each of the phonological awareness tasks had the following four levels of linguistic complexity: "analyzing onsets and rimes, analyzing vowels and codas within rimes, analyzing phonemes composing cluster onsets, and analyzing phonemes composing cluster codas" (Stahl & Murray, 1994, p. 224). They compared these phonological awareness tasks and different levels of phonological awareness to letter identification and spelling, as well as a reading test, Basic Reading Inventory (Johns,

1991 as cited in Stahl & Murray, 1994), which included tasks of word identification and passage comprehension.

The authors found that for the traditional phonological awareness tasks administered to both the kindergartners and first-graders, phoneme isolation was the easiest task, followed in order by blending, deletion, and segmentation. When evaluating these results based on linguistic complexity, they found that the easiest task was analyzing onsets and rimes, followed successively by analyzing vowels and codas, analyzing cluster codas, and analyzing cluster onsets.

Furthermore, they performed a logical analysis and found that the children's ability to name letters was related to their ability to manipulate onsets and rimes. As a result of this analysis, a relationship was apparent between the awareness of onsets and rimes and word recognition. They concluded that for their study only one of the phonological awareness tasks, phoneme isolation, had a predictive relationship with reading ability. They also decided that onset-rime awareness and spelling were related. They concluded that the ability to manipulate onsets and rimes was the stronger predictor of reading ability than was

phonological awareness. These results need to be interpreted with caution, for an "elemental logical analysis" (Stahl & Murray, 1994, p. 226), not a statistical analysis, was used to examine the relationships between linguistic complexity and reading ability, thus making premature the claims for the predictive nature of the linguistic complexity tasks.

This serious limitation makes it difficult to draw the same conclusions that were drawn by Stahl and Murray (1994), that the linguistic complexity level of phonological awareness is a stronger predictor of reading ability than are the more traditional measures of phonological awareness. However, Stahl and Murray's study does lend support to the assertion that phonological awareness is a phenomenon that is a clustering of skills, in essence having levels that, as of yet, have not been explored to their fullest capacity. One of the known levels of phonological awareness that to date has not been explored fully is the implicit level.

Implicit Phonological Awareness

Phonological awareness has been demonstrated as a behavior that has different levels of complexity.

Perfetti and co-workers (1987) support the idea that the tasks we now use to measure phonological awareness do not tap into linguistic competence, and that these tasks can be influenced by reading and spelling instruction.

The influence of reading and spelling instruction was demonstrated in a seminal study conducted by Liberman and her co-workers (1974), in which they assessed children's ability to segment the syllables of words and the sounds of words. The subjects were 46 preschoolers, 49 kindergartners, and 40 first-graders. Each of the grade divisions was separated into two experimental groups: One group was required to segment the syllables of words, and the other was required to segment the phonemes of words.

For the phoneme segmentation each subject was required to reproduce the words spoken by the examiner and then to demonstrate, by tapping a wooden dowel on the table, the number of elements, sounds, or syllables in the stimulus items. The number of elements per

stimulus item was never greater than three, regardless of whether the word list was for phoneme segmentation or syllable segmentation.

The results were analyzed in two different ways. The first dependent measure was the number of trials it took the child to reach a criterion level of six consecutive correct items on the task without the need for any demonstration from the examiner. The second measure was a mean error score obtained before the criterion was reached. For the preschoolers, none achieved the criterion level for the phoneme segmentation task, but 46 percent achieved the criterion level for the syllable segmentation. For the kindergartners, 17 percent obtained the criterion level for phoneme segmentation, whereas 48 percent obtained the criterion level for syllable segmentation. The first-graders performed much higher on both experimental tasks, 70 percent obtaining criterion level for phoneme segmentation and 90 percent obtaining the criterion level for syllable segmentation.

The number of errors for the phoneme segmentation was higher than for the syllable segmentation. Also, the phoneme and syllable segmentation were more

difficult for the preschoolers than for the kindergartners, and more difficult for the kindergartners than for the first-graders. For all grade levels more errors occurred on the phoneme segmentation task than on the syllable segmentation task.

The authors also examined the errors by reading level and found that beginning readers tapped out the number of graphemes per word instead of tapping out the number of phonemes, thus exhibiting overshoot errors. For example, beginning readers tended to tap out three counts instead of the correct two for the word /ʃi/ (i.e., she). This is just one example of how tasks of phonological awareness can be influenced by reading and/or spelling instruction.

Real Words Versus Nonsense Words

Another factor that may obscure assessment of phonological awareness is the use of real words to measure the knowledge of or sensitivity to the sound system of one's language. By using a paradigm that includes real words, one runs the risk of confounding the issue of phonological awareness with word

knowledge. This issue is not a new one, for Berko (1958) developed a test of morphology using nonsense words in order to better assess the ability to manipulate the rules of morphology without the influence of word knowledge.

Furthermore, the Woodcock Reading Mastery Tests-Revised (Woodcock, 1987) also makes use of this principle in the word attack subtest, in which nonsense words are used to measure sound to letter associations in novel word contexts. This particular test is considered to be one of the better reading measures of sound to symbol association and is thus a better measure of "phonological processing (e.g., phonological awareness)" (Catts, 1986, p. 506) than other reading measures.

The use of nonsense words when assessing a linguistic ability is an attempt to factor word knowledge out of the equation so that the skill under investigation can be measured in isolation. Several authors use nonsense words as part of their assessment battery for phonological awareness (Dollaghan, Biber, & Campbell, 1993; Kamhi & Catts, 1986; Morais et al., 1979; Perfetti et al., 1987; Read et al. 1986), thus

demonstrating that this is not a new way of examining phonological awareness.

The use of nonsense words may not completely eliminate the word knowledge from the phonological awareness equation. Dollaghan, Biber, and Campbell (1993) used a nonsense word repetition task to examine the influence of word knowledge on production. They hypothesized that nonsense words similar in phonemic structure to real words would be easier to produce than nonsense words not similar in phonemic structure to real words. The results of their study confirmed their hypothesis, indicating that those nonsense words that were closer to real words in phonemic structure were easier to produce. These authors concluded that the repetition of the nonsense words similar to real words in phonemic structure may in fact be produced with more ease because of word knowledge.

Nonsense words are used to assess phonological awareness, and even though to some extent they may be influenced by lexical knowledge, the use nonsense words is a popular way to assess phonological awareness skill (Dollaghan, Biber, & Campbell, 1993; Kamhi & Catts, 1986; Morais et al., 1979; Perfetti et al., 1987; Read

et al., 1986). Most of the research to date that has utilized nonsense words to assess phonological awareness has done so on an explicit production level. There is an apparent lack of literature concerning the use of nonsense words to measure the implicit level of phonological awareness.

One paradigm that helps fill this void is a model first proposed by Whorf (1965), which was devised to assess the internalization of the phonemic rules of one's native language without being confounded by one's knowledge of words. This particular task involved the use of a series of nonsense word pairs, one member of each pair containing phoneme combinations which can occur in English and the other member violating the phonological rules for sound combinations in English. Messer (1967) applied this paradigm to normally developing preschoolers and found that they chose the nonsense words that were allowed in English more often than they chose those that were not.

This paradigm has also been used on two occasions to distinguish between children with developmental apraxia of speech and children with functional articulation disorders. Kloss (1983) compared the

performance of these groups on a task of implicit phonological skill. She examined 28 six- and seven-year-old children who were divided into three groups, two experimental and one control. The two experimental groups consisted of children who exhibited poor articulation skills as demonstrated by the Templin-Darley Test of Articulation-Screening (Templin & Darley, 1969). One experimental group consisted of eight children with poor performance on diadochokinetic rates, and the second experimental group consisted of ten children who did not. The third group contained ten children with normal articulation skills and was used as the control group. The following criteria had to be met in order to qualify for participation in the study: (a) normal hearing, (b) normal intelligence, (c) normal auditory discrimination, (d) no history of clumsiness, and (e) no gross structural anomalies. The children were given a test of implicit phonological awareness that consisted of "paired items that contained phoneme combinations with either one or two consonant clusters 'possible' in English words and its 'impossible' alternative" (Kloss, 1983, p. iv).

The results indicated that on this task the children with developmental apraxia of speech performed more like the children with normal articulation skills than like those with functional articulation disorders. Therefore, children who presented a motor planning disorder demonstrated the appropriate developmental rules for combining sounds into words on an implicit phonological awareness level.

In a similar study, Lance (1994), as part of a larger study, again used this implicit phonological awareness paradigm to measure phonological awareness skill on an implicit level. For this study, she selected subjects and then classified them as exhibiting either developmental apraxia of speech, functional articulation disorders, or normal articulation skill. To assess implicit phonological awareness, a modification of Kloss' (1983) earlier task was used. The Test of Implicit Phonology required each subject to judge which one of two nonsense words was more like a real word. For each of the nonsense word pairs, one member had consonant cluster combinations that could occur in English, and the other member, the foil, had consonant cluster combinations that could

not. The foil items were further divided into nonsense words that were either one consonant sequence combination away from occurring in English (i.e., illegal in English by one degree--IE1) or two consonant sequence combinations away from occurring in English (i.e., illegal in English by two degrees--IE2). The other portion of this study was designed to compare the phonological processes used by the two experimental groups, via the Assessment of Phonological Processes-Revised (Hodson, 1986).

The results of the study indicated that the children with developmental apraxia of speech and the children with normal articulation skill achieved more correct answers on the Test of Implicit Phonology (Lance, 1994) than did the children with functional articulation disorders. Additionally, the children with developmental apraxia of speech and the children with normal articulation skill achieved more correct answers when the foil type was IE2 than when it was IE1, whereas the children with functional articulation disorders did not make that distinction in foil type.

The children with developmental apraxia of speech also differed on the phonological processes exhibited

in their speech; they exhibited significantly higher occurrences of deaffrication, depalatalization, and minimal place shift in their speech. The children with functional articulation disorders exhibited a significantly greater use of syllable reduction. It was concluded that the children with developmental apraxia of speech had the more advanced phonological knowledge of the two experimental groups, for the attempt to maintain the syllable shape of the word resulted in more productive errors due to increased number of phonemes produced.

Neither the study by Kloss (1983) nor the study by Lance (1994) assessed reading performance nor compared the performance on this task with reading measures. Although the children in both of these studies were reported to have been enrolled in regular education, they were young enough (i.e., enrolled in first grade) so that decoding difficulties may not have been considered severe enough to warrant remediation.

Summary

Phonological awareness and reading ability are logically linked, especially in a language that is

orthographically represented in its written form (Adams, 1990; Blachman, 1991; Chall, 1983; Liberman & Liberman, 1990; Liberman & Shankweiler, 1979; Mattingly, 1980; Stanovich, 1988b). As a result of this connection, three different primary theories have emerged concerning the causal connection between these two skills. One is that phonological awareness is the result of reading instruction (Morais et al., 1979; Read et al., 1986). Another is that phonological awareness facilitates reading ability (Bradley & Bryant, 1983, 1985; Maclean et al., 1987; Tunmer & Nesdale, 1985). The last is that phonological awareness and reading instruction are reciprocal in nature (Blachman, 1994; Ehri, 1979; Mann & Liberman, 1984; Perfetti et al., 1981; Stahl & Murray, 1994; Stanovich, 1986). Debate continues in the literature concerning the nature of the relationship between reading and phonological awareness, but on one point most researchers agree, and that is that there is a connection between these two skills (Bradley & Bryant, 1983; Fletcher et al., 1994; Kamhi & Catts, 1986; Perfetti et al., 1987; Stahl & Murray, 1994; Vellutino & Scanlon, 1987).

Phonological awareness is not a one-dimensional skill that can be assessed easily. It is considered to be a constellation of cognitive abilities that are related to the child's understanding of the segmental nature of our language (Perfetti et al., 1987). Thus, several different levels of phonological knowledge exist (i.e., synthesis, analysis, implicit, and explicit) and different tasks have been demonstrated to assess phonological awareness (i.e., phoneme segmentation, phoneme blending, phoneme deletion, phoneme reversal, phoneme tapping, etc.).

Of these different tasks, the explicit level with either analysis or synthesis tasks has received considerable attention. Unfortunately, the use of implicit phonological awareness tasks for measuring phonological awareness has been explored less frequently. The benefit of assessing phonological awareness on this level is that it may evaluate this linguistic skill better than other methods of appraisal currently used (Perfetti, 1985).

The Test of Implicit Phonology (Lance, 1994) employs a paradigm that has been used to compare the implicit phonological awareness skill demonstrated by

children who exhibit developmental apraxia of speech to that of children who exhibit functional articulation disorders (Kloss, 1983; Lance, 1994). This test utilizes a forced choice nonsense word paradigm for which the subjects must choose the member of a nonsense word pair whose phoneme combinations do not violate the rules of English. If this test is to be used as a valid measure of phonological awareness, then it must be compared with other, valid measures of phonological awareness and reading ability.

Purpose

The purpose of this investigation is to examine the criterion-related validity of the Test of Implicit Phonology (TIP) (a modification of Lance, 1994) by comparing it with other valid measures of phonological awareness, reading, and speech sound production. The primary hypothesis of this study is that TIP is a valid measure of phonological awareness. Thus, normally developing children who exhibit satisfactory skills on TIP will also perform comparably on the three additional tasks of phonological awareness, two measures of reading, and one measure of speech sound

production. Another hypothesis is that over-all performance of normally developing second-grade children will exceed that of normally developing first-grade children who are in first grade on the TIP.

To accomplish the purpose of this study, I will seek to determine whether the performance of normally developing children on TIP has a significant positive correlation with any one or all of the following tasks of phonological awareness: the Yopp-Singer phoneme segmentation task (Yopp, 1988), a phoneme deletion task (Bruce, 1964), and a phoneme blending task (Catts, 1993). Furthermore, I will attempt to determine whether the performance of normally developing children on the TIP has a significant positive correlation with the word identification and word attack subtests of the Woodcock Reading Mastery Tests-Revised (Woodcock, 1987). I will also seek to ascertain whether the performance of normally developing children on the TIP has a significant positive correlation with the Phonological Screening-Multisyllabic subtest of the Assessment of Phonological Processes-Revised (Hodson, 1986). Additionally, I will determine if the performance of normally developing first-graders is

significantly lower than the performance of normally developing second-graders on the TIP.

If children perform well on other valid tasks of phonological awareness, then they will be expected to perform similarly on the TIP. Furthermore, if children perform well on tests of decoding ability (reading), it is likely that they will perform comparably on the TIP. Thus, this study will provide a new contribution to the current phonological awareness assessment procedures enabling the more accurate assessment of phonological awareness on an implicit level.

Alternatively, if there is a low correlation between the TIP and any of the other six tasks used for comparison as part of this study the results would imply that the tasks assess related areas, but that they assess different levels of phonological awareness (e.g., analysis, synthesis, implicit, and explicit). A correlation between the TIP and either or both of the measures of reading ability, but not other tasks of phonological awareness, would provide support that there is a relationship between the TIP and reading ability, therefore the TIP may be assessing phonological awareness on some yet undefined level.

Finally, a correlation with the multisyllabic word test, but not any of the other measure used as part of study, would indicate that there is a connection between implicit phonological skill and speech sound production (Fowler, 1991). Thus, any of the alternative outcomes would provide a contribution to the current knowledge of phonological awareness.

Chapter II
Method and Analysis
Method

Subjects

A total of 91 first- and second-grade children from a school in Knoxville, TN, participated in the study. Of these 91 children 81 met the subject selection criteria, although all 91 children were tested. One group consisted of 43 normally functioning first-graders, the other included 38 normally functioning second-graders. The first-graders had a mean age of six years nine months with ages ranging from six years four months to seven years eight months. The second-graders had a mean age of eight years with ages ranging from seven years four months to eight years nine months.

The children's respective teachers were responsible for identification of potential subjects and obtaining written permission for participation from the subjects' parents. Only after the written permission was obtained were parents contacted by the

investigator for the purpose of completing the case history form (see Appendix A for sample form) which was completed via phone interview.

The purpose of the questionnaire was to obtain the child's birth date, information about speech and language development, frequency of ear infections in the past year, and to determine the language spoken in the home. Also, prior to any task administration, each child's teacher was asked questions concerning general academic performance and reading ability (see Appendix B for sample form). Only after these steps were completed were the two criterion measures and the seven experimental measures administered.

Stimuli

Rationale for Experimental Tasks

The Test of Implicit Phonology (a modification of Lance, 1994) was included in this study for the purpose of comparison with other tasks of phonological awareness. The Yopp-Singer task (Yopp, 1988), a test of sound segmentation, and the phoneme deletion task (Bruce, 1964) were also employed. They were included in this study because they were judged to be valid

measures of phonological awareness skills (Yopp, 1988). Both tasks assessed phonological awareness at the level of analysis. Additionally, one was a measure of simple phonemic awareness, and one was a measure of compound phonemic awareness, respectively (Yopp, 1988). The sound blending task (Catts, 1993) was selected because a task of synthesis was needed in order to assess that level of phonological awareness.

Because phonological awareness skill has been positively correlated with reading ability, two tests of reading ability were administered. Both of these tests, the word attack and word identification, were subtests of the Woodcock Reading Mastery Tests-Revised (Woodcock, 1987). The word attack subtest required the child to read a list of nonsense words in isolation. It was used as a measure of grapheme-phoneme correspondence rules and has been considered to provide a better measure of "phonological processing skills (e.g., phonological awareness)" (Catts, 1986, p. 506) than other reading measures. The word identification subtest involved reading a list of real words in isolation and, therefore, has been considered a measure of written word recognition.

The last experimental procedure was the Phonological Screening-Multisyllabic subtest of the Assessment of Phonological Processes-Revised (Hodson, 1986). This test was administered because children who have difficulty reading exhibit more speech sound production errors when producing multisyllabic words than do children who have normal reading ability (Catts, 1986).

Each of these experimental procedures assesses phonological knowledge in a unique way. In order to ensure that these tasks measure the intended skill a set protocol was developed for each task.

The Test of Implicit Phonology

The Test of Implicit Phonology (a modification of Lance, 1994) (see Appendix C for response form) used for this investigation was originally a modification of an earlier test developed by Kloss (1983) based on a paradigm suggested by Whorf (1956). The version used by Lance (1994) contained 25 pairs of monosyllabic nonsense words. One member of each pair was designed so that all consonant combinations could occur in the English Language; the other member was designed so that

there were phoneme combinations that do not occur in the English Language, and was in essence a foil. These phonemic combinations consist of the following consonant-vowel (CV) combinations: CCVC, CVCC, CCVCC, or CCCVCC. Its purpose was to provide an assessment of the subjects' knowledge of phoneme combinations, or consonant combinations permissible by an implicit set of rules, without the interference of other linguistic knowledge.

Additionally, there were two groups of words that were Illegal in English (IE), words that contain consonant combinations that violate the phonological rules of English at either the beginning or the ending of the words (IE1) and nonsense words that contain consonant combinations that violate the rules of English at both the beginning and ending of the words (IE2). In the Lance (1994) version there were 15 pairs in the IE1 group and 10 pairs in the IE2 group.

Several modifications have been made to the Test of Implicit Phonology (Lance, 1994). One is that instead of 25 paired items there are now 30 paired items, with 15 nonsense word pairs for each of the IE1 and IE2 categories. Additionally, several items that

were misclassified in the original tests were discarded, and new nonsense words were created. Another modification concerned the possibility of order effects as it pertained to the arrangement of the correct answer within the word pair, and whether or not a specific item number was to consist of an IE1 foil or an IE2 foil. Therefore a table of random numbers was used when assigning position of correct response and foil type.

In the current version of the Test of Implicit Phonology (a modification of Lance, 1994) (TIP) the nonsense word pairs were initially recorded, employing an external microphone, on a Power Macintosh model 6100/60 AV using SoundEdit 16 speech digitizing software. For the recording of the nonsense word pairs the sampling rate was set at compact disk quality 44.110 and the sampling resolution was set at compact disk quality 16 bits. From the Power Macintosh each of the 30 nonsense word pairs were recorded not only on a master audiotape, but also each word pair was recorded individually, each pair on a separate tape to facilitate the readministration of individual nonsense word pairs if necessary. The recordings for both the

master tape and the individual audiotapes were made on a Marantz PMD430 audiocassette deck using Maxell High Bias audiotapes. Each nonsense word pair was recorded and then checked with a sound level meter to insure that each of the nonsense words was spoken at approximately the same intensity.

In order to prevent inadvertently marking the correct response via duration (i.e., the correct words either being longer or shorter in duration) differences between each of the two nonsense words that comprise a nonsense word pair did not exceed 50 ms. The average duration of the nonsense words is 1040 ms with a range from 748 ms to 1648 ms. The approximate playing time for each word pair was 5 seconds, with a one second pause between each of the nonsense words within the pairs. For more specific information concerning the duration of individual nonsense words see Appendix D.

To insure that the items were produced correctly by the author during the recording of the words, two certified speech-language pathologists trained in phonetic transcription transcribed each of the recordings to determine if the words were produced as intended. Inter-judge reliability for the production-

transcription agreement was 94 percent for the consonants and 96 percent for the vowels. Upon discussion of the discrepancies, the inter-judge reliability for production-transcription agreement was increased to 100 percent for both consonants and vowels.

The directions given to each subject for the TIP were as follows:

You are going to listen to some silly-sounding words on this tape recorder. Each time I start the tape, you will hear two things. Neither of these things is a real word. What I want you to do is to tell me which one, number one or number two, sounds more like a real word to you. You don't have to try to say the words because some of them are very hard to say. Remember, just tell me number one or number two . . . whichever word sounds more like a real word to you. O.K. Ready? We'll try a couple first.

After instructions were given to the subjects, the test was administered via a Marantz PMD430 with stereo

speakers adjusted to each clients most comfortable listening level. There were two training nonsense word pairs for this task, /plit/-/svŮl/ and /tʃlʌb/-/kwist/ for which the child was corrected if an incorrect response was given (e.g., repeating the word rather than saying number one or two). Once the task was initiated it was administered in its entirety, although items were repeated one time upon request, but only after the test had been administered in its entirety.

Phoneme Segmentation

The Yopp-Singer task (Yopp, 1988), a phoneme segmentation test, was a measure of how well children can segment a word into its individual phonemes (see Appendix E for response form). For this task the subjects were asked to segment and produce, in order, the individual phonemes comprising each of the stimulus words. The words were selected from Thorndike and Lorge's (1963 as cited in Yopp, 1988) catalog of frequently occurring words (i.e., at least 100 occurrences per million), with one exception. The exception was the word zoo, which was used to obtain a feature analysis criteria. The words included were

based on an analysis of the sounds within the word. In creating the list, "all commonly occurring places and manners of articulation of English language consonants . . . and all heights and locations of English vowels" (Yopp, 1988, p. 166) were incorporated.

The specific directions for the Yopp-Singer task (Yopp, 1988) were as follows:

In this word game "I'm going to say a word, and I want you to break the word apart. You are going to tell me each sound in the word in order. For example, if I say old, you will say o-l-d. Let's try a few together" (Yopp, 1988, p. 166).

The training items for the present study were the same words used by Yopp, and they included the words ride, go, and man. If any child continued to have difficulty with the task, then other examples were used, and they included common words, common objects, and familiar names. A maximum of 10 additional training items were administered, and then execution of the experimental task proceeded. For each training item, if the child did not provide the correct answer the child was

provided with the correct answer and then asked to repeat it. There was no basal or ceiling for this task.

Phoneme Deletion

The phoneme deletion task (Bruce, 1964) was a task in which the children were asked to delete either the first, middle, or last sound in the stimulus words (see Appendix F for response form). The stimuli consisted of 30 words of which 26 are monosyllabic, 4 are bisyllabic, and 1 was trisyllabic. Bruce (1964) chose the words from the first 500 words in Burroughs' (1957) vocabulary count for children aged five years to six years six months (as cited in Bruce, 1964).

For this task, each child was asked what word would remain if a specific sound were omitted from the stimulus word. Specifically, the directions were tailored for each of the stimulus words, for example "What word would be left if the /t/ were taken away from the end of start." The word list was designed so that the sound deletion position (i.e., initial, medial, or final) was randomly ordered.

Although Bruce (1964) did not provide training items as part of his task, he did suggest that training should occur before the administration of the task. For the administration of the phoneme deletion task (Bruce, 1964), the training protocol and directions were borrowed from Catts (1993). The child was shown a picture of a cow and a picture of a boy's head and was then instructed to say the word cowboy. Next, the picture of the cow was removed from the child's field of vision, and the child was asked to say the word again, but this time leaving out the word cow. If the child responded correctly, the next training word, toothbrush, was presented with a picture of a tooth and a picture of a brush, following the same procedures as outlined above. If there was a correct response from the child, then the third training item was cupcake (pictures used were a cup and a cake). If the child responded incorrectly to any of the training items, then the examiner said "'cowboy without boy is cow'" (Catts, 1993, p. 25). After all of the training items, the examiner proceeded with the administration of the phoneme deletion task (Bruce, 1964), for which no pictures were used. Another adaption from Catts

(1993) was the correction and reinforcement schedule. The first five correct responses were reinforced, and the first five errors were corrected" (Catts, 1993, p. 25). Testing was terminated after eight consecutive incorrect responses.

Phoneme Blending

The sound blending task (Catts, 1993) was a task that involved the auditory presentation of individual syllables or sounds for the child to then combine into a word and included 23 items of commonly occurring English words (see Appendix G for response form). The task instructions were the same as those used by Catts (1993).

The specific directions for the sound blending task (Catts, 1993) were as follows:

This puppet does not talk very well. He says words one sound at a time. Your job is to listen and say the words the right way. For example if he says 'rein (pause) deer' you would say 'reindeer.' Let's try it (p. 14).

There were three different practice items used, and they included the following: bed (pause) room, suit

(pause) case, and snow (pause) man. If the child responded incorrectly to any or all of these practice items, then corrective feedback was given. During the administration of this measure "the first five correct responses are reinforced and the first five errors are corrected" (p. 14), and it was given in its entirety.

Reading Tests

Two subtests from the Woodcock Reading Mastery Tests-Revised (Woodcock, 1987) were administered to assess each subject's reading ability. One was the word attack subtest which contained 50 items. The word attack subtest required the child to read aloud nonsense words which provided a measure of the child's knowledge of sound-symbol associations (Catts, 1986). The word identification subtest, with 150 items, was also administered. The words included in this test ranged in difficulty "from first words included in typical basal readers to words above average difficulty" (Woodcock, 1987, p. 3). These subtests were standardized measures and the items were arranged in maturational order. The basal for both of the subtests was five consecutive correct items, and the

ceiling was five consecutive incorrect items. The published administration directions and examples were used.

Multisyllabic Screening

The next test given was the Phonological Screening-Multisyllabic subtest of the Assessment of Phonological Processes-Revised (Hodson, 1986) (see Appendix H for response form). This test consisted of twelve multisyllabic words, six had five syllables, four had four syllables, and two had three syllables. Each word was elicited by a stimulus picture or object. The child was instructed to name the picture or item, and it was recorded using broad transcription. In case a child had difficulty identifying an object or picture, a delayed imitation technique was employed (Creaghead & Newman, 1985). The subject was presented with the target word, then the target word in a sentence, and the subject was then asked to repeat the word after a minimum of a three-second delay. Additionally, in the instance of a self-corrected production the second response was used for scoring.

To reduce the possibility of order effects influencing the results of this study, the order in which the experimental tasks were administered was randomized. The randomization and assignment of order of test administration occurred before the testing of the subjects began.

Testing

All testing was conducted in a small, quiet room on the school's premises during nonacademic activities, such as free time or physical education class. For their participation, the subjects were offered their choice of several small toys after all testing had been completed.

Each child participated in two testing sessions of approximately 45 minutes each, separated by at least 24 hours to minimize testing fatigue. Initially, the guideline for the maximum number of days between the first and second testing sessions was set at 14, but for 18 of the subjects that guideline was violated because of inclement weather, with a range from 16 to 28 days and a mean of 23 days between the two sessions. For all of the other subjects the second testing

session was within 14 days of the first testing session.

During the first session the tests administered were to determine whether children met the subject selection criteria. The second session consisted of the experimental procedures. During test administration, short breaks of approximately five minutes were granted upon request or when any signs of fatigue were noticed, but only after the task being administered was completed.

The administration of all tests was tape recorded on Sony TC-RX606ES audiocassette deck using a Maxell High Bias (90 minute) audiocassette and Sony ECM-T150 Tie Pin Microphones that were placed approximately six inches from each subject's mouth.

First Session

During the first session and to qualify for participation in this study, each child met the following criteria: (a) was a "normal learner" (teacher judgement); (b) received only regular education instruction (no remedial classes); (c) achieved a receptive vocabulary score that was no more than two

stanines below the mean for their age on the Peabody Picture Vocabulary Test-Revised, Form L (Dunn & Dunn, 1981); (d) demonstrated normal-bilateral hearing as assessed by a pure tone screening at 20 dB HL (ANSI-1989) for the frequencies 1000, 2000, 4000 and 6000 Hz (i.e., normal-bilateral hearing = a positive response for each frequency in both the left and right ears); (e) exhibited no significant history of chronic middle ear disease (i.e., fewer than six ear infections in the last six months) as reported by at least one parent; and (f) was a native monolingual English speaker from a home where English is the only language spoken. The Templin-Darley Screening Test of Articulation (Templin & Darley, 1969) was also administered during this session, but only to provide information about speech sound production of the subjects.

The Templin-Darley Screening Test of Articulation (Templin & Darley, 1969) was administered for descriptive purposes, and no child was eliminated from the subject pool based on the score. The first-graders obtained a mean score of 46 with a range from 31 to 50, and the second-graders obtained a mean score of 48 with a range from 34 to 50. The mean scores for both the

first- and second-graders were appropriate for their ages. Seven out of the 81 subjects obtained a score that was below the cut-off score for their age.

The subjects also performed satisfactorily on the Peabody Picture Vocabulary Test-Revised, Form L (Dunn & Dunn, 1981). The first-grade subjects achieved a mean standard score of 112 with a range from 84 to 126, and the second-grade subjects achieved a mean standard score of 107 with a range from 88 to 130. None of the children were removed from this investigation based on their performance on this test.

Second Session

In the second session a total of seven different experimental measures were administered with each taking 10 minutes or less to complete. Of these assessment tools, four were phonological awareness tasks and included the following: (a) the TIP; (b) a phoneme deletion task (Bruce, 1964); (c) the Yopp-Singer task, a phoneme segmentation task (Yopp, 1988); and (d) a phoneme blending task (Catts, 1993). Two subtests, the word attack and the word identification, both from the Woodcock Reading Mastery Tests-Revised

(Woodcock, 1987), were used to assess reading skill. Lastly, the Phonological Screening-Multisyllabic subtest of the Assessment of Phonological Processes-Revised (Hodson, 1986) was given.

Reliability

Intra-subject reliability measures were performed on the nonstandardized measures which included the following: (a) a phoneme deletion task (Bruce, 1964); (b) the Yopp-Singer phoneme segmentation task (Yopp, 1988); (c) a sound blending task (Catts, 1993), (d) the Multisyllabic Screening subtest of the Assessment of Phonological Processes-Revised; and (e) the TIP. Before test administration, three subject numbers from each group (i.e., first-grade, second grade) were randomly selected for use in the intra-subject reliability procedure for the five tasks. The subjects that were included in the intra-subject reliability measure were given each of the four nonstandardized tasks at some time after initial administration.

Inter-judge reliability was assessed from the audiotape recordings of the testing session. An assessment of inter-judge reliability was not obtained

for the Peabody Picture Vocabulary Test-Revised, Form L, (Dunn & Dunn, 1981) because pointing was the only response that was required. For the purpose of determining scoring reliability, three subjects from each group (i.e., first-grade, second-grade) were randomly selected for rescoring based on the answers marked on the score form from the original test administration.

Statistical Analysis

Statistical analyses were performed using SAS statistical analysis software. Pearson product-moment correlation coefficients were computed to determine if there was a relationship between the scores on the Test of Implicit Phonology (a modification of Lance, 1994) and scores on any of the other six experimental tasks. Each correlation was tested for significant departure from zero using the significance level of .05. Additionally, the Bonferroni method, a procedure that decreases the alpha level and thus provides protection against a type I error (Bray & Maxwell, 1985), was calculated to reduce the chance of making a Type I error.

Seven Analyses of Variance (ANOVAs) comparing first- and second-graders were performed to test the hypotheses that first-graders perform lower than second-graders on all of the experimental tasks. Each of the ANOVAs had one factor (experimental task) with two levels (grade level). The significance level for each test was set at an alpha level of .05. The Bonferroni method was also used as a test of significance for these analyses.

A multivariate analysis of variance (MANOVA) was computed to determine if there was a difference between the groups on all of the experimental tasks. The MANOVA had one factor (group) with two levels (first and second graders) and seven dependent variables (the experimental tasks).

CHAPTER III

Pilot Study

A pilot study was performed to determine if a relationship between the Test of Implicit Phonology (modification of Lance, 1994) (TIP) and the other experimental measures could be demonstrated prior to conducting the study. Furthermore, information was gathered concerning the procedures and the execution of data collection.

Subjects

The subjects for this pilot study were three children. One was a male third grader (C.A. = nine yrs., five mos.) who had a known reading disorder and had been receiving remediation for his reading deficit for three years. The second subject was a male first-grader (C.A. = six yrs., three mos.) with no known history of reading or educational problems. The third subject was a male second-grader (C.A. = seven yrs., five mos.) with no known history of reading or educational problems. The two subjects with normal reading ability met all of the criteria for

participation as outlined in Chapter II. The reading-impaired child met all of the criteria outlined in Chapter II except for two. He received special education instruction in reading, and he was not judged to be a normal reader.

Procedures

All of the methods used for the pilot study were the same as those outlined in Chapter II except for some minor procedural differences. The recruitment process was slightly altered, and subjects were not obtained from any of the area schools. They were instead known to the investigator prior to the initiation of the study, so the initial contact was made by the investigator. Additionally, the children were tested in one session instead of two, and the testing occurred at the University of Tennessee Hearing and Speech Center.

Another deviation pertained to the administration of the stimuli of the TIP. Instead of using audiotapes for the administering of the stimuli, a Bell and Howell Language Master and magnetic strip cards were used. The Bell and Howell Language Master was not used for

the recording and administration of the TIP in the ensuing investigation.

Experimental Measures

The experimental tasks included the following items: (a) the TIP; (b) the Yopp-Singer phoneme segmentation task (Yopp, 1988); (c) the phoneme deletion task developed by Bruce (1964); (d) a phoneme blending task developed by Catts (1993); (e) the word attack subtest of the Woodcock Reading Mastery Tests-Revised (Woodcock, 1987); (f) the word identification subtest of the Woodcock Reading Mastery Tests-Revised (Woodcock, 1987); and (g) the Phonological Screening-Multisyllabic subtest of the Assessment of Phonological Processes-Revised (Hodson, 1986).

Results

In Table 1 the specific results of the subtests are reported for each subject. On all of the subtests the reading-impaired subject performed lower than did either of the normal children, in spite of their age or educational levels. He performed in the sixteenth

Table 1

Summary of Pilot Subjects' Scores

Sub.	TIP	Hodson	Bruce	Yopp	Catts	Attck	Ident.
RI	15	2	15	13	18	16th	2nd
NA1st	18	4	16	22	22	85th	84th
NA2nd	20	9	18	17	22	83rd	90th

Note. Sub=Subjects; RI=reading-impaired subject;
 NA1st=normal first-grader; and NA2nd=normal second-
 grader; TIP=Test of Implicit Phonology (max. score 30);
 Hodson=Phonological Screening-Multisyllabic (max. score
 12); Bruce=phoneme deletion (max. score 30); Yopp=Yopp-
 Singer phoneme segmentation (max. score 22);
 Catts=phoneme blending (max. score 30); Attack=word
 attack (reported in percentile); Ident.=word
 identification (reported in percentile).

percentile and in the second percentile respectively on the word attack and word identification subtests, and based on those scores, he would be expected to perform poorly on the other measures. Of particular interest was his low performance on the TIP and the correspondence with the low scores that he obtained on all of the other tasks.

The second subject, the normal first-grader, as stated earlier, made fewer errors than did the reading-impaired subject on all of the tasks of phonological awareness and on the TIP. This is of particular interest, for it was proposed that there would be a relationship between the score on the Test of Implicit Phonology and the other six measures.

The third subject, the normal second-grader, made fewer errors than did the reading-impaired child. Additionally, he made fewer errors than the did first-grader on all the tests of phonological awareness except for the Yopp-Singer phoneme segmentation task (Yopp, 1988) and the phoneme blending task (Catts, 1993). The lower results on these last two tests may have been caused by fatigue, since they were the last

two tests administered, or they may have been a function of normal variation.

Discussion

Although these results are limited in scope, they are informative. Apparently, there is a relationship among these tasks of phonological awareness and reading measures that warrants further study. For example, the reading-impaired child performed lower than the other two normal children. For these three subjects, the TIP differentiated between normal and reading disordered children. Additionally, not only did the normally developing children perform better than the reading-impaired child, but the test was able to separate between the first- and second-grade children. The scores on the TIP and the other tests of phonological awareness corresponded. For example, the normal first-grader had scores that were higher than the reading-impaired child's, not just on one test, but on all of the experimental procedures. Therefore, as the score on the TIP increased, so did the scores on the other phonological awareness tasks.

Conclusion

In summary, these results indicated that there was a relationship between the TIP and the other experimental procedures requiring further investigation. Additionally, there also appeared to be a difference between the first- and second-graders which also necessitates more inquiry.

The pilot study exposed procedural areas that needed to be modified to assure a more sound study. One area concerned the number of sessions allowed for testing. Each of the three pilot subjects were tested in one session, and based on their level of attention it was decided to increase the number of sessions used to gather data from one to two. Also, the method of administration of the TIP was changed from using the Bell and Howell language master to using an audiotape recording.

Chapter IV

Results

Each of the 81 subjects who qualified for the study was asked to perform all seven of the experimental tasks, and the scores that summarize their performance are presented in Table 2 (for individual subject's scores see Appendix I). In general, the children exhibited the most difficulty with the word attack and word identification subtests of the Woodcock Reading Mastery Tests-Revised (Woodcock, 1987); the phoneme deletion task (Bruce, 1964); and the TIP. The phoneme blending task (Catts, 1993) appeared to be the least demanding of the experimental tasks. A ceiling effect was observed on the phoneme blending task, since only 19 of the 81 subjects achieved scores that were lower than 20 out of 23 items correct. Only one of the subjects, a first grader, achieved the low score of 15 out of 23 correct. For the Yopp-Singer phoneme segmentation task (Yopp, 1988) and the Phonological Screening-Multisyllabic subtest of the Assessment of Phonological Processes-Revised (Hodson, 1986) the

Table 2

Summary of Subjects' Scores for the Experimental Tasks

	<u>N</u>	<u>Mean</u>	<u>SD</u>	<u>Range</u>
TIP	81	20	3.55	10 to 29
Bruce	81	18	6.18	1 to 28
Yopp	81	17	3.98	3 to 22
Catts	81	20	1.92	15 to 23
Word Id.	81	69	34.92	1 to 124
Word Atk.	81	20	15.10	0 to 50
Hodson	81	8	2.70	3 to 12

Note. The scores are reported as number of items correct. TIP = Test of Implicit Phonology (max. score 30); Bruce = phoneme deletion (max. score 30); Yopp = Yopp-Singer phoneme segmentation (max. score 22); Catts = phoneme blending (max. score 30); Word Id. = Word Identification (max. score 150); Word Atk. = Word Attack (max. score 50); Hodson = Phonological Screening-Multisyllabic (max. score 12).

subjects exhibited the expected amount of variability in their responses.

Reliability

Intra-subject reliability was calculated based on the test re-test scores of three subjects selected from the first-grade group and three subjects selected from the second-grade group. The formula used for calculating the reliability measures reported was agreement/agreement + disagreement. All but one of the intra-subject reliability scores were calculated to be above .85, which is the standard that Hills (1991) suggested if the test scores are going to be used for treatment decisions. The one task with the lower intra-subject reliability was the Yopp-Singer phoneme segmentation task (Yopp, 1988), whose intra-subject reliability was calculated to be .83. For a summary of the other scores, refer to Table 3. Inter-judge reliability was measured using the audiotapes from the testing sessions, and the overall inter-judge reliability rating was .94 (see Table 4 for summary).

Table 3

Summary of Intra-Subject Reliability for the
Experimental Tasks

Phoneme Blending	.91
Phoneme Deletion	.89
Multisyllabic Screening	.88
Test of Implicit Phonology	.87
Phoneme Segmentation	.83

Table 4

Summary of Inter-Judge Reliability for the Experimental Tasks

Phoneme Blending	.98
Test of Implicit Phonology	.97
Phoneme Deletion	.96
Word Identification	.96
PPVT-R	.95
Phoneme Segmentation	.93
Templin-Darley	.93
Word Attack	.92
Multisyllabic Screening	.91

Note. Templin-Darley=Templin-Darley Screening Test of Articulation (Templin & Darley, 1969); PPVT-R=Peabody Picture Vocabulary Test-Revised (Dunn & Dunn, 1981); Word Attack=word attack subtest of the Woodcock Reading Mastery Tests-Revised (Woodcock, 1987); Word Identification=word identification subtest of the Woodcock Reading Mastery Tests-Revised (Woodcock, 1987).

Statistical Analyses

Correlational Analyses

The primary objective of this study was to determine if the TIP (modification of Lance, 1994) possesses criterion-related validity as a measure of phonological awareness. To achieve this goal, Pearson product-moment correlation coefficients were performed to determine if the TIP was significantly positively correlated to any of the experimental tasks. These included three tasks of phonological awareness, two task of decoding (reading), and one task of multisyllabic word production. Each correlation was tested for significant departure from zero using the significance level of .05.

The results of these procedures indicated that there were five significant positive correlations between the TIP and the experimental tasks (see Table 5). The first and strongest correlation ($r = .66$) was between the TIP and the sound deletion task (Bruce, 1964). The next two significant positive correlations observed were between the TIP and the word attack, and between the TIP and the word

Table 5

Correlation Matrix for the Experimental Tasks

	1.	2.	3.	4.	5.	6.	7.
1. TIP	--	.66**	.34**	.19	.50**	.55**	.44**
2. Bruce		--	.36**	.34**	.50**	.60**	.50**
3. Yopp			--	.33**	.20	.31**	.26*
4. Catts				--	.12	.28*	.20
5. Word Id.					--	.87**	.66**
6. Word Atk.						--	.64**
7. Hodson							--

Note. The items in bold indicate the significant positive correlations that occur between the TIP and the other experimental tasks, and are therefore the correlations of primary concern for this study.

* = $p < .05$

** = $p < .008$

identification subtest of the Woodcock Reading Mastery Tests-Revised (Woodcock, 1987) (i.e., $r = .55$ and $r = .50$, respectively). A fourth positive significant correlation occurred between the TIP and the Phonological Screening-Multisyllabic subtest of the Assessment of Phonological Processes-Revised (Hodson, 1986) ($r = .44$). The fifth and weakest positive significant correlation ($r = .34$) occurred between the TIP and the Yopp-Singer phoneme segmentation task (Yopp, 1988) (for scatter plots of each of the correlations between the TIP and the other six experimental tasks see Appendix J). The only test of phonological awareness that did not have a significant correlation with the TIP was the phoneme blending task (Catts, 1993) ($r = .19$). The phoneme blending task was the same task on which a ceiling effect was observed.

Due to the fact that with each additional correlation performed the risk of making a type I error increases, precautions were taken. The Bonferroni method was utilized to reduce the chance of making a Type I error (Bray & Maxwell, 1985). Thus, each correlation was tested for significance at an alpha level of .008 (.05 divided by 6 = .008, where six is

the number of correlations performed). Even with the more rigorous alpha level of .008, there were no changes in the number of significant positive correlations.

Differences Between First- and Second-Grade Children

Another component of this investigation was to determine if the first-grade children performed significantly lower than the second-grade children on the TIP. To answer that question, seven Analyses of Variance (ANOVAs) were performed, comparing the means of the first- and second-graders on all seven of the experimental tasks administered (for mean scores of first- and second-graders see Table 6). The purpose served by examining the differences between the groups on all experimental tasks was to avoid performing statistical analyses on one task in isolation when the task was not administered in isolation (Dawson-Saunders & Trapp, 1994). Each of the ANOVAs had one factor (experimental task) with two levels (grade level). The significance level for each test was set at an alpha level of .05.

Table 6

Mean Experimental Task Scores For First- and Second-Graders

	<u>1st-Graders</u>			<u>2nd-Graders</u>		
	<u>n</u>	<u>Mean</u>	<u>SD</u>	<u>n</u>	<u>Mean</u>	<u>SD</u>
TIP	43	18	3	38	22	4
Phoneme Deletion	43	16	6	38	21	5
Phoneme						
Segmentation	43	17	4	38	18	3
Phoneme Blending	43	20	2	38	20	2
Word Identification	43	44	28	38	98	13
Word Attack	43	11	11	38	31	12
Multisyllabic						
Screening	43	7	2	38	10	2

Note. The TIP=Test of Implicit Phonology (max. score 30); Phoneme Deletion (Bruce, 1964) (max. score 30); Phoneme Segmentation=Yopp-Singer phoneme segmentation (max. score 22); Phoneme Blending (Catts, 1993) (max. score 30); Word Identification (Woodcock, 1987) (max. score 150); Word Attack (Woodcock, 1987) (max. score 50); Multisyllabic Screening (Hodson, 1986) (max. score 12).

The first reported ANOVA determined if there was a significant difference between the first- and second-graders' performance on the TIP. The results indicated that the second-graders exhibited significantly higher scores than the first-graders [$F(1,79) = 12.61$, $p < .0007$] (see Table 7) on the TIP.

The next ANOVA was executed to determine if the two subject groups performed with significant difference on the phoneme blending task (Catts, 1993). The results suggested that there was not a significant difference in the mean scores of the first- and second-grade subjects on this task [$F(1,79) = .02$, $p < .8986$] (see Table 8).

To determine if there was a significant difference between the two groups on the Yopp-Singer phoneme segmentation task (Yopp, 1988), another ANOVA was calculated. This test indicated that there was not a significant difference between the mean scores of the first- and second-grade children on this task [$F(1,79) = 0.71$, $p < .4023$] (see Table 9).

There was also an ANOVA performed to ascertain if the differences between the first- and second-grade children on the word attack subtest of the Woodcock

Table 7

ANOVA of Group Means for the Test of Implicit Phonology

Source	<u>df</u>	<u>F-Value</u>
Grade	1	12.61*
Error	79	(11.02)

Note. Value enclosed in parentheses represents mean square error.

* = $p < 0.05$

Table 8

ANOVA of Group Means for the Phoneme Blending Task
(Catts, 1993)

Source	<u>df</u>	<u>F-Value</u>
Grade	1	0.02
Error	79	(3.73)

Note. Value enclosed in parentheses represents mean square error. No statistical differences between first- and second-grade children on this task.

Table 9

ANOVA of Group Means for the Yopp-Singer Phoneme
Segmentation Task (Yopp, 1988)

Source	<u>df</u>	<u>F-Value</u>
Grade	1	0.71
Error	79	(13.99)

Note. Value enclosed in parentheses represents mean square error. No statistical differences between first- and second-grade children on this task.

Reading Mastery Tests-Revised (Woodcock, 1987) was significant. As indicated in Table 10, the first-grade subjects performed significantly lower than the second-grade subjects on this particular word decoding task [$F(1,79) = 61.61, p < .0001$].

An ANOVA was computed to examine the differences between the first-grade subjects and the second-grade subjects on the word identification subtest of the Woodcock Reading Mastery Tests-Revised (Woodcock, 1987). The resulting F test demonstrated that the second-grade subjects performed significantly better than the first-grade subjects on this task [$F(1,79) = 115.54, p < .0001$] (see Table 11).

An ANOVA was also performed to determine if the first- and second-graders performed significantly different on the phoneme deletion task (Bruce, 1964). As indicated by the analysis, there was a significant difference between the performance of first- and second-grade children on this task [$F(1,79) = 28.93, p < .0001$] (see Table 12).

The last ANOVA was calculated to examine the differences between the first- and second-graders' performance on the Phonological Screening-Multisyllabic

Table 10

ANOVA of Group Means for the Word Attack Subtest of the
Woodcock Reading Mastery Tests-Revised (Woodcock, 1987)

Source	<u>df</u>	<u>F-Value</u>
Grade	1	61.61*
Error	79	(103.18)

Note. Value enclosed in parentheses represents mean
square error.

* = $p < 0.05$

Table 11

ANOVA of Group Means for the Word IdentificationSubtest of the Woodcock Reading Mastery Tests-Revised(Woodcock, 1987)

Source	df	F-Value
Grade	1	115.54*
Error	79	(501.55)

Note. Value enclosed in parentheses represents mean square error.

* = $p < 0.05$

Table 12

ANOVA of Group Means for the Phoneme Deletion Task(Bruce, 1964)

<u>Source</u>	<u>df</u>	<u>F-Value</u>
Grade	1	28.93*
Error	79	(5.41)

Note. Value enclosed in parentheses represents mean square error.

* = $p < 0.05$

subtest of the Assessment of Phonological Processes-Revised (Hodson, 1986). The score obtained for this task consisted of the number of words correctly produced. Again, on this task the first-graders scored significantly lower than the second-graders [$F(1,79) = 13.91, p < .0004$] (see Table 13).

In summary, five of the seven ANOVAs revealed that the first-graders performed significantly lower than the second-graders on the following tasks: (a) the TIP (Lance, 1994); (b) the word attack subtest of the Woodcock Reading Mastery Tests-Revised (Woodcock, 1987); (c) the word identification subtest of the Woodcock Reading Mastery Tests-Revised (Woodcock, 1987); (d) the phoneme deletion task (Bruce, 1964); and (e) the Phonological Screening-Multisyllabic subtest of the Assessment of Phonological Processes-Revised (Hodson, 1986). The experimental tasks for which no significant differences between the first- and second-grade subjects were found include the phoneme blending task (Catts, 1993) and the Yopp-Singer phoneme segmentation task (Yopp, 1988). Again, due to the number of ANOVAs performed, the Bonferroni method was

Table 13

ANOVA of Group Means for the Phonological Screening-
Multisyllabic Subtest of the Assessment of Phonological
Processes-Revised (Hodson, 1986)

Source	df	F-Value
Grade	1	13.91*
Error	79	(32.89)

Note. Value enclosed in parentheses represents mean square error.

* = $p < 0.05$

employed to reduce the chance of a Type I error. Therefore, each p value was tested for significance at an alpha level .007 (.05 divided by 7 = .007, where seven is the number of ANOVAs calculated). Although this was a more stringent alpha level the first-grade children performed significantly lower than the second-grade children on the same five tasks.

A multivariate analysis of variance (MANOVA) was computed to determine if there was a significant difference between the first- and second-graders on the means of the experimental tasks considered simultaneously. The MANOVA provides an omnibus, multivariate F test; thus providing an indication of whether or not first- and second-graders perform differently on these types of tasks. The MANOVA had one factor (group) with two levels (first- and second-graders) and seven dependent variables (the experimental tasks). The probability level of 0.05 was chosen for this analysis. This analysis, also known as the Hotelling-Lawley Trace test, indicated that there was a significant difference for the seven tasks [$F(1,81) = 15.81, p < .0001$].

Summary of Results

The primary purpose of this study was to establish the criterion-related validity of the TIP as a measure of phonological awareness. In order to accomplish the purpose of this study Pearson product-moment correlations were performed to assess the relationship between the Test of Implicit Phonology (modification of Lance, 1994) (TIP) and the other experimental tasks. Additionally, the differences in performance between the first- and second-grade children on the TIP and all of the tasks was examined using ANOVAs and a MANOVA.

It was hypothesized that the TIP would be significantly correlated with one or all of the other six experimental tasks employed as part of this study. The TIP was found be significantly correlated with five of the six experimental tasks.

It was also hypothesized that the first-graders would perform significantly lower than the second-graders on the experimental tasks. The ANOVAs demonstrated that the first-grade children performed significantly lower than the second-grade children on the TIP, the phoneme deletion, the word attack task, the word identification task, and the multisyllabic

word production task. The two tasks on which the two groups did not perform significantly different were the phoneme segmentation task, and the phoneme blending task. Results from the MANOVA indicated the two groups performed significantly differently when all of the tasks were considered simultaneously.

Chapter V

Discussion

The primary purpose of this investigation was to establish the criterion-related validity of the TIP as a test of phonological awareness based on the performance of normally developing first- and second-grade children. One of the means used to achieve this goal was to determine to what extent the TIP was related to other valid measures of phonological awareness, decoding, and the production of phonemically complex words. The TIP was significantly positively related to two of the three phonological awareness measures. It also exhibited a significant positive correlation with both measures of decoding and with the multisyllabic word production task.

TIP and Other Phonological Awareness Tasks

The relationship between the TIP and the phoneme deletion task (Bruce, 1964) was the strongest of the correlations found between the TIP and any of the phonological awareness tasks, with a correlation

coefficient of .66. This in itself supports the view that the TIP and the phoneme deletion task share the same underlying phonological construct. Furthermore, this correlation coefficient was in agreement with the pattern noticed for most correlations in the social sciences, for which the expected range of correlation coefficients is between .30 to .70 (Freedman, Pisani, & Purves, 1978).

Relationship Between Phoneme Deletion and the TIP

Although the correlation between the TIP and the phoneme deletion task was not extremely high ($r = .66$), this can be explained by the mere fact that these tasks assessed phonological awareness on two different phonological levels. That is, the phoneme deletion task is an explicit task whereas the TIP is an implicit task.

Another reason for the lack of a higher correlation between these two tasks could be the different number of component steps required to complete each task. Yopp (1988) outlined the different steps/skills required for different phonological awareness tasks. The phoneme deletion task was

classified as an explicit task of compound phoneme awareness and required 13 different steps to complete the task successfully. These steps included (a) hearing the stimulus items; (b) perceiving the separate sounds; (c) holding the stimulus items in memory; (d) segmenting the sounds; (e) counting the sounds; (f) locating a given position in the word; (g) identifying the sounds in a given position; (h) isolating a given sound; (i) holding a given sound in memory; (j) holding other sounds in memory; (k) blending the sounds; (l) sequencing the sounds; and (m) articulating the sounds or words. The TIP, on the other hand, was an implicit task of phonological awareness which required the following six steps: (a) hearing the stimulus items; (b) perceiving the separate sounds; (c) holding the stimulus items in memory; (d) holding the consonant sequence(s) in memory; (e) comparing the consonant combination(s) to phonological rules; and (f) making a judgement.

Although these tasks have some components in common, based on this type of task analysis, they are not similar enough to explain the strength of their relationship. Another element that could have had a

positive influence on the relationship between these two tasks is the commonality seen in the surface structure of the stimuli used by both. The TIP was specifically designed to be a task of consonant sequences, which required subjects to determine if consonant sequences were acceptable in English or not. The phoneme deletion task chosen for this study was heavily loaded with words containing consonant sequences. In fact 20 of the 30 stimulus words for the phoneme segmentation task contained consonant sequences. Of these 20 words, 19 required one member of a consonant sequence to be deleted.

To further explore this area as a possible connection between these two tasks, an error analysis was performed on the subjects' responses on the phoneme deletion task. Several different error patterns noted were as follows: (a) difficulty segmenting consonant sequences, (b) creating a new rhyming word, (c) unstressed syllable deletion, (d) prevocalic consonant deletion, (e) postvocalic consonant deletion, and (f) miscellaneous.

The subjects tended to have difficulty separating the two members of a consonant sequence. In fact this

error classification made up about 32 percent of the total error types seen for this particular task. For example the subjects were asked to delete the /t/ in the word stand. Two very frequent responses were /stænd/ and /ænd/. Both errors are suggestive of an inability to separate two abutting consonants. In other words the cluster is seen as an entity rather than two separable sounds.

Another error classification was rhyming error, which was defined as the creation of a new word which required the deletion of the prevocalic phoneme(s), and the insertion of a different prevocalic phoneme. This criteria was chosen because initial consonant deletion and creating a new rhyming word were considered to be two different strategies. For example, the child who deleted the initial consonant was just deleting, and therefore may have just been employing the deletion as the strategy; whereas the child who created a new rhyming word for the response was not only deleting, but was also adding which was not what the task required. Rhyming constituted about 15 percent of the total error types.

Unstressed syllable deletion was another error type observed, and it occurred six percent of the time. Although this error type did not make up the bulk of the errors, as there were only few contexts in which this error could occur, it appeared with enough regularity that it seems important to mention. There were only four words on which this error could occur, yet it accounted for 57 out of a possible 324 errors.

Prevocalic and postvocalic errors occurred with a frequency of 10 percent and 8 percent, respectively, and again demonstrate the children's attempt to eliminate a phoneme from the stimulus word. Based on the error, it appeared that the subjects were having difficulty unfolding the sounds within the word. The miscellaneous errors made up the rest of the mistakes noted on the task and consisted of no responses, alliterated words, and unrelated words.

Another component of the response patterns observed on the phoneme deletion task involved the two stimulus words pink and think. The children were required to remove the voiceless velar stop, /k/, from the end of both of these words. Some of the subjects produced /pɪŋ/ and /θɪŋ/, thus eliminating the

postvocalic /k/. This particular pattern occurred 31 out of a possible 162 times and was counted as correct because it is actually a better reflection of the task than the alternative correct answer (i.e., /pIn/ and /θIn/). That is, in order to respond with the answer /pIn/ instead of /pIn̩/ the child would have to know the orthographic spelling, remove the /k/ from that sequence of letters, and then produce the orthographic equivalent for the pink without the k which is /pIn/. To respond with /pIn̩/ requires an acoustic level of performance for which the child would have to remove a sound from a string of sounds. If the /k/ is removed from /pIn̩k/ then, of course, the resulting answer is /pIn̩/.

Of these particular error types, the consonant sequence errors appear to be the most relevant in terms of explaining the correlation demonstrated between these two tasks. There are two different accounts of phonological development and representation that are related to the way individuals encode the phonological structure of language, and both are pertinent to this line of discussion. One is the linear view which suggests that words are encoded at the phoneme level

and are phonologically represented as such (e.g., trip = /t/+/r/+/I/+/p/). The other is the nonlinear view of phonological development which suggests that initially the child encodes and retrieves phonetic gestures of the entire syllable or syllabic unit (Bernhardt & Gilbert, 1992; Bernhardt & Stoel-Gammon, 1994; Fowler, 1991). These phonetic gestures stored in the underlying representation become increasingly phonemic from the ages three to seven years (Fowler, 1991). For example, in normal phonological development, the phonological representation of the word trip would be /tr/ + /Ip/ before it would be represented by its individual phonemes of /t/ + /r/ + /I/ + /p/. It is suggested that even as the phonemic gesture becomes more phonemic in nature, there continues to be a nonlinear phonological representation. This theory suggests that subunits, called the onset and rime (e.g., /tr/ + /Ip/, respectively), continue to exist between the syllable and the phoneme (Fowler, 1991).

By applying the principles outlined for the nonlinear model of phonological development, better insight may be obtained concerning the relationship between these two tasks. This model was able to

predict that the subjects were going to have difficulty deleting a member of the consonant sequences that made up a good portion of the phoneme deletion task. When the nonlinear model was applied to the TIP it also predicted the difficulty the children exhibited. The TIP required the analysis of the consonant sequences for one member that did not belong, thus at some level requiring segmentation, and this explains the subjects' difficulty. As a result, the nonlinear model can explain the difficulty the subjects exhibited on these two tasks and can therefore better explain the relationship between the TIP and the phoneme deletion task. This particular examination supports the notion that the TIP and the phoneme deletion task are related at the level of phonological representation, thus adding support for the notion that the TIP has criterion-related validity as a task of phonological awareness.

Relationship Between Phoneme Segmentation and the TIP

The other phonological awareness task that the TIP was positively significantly correlated with was the Yopp-Singer phoneme segmentation task. The correlation

coefficient obtained for the relationship between the TIP and the Yopp-Singer phoneme segmentation task was .35. This was a weaker correlation than the one exhibited between the TIP and phoneme deletion, but it nonetheless provided support for the criterion-related validity of the TIP.

As the TIP exhibited such a strong relationship to a compound measure of phonological awareness, it stands to reason that it would have less in common with a measure of simple phonological awareness (i.e., phoneme segmentation). Additionally, the relatively low correlation can also be explained by the different levels at which both of these tasks assessed phonological awareness. The phoneme segmentation task required the explicit understanding of the existence of individual phonemes as discrete units, whereas the TIP required understanding of the correct combining of consonant sequences. The fact that these tests exhibited a positive significant correlation at all suggested that they are at some level assessing the same underlying phonological system, the same system that supported the function of decoding written words.

Some of the children had difficulty on the segmentation task but, for the most part, the mean performance on this task was better than that for the TIP (see Appendix K for stem and leaf plots). For example, on the TIP the children obtained a mean score of 67 percent, whereas on the phoneme segmentation task the mean score was 78 percent.

Additionally, just as was suggested by Liberman and her co-workers (1974), some of the children exhibited overshoot errors but, for the most part, the error patterns of this particular test were insufficient segmentation (e.g., /weIv/ → /w/-/eIv/). These error types provide further support for a nonlinear theory of phonological development and organization, and they suggest an intrasyllabic level of underlying phonological representation (i.e., onset-rime).

Relationship Between Phoneme Blending and the TIP

The phoneme blending task was included in this study to provide a measure of synthesis ability in the first- and second-grade children tested. Although this type of task was not judged to be a valid measure of

phonological awareness tasks in Yopp's (1988) study, it was included in this investigation because it was felt that a task of synthesis was needed in order to allow for a comparison between the TIP and that level of phonological awareness. The correlation coefficient for the relationship between the TIP and the phoneme blending task (Catts, 1993) was .19, which, although positive, was not statistically significant.

A possible reason for this surprisingly low correlation coefficient could be the result of the ceiling effect (see Appendix K for a stem and leaf plot) that was noted on this task. There were no significant differences between the performance of these two groups on the phoneme blending task, and the subjects performed better on this task than on any other task, obtaining a mean of 91 percent correct. In contrast, they achieved a mean of 67 percent correct on the TIP.

The test consisted of 23 items of which seven required the blending of syllables, seven required the blending of an onset and rime, five required the blending of three different phonemes, and three required the blending of four different phonemes. It

was noted that for this task the majority of the errors occurred on items that required four phonemes to be blended. It is possible that if the test had contained more of the three and four phoneme blending items, the ceiling effect might not have occurred, thus resulting in a better demonstration of a relationship between these two tasks.

Relationship Between Measures of Decoding and the TIP

Another aspect of determining the criterion-related validity of the TIP was being able to establish a relationship of this task to that of decoding ability. There is overwhelming evidence supporting the relationship between phonological awareness and reading ability in children (Bradley & Bryant, 1983; Catts, 1993; Fletcher et al., 1994; Kamhi & Catts, 1986; Mann & Liberman, 1984; Perfetti et al., 1987; Shankweiler & Liberman, 1976; Stahl & Murray, 1994; Vellutino & Scanlon, 1987; Yopp, 1988). Therefore no test of phonological awareness could be called such unless it exhibited an acceptable level of correlation with reading measures.

The two tests of reading ability, subtests of the Woodcock Reading Mastery Tests-Revised (Woodcock, 1987), administered as part of this study were word identification and word attack. A positive significant correlation of .55 was found between the TIP and the word attack, and a positive significant correlation of .50 was found between the TIP and the word identification. These results supported the view that the TIP has criterion-related validity as a test of phonological awareness.

The results are very similar to correlation coefficients obtained by other researchers in studies that explored the relationship between phonological awareness and reading tasks. In an overview of the different studies which reported correlations between reading and phonological awareness measures, Stanovich (1992) indicated that the median correlation between reading and phonological awareness tasks was .52.

One explanation of this relationship could be that the reading method used to teach reading to the subjects increased these particular subjects' performance on the TIP alone. The basal reader series used by this particular school district included direct

instruction in sound-symbol relationships and in rhyming patterns. These techniques were particularly prevalent in the first-grade instruction.

A more reasonable explanation is that the reading and spelling instruction provided to these first- and second-graders was equal for all of the phonological awareness tasks administered and had an impact on their overall phonological sensitivity. Therefore, the reading and spelling instruction did not misrepresent the TIP's relationship to the tasks of decoding. This opinion is supported by the research indicating that an increase in phonological awareness skill will indicate an increase in reading skill (Liberman et al., 1974; Perfetti et al., 1987; Vellutino & Scanlon, 1987). Regardless of the direction of cause, the relationship demonstrated between the tests of reading and the TIP was expected, and without this correlation the TIP would have little use as a phonological awareness assessment procedure.

Relationship Between Articulation and the TIP

The last relationship that was explored as part of this study was between the ability to select the

correct nonsense word on the TIP and the ability to produce multisyllabic words. In previous studies implicit phonological skill has been demonstrated to be related to articulation ability (Kloss, 1983; Lance, 1994; Whitacre, Luper, & Pollio, 1970) and reading ability has been related to articulation ability (Catts, 1986; Kamhi & Catts, 1986).

The correlation coefficient between the TIP and the Phonological Screening-Multisyllabic subtest of the Assessment of Phonological Processes-Revised (Hodson, 1986) was .44. The moderate correlation between these two tasks suggests that they tap into the same phonological system, consequently supporting the assertion of criterion-related validity for the TIP.

These results are in agreement with Fowler (1991) who suggests that phonological awareness and control over the articulators are integrally connected. Consequently, the relationship seen between these two measures should be expected. This correlation further demonstrates that phonological awareness ability and reading extends beyond the level of explicit awareness to the level of phonological representation and organization.

The extent to which the TIP was related to other tasks of phonological awareness, reading ability, and multisyllabic word production provides strong evidence in support of the statement that the TIP has criterion-related validity as a phonological awareness task. These results are in concordance with other studies that looked at the relationships between phonological awareness tasks and reading.

Developmental Differences on the TIP

This investigation also addressed the performance differences exhibited between first- and second-graders on phonological awareness tasks, and more specifically on the TIP. It was found that the second-graders performed significantly higher than the first-graders on this task.

In earlier studies it was demonstrated that children with normal articulation skills could more easily identify correct responses for the items when the foil type was an IE2 than IE1. In order to explore this aspect of the TIP as a possible explanation of the lower correlation between it and the phoneme segmentation task, a two-factor ANOVA, with one between

subjects factor (i.e., group) and one within subjects factor (i.e., complexity level), was performed to determine if there were any differences of the mean performance between the two foil types (see Appendix L for ANOVA table). As was predicted, there were significant differences between the two error types [$F(1,81) = 184.04, p < .0001$], with the subjects exhibiting more correct responses when the foil type was IE2 versus than when the foil type was IE1.

Additional information obtained from the two-factor ANOVA indicated that there was no interaction between the first- and second-graders' performance and the two foil types (i.e., IE1 vs. IE2). These results suggest that the different complexity levels work in the same manner for both the first- and second-graders and that the second-graders are better at the task. This demonstrated that the TIP was sensitive to developmental differences which might have been attributed to the different complexity level built into the test.

Differences in Skill Level on Tasks of
Phonological Awareness

Another aspect of this investigation examined whether there were differences in performance between the first- and second-graders on all the tasks: phonological awareness, reading ability, and multisyllabic word production. That first-grade children performed significantly lower than the second-grade children on the phoneme deletion task, the TIP, the word attack subtest, the word identification subtest, and the multisyllabic word production task is evidence of this. The relative ease with which the second-grade children performed these tasks shows a developmental trend in terms of skill mastery.

Although there were no significant differences between the first- and second-graders on the Yopp-Singer phoneme segmentation task and the phoneme blending task due to ceiling effects, this too provides support for that opinion. Perfetti and associates (1987) suggested that phoneme blending ability develops before phoneme deletion ability. Therefore it would stand to reason that simple phoneme awareness (e.g., phoneme blending and phoneme segmentation) would be

mastered prior to compound phoneme awareness (e.g., phoneme deletion).

The fact that the first-graders performed significantly lower than the second-graders on the majority of the tasks may have been influenced by reading and spelling instruction. If the first-graders' performance on the phonological awareness tasks was indicative of the second-graders' phonological awareness when they were in first-grade, then the reading instruction that they received as part of their academic studies not only increased their reading skill, but also increased their level of phonological awareness. This phenomenon suggested that very young readers (i.e., first-grade readers) who have had relatively less reading instruction than their second-grade compatriots exhibit a lesser degree of phonological awareness. It also supported the hypothesis that reading and spelling instruction influence the acquisition of phonological awareness skills. Although this study was not designed to test the bidirectional hypothesis, it provides very limited support for it.

The TIP as a Valid Clinical Tool

The TIP is a test of implicit phonological awareness that is significantly correlated with other phonological awareness tasks, decoding tasks, and the production of phonetically complex words. It also proved to be more sensitive than other similar tasks to the differences in phonological awareness skill exhibited by first- and second-grade children. In actuality, it was more sensitive than the phoneme segmentation task and the phoneme deletion task used for this study. Based on this evidence, it has been demonstrated that the TIP has criterion-related validity as a test of phonological awareness.

Modifications of the TIP

Although, the TIP is not a new protocol, it has been modified several times since it was first used by Messer (1967). In the past, the test was either orally presented to subjects, or the items were recorded and presented to the subjects with no attempt to regularize the acoustic properties of the nonsense word pairs. This version of the TIP has several advantages over the previous versions. Several standards were put into

place during the creation of the stimuli for this study. These standards were employed in an attempt to prevent the unintentional marking of one member of the nonsense word pair, which possibly could have influenced nonsense word choice regardless of the phonetic properties.

For example, steps were taken to ensure that each member of a nonsense word pair was approximately the same in amplitude. The duration of each member of the nonsense word pair was also controlled; there was no more than a 50 ms difference between the members of a word pair. Recording conditions were utilized to produce the best possible recordings (see Chapter II for the recording specifications).

Clinical Utility of the TIP

As this test takes under 10 minutes to administer, it is a time-efficient procedure that can yield important information about phonological awareness ability. The fact that the TIP is audiotaped is one advantage over other tasks of phonological awareness. Because of this, it is not influenced by the limitations of live voice administration, which include

lack of control of the acoustic characteristics of the stimuli.

Also, because the test is audiotaped, the presentation of the stimuli can occur through headphones and/or speakers. As opposed to typical performance, the TIP provides a measure of optimal performance that gives the clinician critical information in terms of diagnosis and treatment strategies. Additionally, the increased performance of a child with the headphones possibly could provide useful information when making decisions about purchasing a personal FM system for use in the classroom.

Another advantage of testing phonological awareness using the TIP is that this method is not used for instruction of the phonological awareness skill. This cannot be said about most of the other measures of phonological awareness. In fact, most published phonological awareness programs utilize rhyming, synthesis, and analysis tasks, all of which are used for assessing phonological awareness.

The TIP's forced choice nonsense word paradigm is not typically used as a remediation technique.

Therefore, since the clinician does not teach this task, a change in performance on the TIP would more likely represent a change in the underlying phonological representation. Developing a more phonemic underlying representation perhaps could be extremely difficult for some children, for even though they may be taught to perform tasks of analysis and synthesis with some accuracy, their underlying representation may be resistant to change. This could result in premature dismissal from treatment when in fact further, possibly different steps need to be taken to effect a change in the underlying representation.

The TIP can provide a more accurate assessment of young readers' phonological systems before, during, and after therapeutic intervention. Therefore, the TIP could be included in the diagnostic battery for the appraisal of phonological awareness problems in children.

Areas of Further Investigation

Although, the principle goal of this investigation was achieved and the criterion-related validity of the TIP has been established, questions about the TIP's

possible limitations remain to be answered. One question concerns the youngest age for which the TIP can be used to identify phonological awareness skills. Messer (1968) applied the first version of this forced choice nonsense word paradigm to children whose ages ranged from three years one month to four years five months. Four of the 20 subjects were eliminated from his study because they did not understand the task. Since the ages of those subjects who did not understand the task were not reported, and the total number of subjects was relatively small, further research is required to establish the ages for which the TIP can be most useful for assessing phonological awareness skills.

Another area of research should involve the establishment of normative data for the TIP, including the application of this task to children with different ethnic backgrounds. To date this task has been used with children from fairly similar circumstances (Kloss, 1983; Lance, 1994; Messer, 1968; Whitacre et. al, 1970). It is important to determine if the task is biased against ethnic differences in order for modifications to be made that insure the test is a

sensitive measure of phonological awareness for all children learning to read.

An additional question concerns the influence that different methods of reading instruction has on children's performance on the TIP. In the current investigation the subjects were being taught to read with a basal reader that included typical phonics-based reductionism. Therefore, it needs to be determined if children receiving either whole language instruction or an even more traditional basal reader instruction would perform any differently on the TIP than would children receiving phonics-based instruction.

As Liberman and Liberman (1990) suggest that 75 percent of all children learn the alphabetic principle, in spite of the unhelpful reading methods employed in the classroom, the method of reading instruction for the majority of the children probably would not influence performance on the TIP. For the remaining 25 percent of children who require explicit instruction in order to master the alphabetic principle, it is predicted that the method of reading instruction would influence performance on the TIP.

Therefore, an added area that needs to be explored concerns how children from special populations who are at risk for decoding difficulties (i.e., children with specific language impairment, auditory processing disorders, reading disabilities, etc.) perform on the TIP. It is hypothesized that the TIP would be able to detect phonological awareness problems in children who are at risk for reading problems, but to date it has only been tested on normally developing children and on children with unintelligible speech.

Another area that warrants attention is the method used to administer the test. Do children perform better if the test is administered through circumaural headphones rather than over speakers? Are children with auditory processing problems sensitive to the difference in stimuli presentation?

There is an excess of new avenues of research that have been generated from this investigation which established the criterion-related validity of the TIP. These additional lines of investigation should prove the TIP to be a versatile phonological awareness assessment tool capable for use with many different populations.

Chapter VI
Summary and Conclusions

Summary

This study was designed to investigate the criterion-related validity of the Test of Implicit Phonology (modification of Lance, 1994) (TIP) as a test of phonological awareness. The TIP, three tasks of phonological awareness, two tasks of decoding, and one task of multisyllabic word production were given to 43 first-grade children and to 38 second-grade children.

The TIP utilized a forced choice nonsense word pairs paradigm that involved choosing the one member of the nonsense word pair that did not violate the consonant combination rules of English. The phonological awareness tasks chosen for comparison to the TIP were a phoneme deletion task (Bruce, 1964), the Yopp-Singer phoneme segmentation task (Yopp, 1988), and a phoneme blending task (Catts, 1993). These tasks were chosen so that the TIP could be compared to tasks that assessed phonological awareness on different levels (i.e., analysis, synthesis, implicit, and

explicit). The decoding tasks were two subtests from the Woodcock Reading Mastery Tests-Revised (Woodcock, 1987), the word attack and the word identification subtests. The last experimental procedure, the Phonological Screening-Multisyllabic subtest of the Assessment of Phonological Processes-Revised (Hodson, 1986), was chosen because it is a task of phonological processing.

The relationship between the TIP and the other experimental tasks was examined by calculating Pearson product-moment correlation coefficients. Positive significant correlations were found between the TIP and five of the other tasks administered, which included the following: the phoneme deletion task ($r = .66$), word attack subtest ($r = .55$), the word identification subtest ($r = .50$), multisyllabic word production ($r = .44$), and phoneme segmentation task ($r = .34$).

The TIP was also demonstrated to be sensitive to the developmental changes present in first- and second-graders. ANOVAs and a MANOVA were used to examine the differences in the two groups' performance on the TIP and on the other experimental tasks. The first-grade children performed significantly ($p = < .05$) lower than

the second-grade children on the TIP, the phoneme deletion task, the two tasks of decoding, and the multisyllabic word production task. The two tasks on which the first- and second-graders did not perform with significant difference were the phoneme blending task and the phoneme segmentation task. This was due to the high level of accuracy exhibited by the groups on both tasks.

Conclusions

The TIP is a phonological awareness test with criterion-related validity. It has been demonstrated to be significantly correlated with tasks of phonological awareness, decoding, and multisyllabic word production. The fact that the TIP has a strong correlation with the phoneme deletion task and a moderate correlation with the phoneme segmentation task, both of which are tasks of phonological awareness, supports the assertion that the TIP has criterion-related validity. Additional support for this statement is obtained from the moderate relationship that was demonstrated between the TIP the tasks of decoding skill. The TIP was also found to

have a moderate correlation with multisyllabic word production, a phonological processing task which adds even more evidence in support of the TIP as a valid measure of phonological awareness skill.

Furthermore, the TIP is sensitive to the phonological developmental differences between first- and second-graders. The first-grade children performed significantly lower than the second-grade children on the TIP. The fact that the TIP was sensitive to the differences between these two groups is confirmation that the TIP can be a useful phonological awareness assessment tool.

The TIP also has advantages over other measures of phonological awareness. It is the only assessment tool to date administered via an audiotape that assesses implicit phonological awareness. It also provides for test administration under optimal conditions, which is important in gathering information for the decision to purchase a personal FM amplification system for an individual. Additionally, use of the TIP precludes the problems of teaching the test, which currently occurs as part of phonological awareness instruction.

As a test of phonological awareness, the TIP is an important new tool that can improve the early identification of children who are at risk for difficulty in learning how to decode words.

Although there are several questions that need to be answered, there are many reasons for the inclusion of this test as part of an assessment battery for children if there is a concern about phonological awareness skill.

Glossary

Glossary

Criterion-Related Validity--is concerned with the correlation of the test with the behavior that is measured.

Developmental apraxia of speech--a disorder of volitional oral motor planning, which affects speech production as well as other oral motor movements.

Face Validity--is the surface examination of items to assess whether the test items really cover the behaviors that are measured.

Functional articulation disorder--"incorrect production of standard speech sound(s) for which there is no known physiological, anatomical, or neurological bases"

(Nicolosi, Harryman, & Kresheck, 1989, p. 17).

Stanine--"represents bands of values [and] with the exception of 1 and 9 which are open-ended, each stanine is exactly one-half of a standard deviation in width. The mean of the stanine scale is five, and the standard deviation is two" (Peterson & Marquardt, 1990, p. 7).

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Appendices

Appendix A

Appendix A

Parent Questionnaire

Name: _____ Parent: _____
DOB: _____ CA: _____ Sex: _____ Sub. #: _____
Address: _____
Phone: _____ (home)
_____ (work)

1. Has your child ever received speech therapy or any type of special services? _____ If so, what type?

2. Has your child ever failed a grade? _____
3. How many ear infections has he/she had in the last six months? _____
4. When did your child say his/her first words _____;
(e.g., _____)
and two word combinations _____ (e.g., _____)?
5. Does any member of your child's immediate family have a history of reading problems? _____ If so, what is the relationship to the child? _____
6. Is your child receiving any foreign language instruction? _____ If so, what language? _____

Appendix B

Appendix B
Teacher Questionnaire

Name: _____ Teacher: _____

Sub. # _____ Classroom # _____

1. How would you rank his/her learning ability--below
average, average, or above average? _____

2. How would you rank his/her speech/language skills--
below average, average, above average? _____

3. What is his/her reading level? grade _____ mos. _____

4. Is he/she receiving any special services? _____

5. What days and times would be the best to test
him/her? _____

6. Has he/she been retained a grade? _____

Appendix C

Appendix C
Test of Implicit Phonology
D. Lance

Items	Correct Response	I-E1	I-E2
1. ʃrib--ʃkib	<u>1</u>	X	
2. tʃluf--gluf	<u>2</u>	X	
3. zɫʃt--plʃf	<u>2</u>	X	
4. tseɪtk--blɫʃt	<u>2</u>		X
5. fwaɪz--slaɪz	<u>2</u>	X	
6. spræŋk--spweɪfk	<u>1</u>		X
7. trɪsk--tleɪdk	<u>1</u>		X
8. tɫɪb--spɪb	<u>2</u>	X	
9. ʒræzp--dræsk	<u>2</u>		X
10. preɪbz--pfeɪzm	<u>1</u>		X
11. dwɪl--nwɪl	<u>1</u>	X	
12. kleɪst--dleɪsf	<u>1</u>		X
13. θrup--pʃup	<u>1</u>	X	
14. dleɪk--kleɪk	<u>2</u>	X	
15. brɪts--ŋtiwd	<u>1</u>		X
16. swald--spweɪθk	<u>1</u>	X	
17. spɛln--ʃkumv	<u>1</u>		X
18. ʃrʌnt--sræŋk	<u>1</u>		X
19. ʒærdz--nærts	<u>2</u>	X	
20. kmɪpz--drædz	<u>2</u>		X
21. fwævp--flæmp	<u>2</u>		X
22. bʒust--dʒrælʋ	<u>1</u>		X
23. mɹul--frul	<u>2</u>	X	
24. tredʒd--ʒredʒd	<u>1</u>	X	
25. fwɪg--grɪg	<u>2</u>	X	
26. mʒubz--bzɪfk	<u>1</u>		X
27. srot--drot	<u>2</u>	X	
28. tʃɪst--hɒɫʃ	<u>1</u>	X	
29. spʊts--bwʊmf	<u>1</u>		X
30. gnʌlb--brʌln	<u>2</u>		X

*IE1 = Impossible in English by one consonant combination.

*IE2 = Impossible in English by two consonant combinations.

Appendix D

Appendix D

Duration of Nonsense Words

- | | |
|-------------------------|-------------------------|
| 1. ʃrɪb = 982.7 ms* | 11. dwɪl = 928.8 ms* |
| ʃkɪb = 934.3 ms | nwɪl = 894.0 ms |
| 48.4 ms difference | 34.8 ms difference |
| 2. gluf = 1021.7 ms | 12. kleɪst = 1323.5 ms* |
| tʃluf = 1015.0 ms* | dleɪsf = 1311.9 ms |
| 6.7 ms difference | 11.6 ms difference |
| 3. zɪʃt = 940.0 ms | 13. θrup = 1178.4 ms* |
| plɪʃf = 894.0 ms* | pʃup = 1195.8 ms |
| 46 ms difference | 17.4 ms difference |
| 4. tseɪtk = 986.8 ms | 14. dleɪk = 795.3 ms* |
| blɪʃft = 992.7 ms* | kleɪk = 780.8 ms |
| 5.9 ms difference | 14.5 ms difference |
| 5. fwaɪz = 1137.8 ms | 15. ɲtiwd = 1126.2 ms |
| slaɪz = 1126.2 ms* | brɪts = 1122.6 ms* |
| 11.6 ms difference | 3.6 ms difference |
| 6. spræŋk = 1242.0 ms* | 16. swald = 1126.2 ms* |
| spweɪfk = 1248.0 ms | spweɪθk = 1172.6 ms |
| 6 ms difference | 46.4 ms difference |
| 7. trɪsk = 1346.8 ms* | 17. spɛln = 1142.2 ms* |
| tɪleɪdk = 1358.4 ms | ʃkumv = 1149.4 ms |
| 11.6 ms difference | 7.2 ms difference |
| 8. tɪlɪb = 748.8 ms | 18. ʃrʌnt = 1068.0 ms* |
| spɪb = 795.3 ms* | sræŋk = 1056.8 ms |
| 46.5 ms difference | 11.2 ms difference |
| 9. ʒræzp = 789.5 ms | 19. ʒærdz = 1311.9 ms |
| dræsk = 766.0 ms* | nærts = 1300.3 ms* |
| 23.5 ms difference | 11.6 ms difference |
| 10. preɪbz = 1602.2 ms* | 20. kmɪpz = 1079.7 ms |
| pfeɪzm = 1648.6 ms | drædz = 1056.5 ms* |
| 46.4 ms difference | 23.2 ms difference |

* = correct response

Appendix D continues

Appendix D cont.

- 21. fwævp = 1184.2 ms
flæmp = 1172.6 ms*
11.6 ms difference
- 22. bjust = 1149.4 ms*
dʒrælv = 1126.2 ms
23.2 ms difference
- 23. mrul = 1277.1 ms
frul = 1288.7 ms*
11.6 ms difference
- 24. treIdʒd = 1300.3 ms*
ʒreIdʒd = 1323.5 ms
23.2 ms difference
- 25. fwig = 1184.2 ms
grig = 1172.6 ms*
11.6 ms difference
- 26. mjubz = 1033.3 ms*
bzifk = 1010.1 ms
23.2 ms difference
- 27. srot = 928.8 ms
drot = 952.0 ms*
23.2 ms difference
- 28. tʃIst = 1137.8 ms*
holʃ = 1161.0 ms
23.2 ms difference
- 29. spŮts = 1294.2 ms*
bwŮmf = 1277.4 ms
16.8 ms difference
- 30. gn\lb = 1114.6 ms
br\ln = 1123.9 ms*
9.3 ms difference

* = correct response

Appendix E

Appendix E
The Yopp-Singer Phoneme
Segmentation Task

H. K. Yopp

- | | |
|---------|-----------|
| 1. dog | 12. do |
| 2. fine | 13. keep |
| 3. she | 14. no |
| 4. grew | 15. wave |
| 5. red | 16. that |
| 6. sat | 17. me |
| 7. lay | 18. race |
| 8. zoo | 19. three |
| 9. job | 20. in |
| 10. ice | 21. at |
| 11. top | 22. by |

Appendix F

Appendix F

Phoneme Deletion Task

L. J. Bruce

- | | |
|--------------|---------------|
| 1. S-T-AND | <u>Middle</u> |
| 2. J-AM | <u>First</u> |
| 3. FAIR-Y | <u>Last</u> |
| 4. HA-N-D | <u>Middle</u> |
| 5. STAR-T | <u>Last</u> |
| 6. NE-S-T | <u>Middle</u> |
| 7. F-ROCK | <u>First</u> |
| 8. TEN-T | <u>Last</u> |
| 9. LO-S-T | <u>Middle</u> |
| 10. N-ICE | <u>First</u> |
| 11. S-TOP | <u>First</u> |
| 12. FAR-M | <u>Last</u> |
| 13. MON-K-EY | <u>Middle</u> |
| 14. S-PIN | <u>First</u> |
| 15. FOR-K | <u>Last</u> |
| 16. C-OLD | <u>First</u> |
| 17. PART-Y | <u>Last</u> |
| 18. WE-N-T | <u>Middle</u> |
| 19. F-R-OG | <u>Middle</u> |
| 20. N-EAR | <u>First</u> |
| 21. THIN-K | <u>Last</u> |
| 22. P-LATE | <u>First</u> |
| 23. S-N-AIL | <u>Middle</u> |
| 24. B-RING | <u>First</u> |
| 25. PIN-K | <u>Last</u> |
| 26. LE-F-T | <u>Middle</u> |
| 27. CAR-D | <u>Last</u> |
| 28. S-P-OON | <u>Middle</u> |
| 29. H-ILL | <u>First</u> |
| 30. EVER-Y | <u>Last</u> |

Appendix G

Appendix G
Phoneme Blending
H. Catts

- | | | |
|--------------|------------|--------------|
| 1. birth day | 9. s ing | 17. f ee t |
| 2. air plane | 10. sh irt | 18. m i ss |
| 3. pen cil | 11. m uch | 19. c oa t |
| 4. dol lar | 12. g ood | 20. p a ge |
| 5. mo ther | 13. t op | 21. t r u ck |
| 6. pa per | 14. b ug | 22. s m o ke |
| 7. for get | 15. f i sh | 23. s l i p |
| 8. f un | 16. s oa p | |

Appendix H

Appendix H

Phonological Screening-Multisyllabic Word

B. Hodson

Name _____ Date _____ Examiner _____

STIMULI	TRANSCRIPTIONS	CONSONANT OMISSIONS		METATHESIS MIGRATION	ASSIMILATIONS	OTHER
		SINGLETONS	SEQUENCES			
1. aluminum foil						
2. fire extinguisher						
3. hippopotamus						
4. jewelry box						
5. measuring spoons						
6. movie projector						
7. refrigerator						
8. Sleeping Beauty						
9. spaghetti						
10. stethoscope						
11. telephone message						
12. thermometer						
TOTALS						

Were there three (or more) examples of any of the following error patterns?

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consonant singleton omissions _____
 consonant sequence reductions _____
 metathesis or migrations _____
 assimilations _____

If the answer to two (or more) of the above questions is yes, refer to the manual.

Appendix I

Appendix I

Subjects' Raw Scores

SUB	TD	PPVT	TIP	CATTS	YOPP	WA	WI	HOD	BRUCE	GRADE
1	49	84	14	19	8	0	3	4	13	1
2	46	123	20	23	18	35	97	12	24	1
3	49	117	22	22	21	23	75	7	22	1
4	47	127	24	20	20	22	72	7	17	1
5	49	112	14	17	11	0	22	5	1	1
6	50	91	19	22	19	27	68	11	22	1
7	49	120	22	21	18	13	58	10	23	1
8	49	116	21	22	14	31	100	8	15	1
10	49	124	16	20	7	0	2	4	1	1
11	37	124	10	20	14	6	29	3	16	1
12	50	89	17	15	11	0	22	7	6	1
13	50	110	21	22	19	19	40	6	19	1
14	48	103	19	16	15	13	82	6	11	1
15	50	95	20	19	21	9	39	7	17	1
16	48	94	24	23	17	21	84	6	18	1
17	37	120	20	22	18	1	8	5	15	1
18	38	115	18	21	22	9	9	4	7	1
19	39	126	16	22	17	16	48	10	11	1
20	48	122	22	22	21	11	32	10	22	1
21	50	102	20	19	16	0	32	3	7	1
22	49	101	16	20	3	1	42	8	13	1
23	35	103	17	22	22	25	39	10	20	1
24	49	116	18	22	19	1	17	3	18	1
25	50	126	26	21	22	24	94	12	22	1
26	49	124	20	21	15	0	7	7	19	1
27	38	124	22	21	21	16	44	10	19	1
28	49	105	20	22	14	11	39	5	26	1
29	50	120	20	22	19	15	41	8	18	1
30	37	114	14	21	11	22	62	4	1	1
31	31	109	21	20	19	24	83	4	12	1
32	40	122	20	22	17	2	20	4	15	1
33	50	126	17	22	16	16	63	10	19	1
34	49	106	14	23	14	4	53	5	11	1
35	49	124	22	23	19	13	42	7	21	1
36	50	101	18	20	17	7	18	9	13	1
38	50	120	18	21	18	33	96	12	19	1
37	49	117	23	23	19	13	55	10	23	1
40	49	104	17	22	15	2	11	5	18	1
41	42	88	19	18	20	0	1	6	19	1
42	50	123	24	20	22	6	35	8	21	1

Appendix I continues

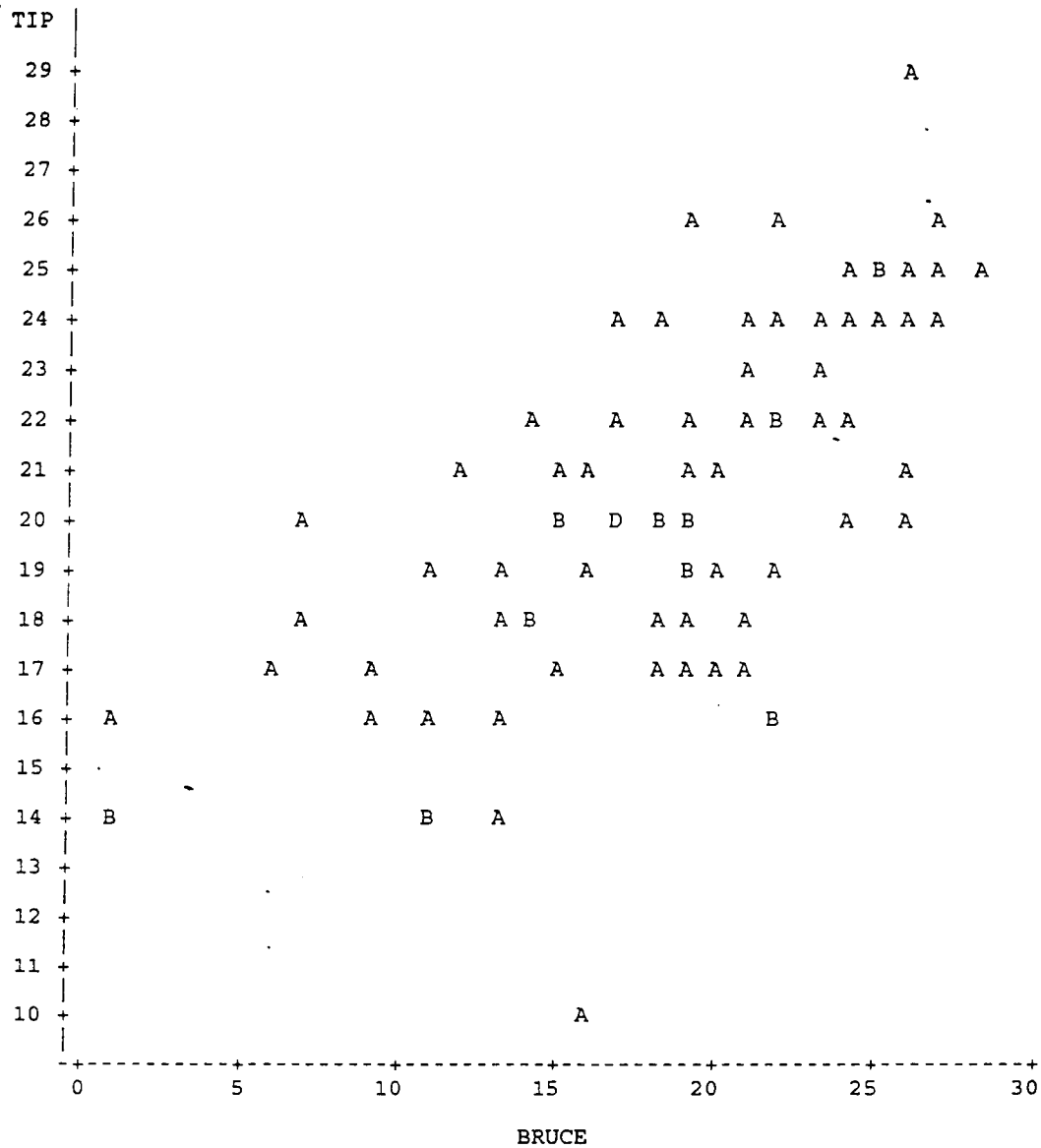
Appendix I cont.

SUB	TD	PPVT	TIP	CATTS	YOPP	WA	WI	HOD	BRUCE	GRADE
43	50	99	16	22	22	1	47	7	22	1
44	48	121	16	22	21	0	30	6	9	1
45	50	115	18	18	16	0	37	5	14	1
46	50	117	24	21	18	44	119	11	26	2
47	50	125	20	23	16	24	95	9	17	2
48	49	111	20	22	21	39	100	11	17	2
49	50	113	29	22	21	43	124	11	26	2
50	50	88	21	19	17	32	98	9	26	2
51	50	130	19	20	20	23	99	12	16	2
52	50	112	25	23	19	43	117	11	26	2
53	50	107	22	17	17	20	83	7	14	2
54	38	99	25	21	18	50	102	11	25	2
55	50	108	25	16	19	47	116	10	28	2
56	50	106	22	18	18	18	88	11	17	2
57	50	106	24	20	20	35	99	7	25	2
58	50	122	26	22	20	44	118	10	27	2
60	49	104	21	18	16	33	97	10	20	2
61	50	114	23	20	15	24	97	11	21	2
62	50	101	17	22	21	37	103	11	15	2
63	41	119	24	23	20	43	101	11	27	2
64	50	94	25	23	21	48	105	11	25	2
65	50	106	17	23	20	19	83	6	21	2
66	44	109	16	22	17	43	118	11	22	2
69	47	106	22	21	20	33	91	4	24	2
70	49	105	24	22	16	41	97	10	24	2
72	34	112	17	19	20	19	94	10	9	2
74	50	114	24	22	18	29	95	12	23	2
75	50	93	19	23	18	24	94	11	13	2
77	49	112	25	23	18	47	110	10	24	2
78	49	92	19	20	13	29	88	9	20	2
79	35	121	14	18	17	21	96	10	11	2
80	50	104	20	20	15	12	88	10	17	2
81	49	88	18	23	21	23	66	7	14	2
82	50	105	21	19	14	5	79	7	16	2
83	50	101	20	23	20	30	96	12	19	2
84	50	108	18	18	13	27	106	10	21	2
86	49	98	19	19	11	10	78	6	19	2
87	50	94	26	22	12	14	75	11	19	2
88	50	114	24	23	16	44	108	9	22	2
89	50	108	25	21	12	37	103	12	27	2
90	49	110	20	22	22	26	88	10	18	2

Appendix J

Appendix J Scatter Plots

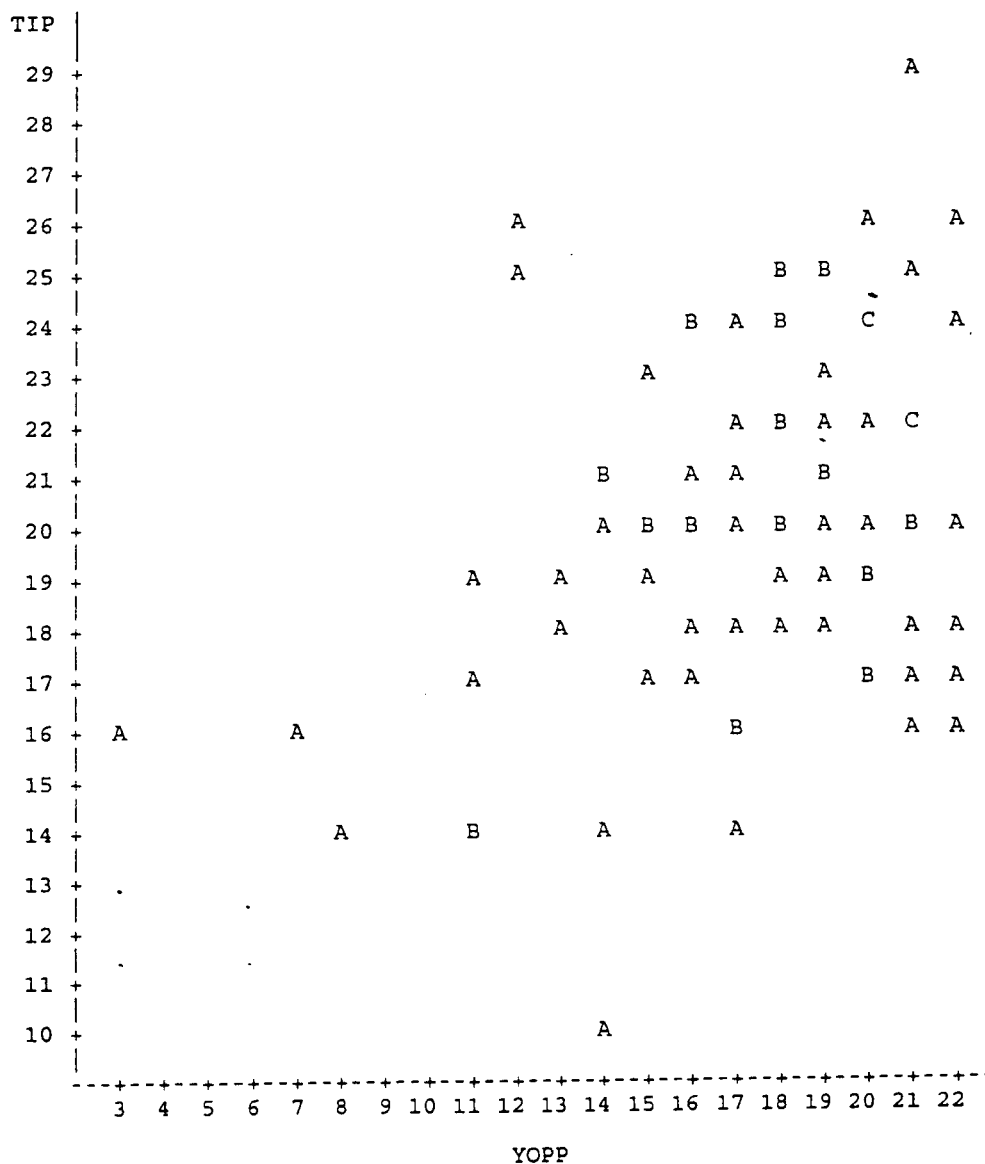
Scatter Plot of the TIP by the Phoneme Deletion Task



Appendix J continues

Appendix J cont.

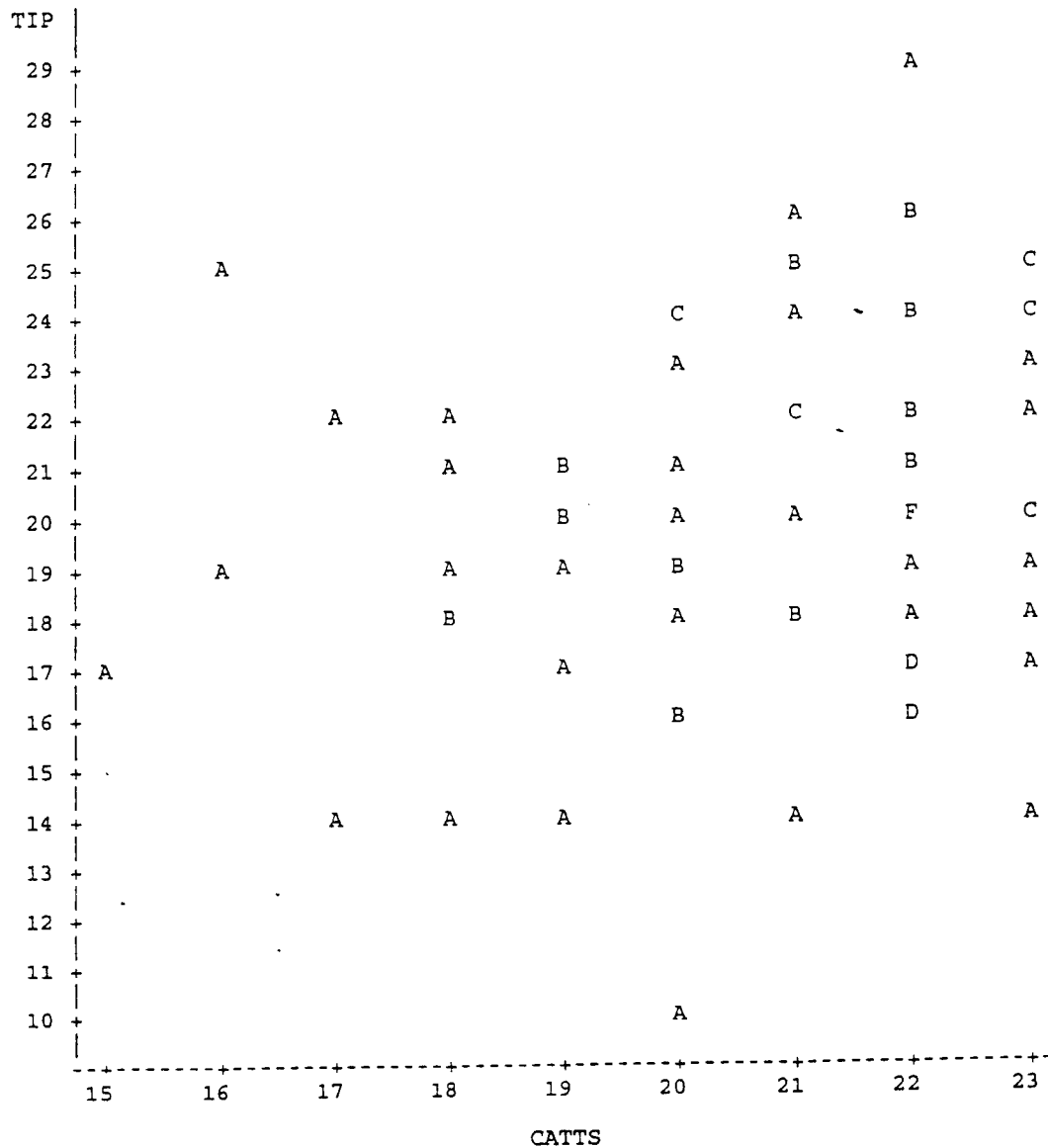
Scatter Plot of the TIP by the Yopp-Singer Phoneme Segmentation Task



Appendix J continues

Appendix J cont.

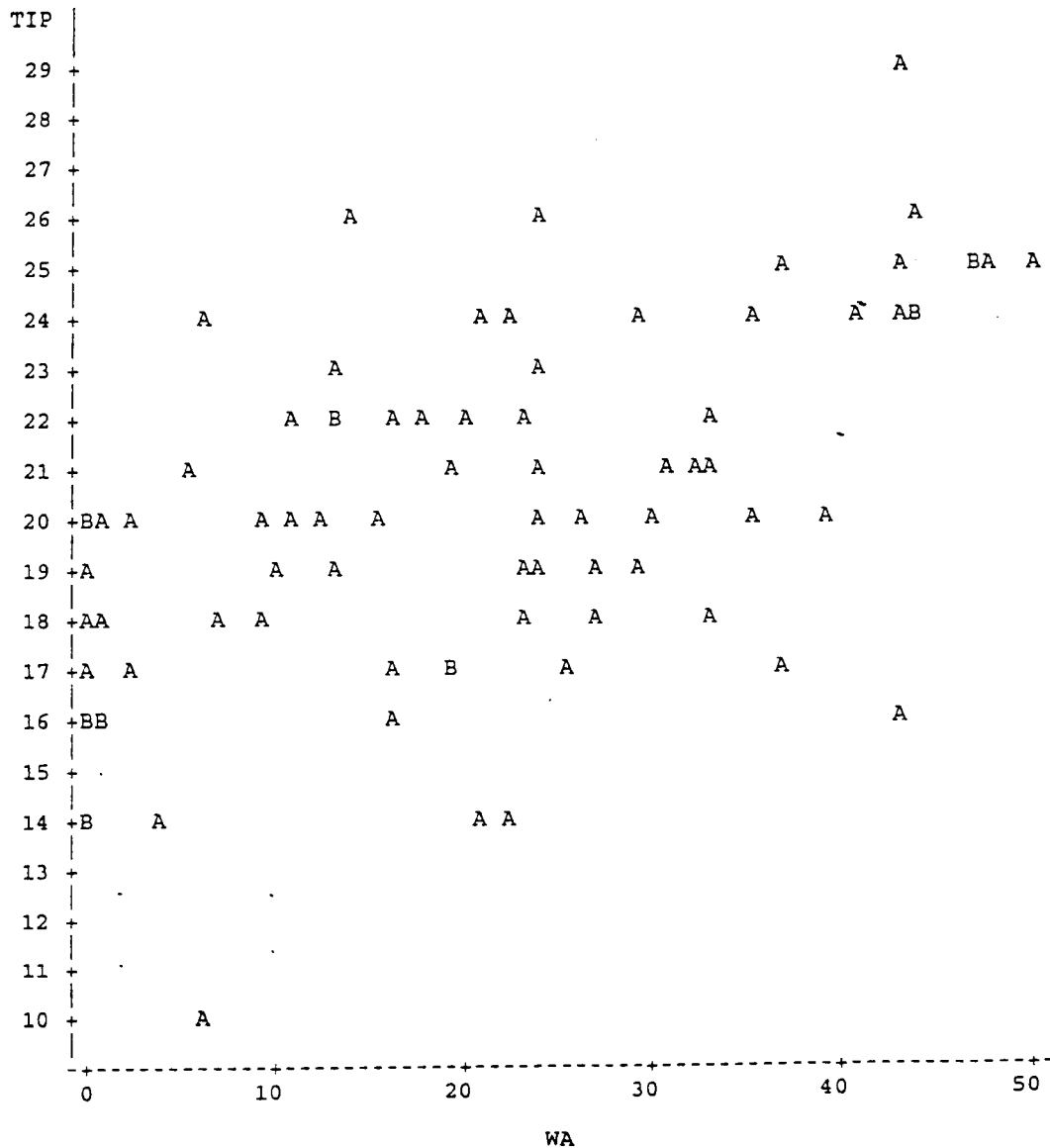
Scatter Plot of the TIP by the Phoneme Blending Task



Appendix J continues

Appendix J cont.

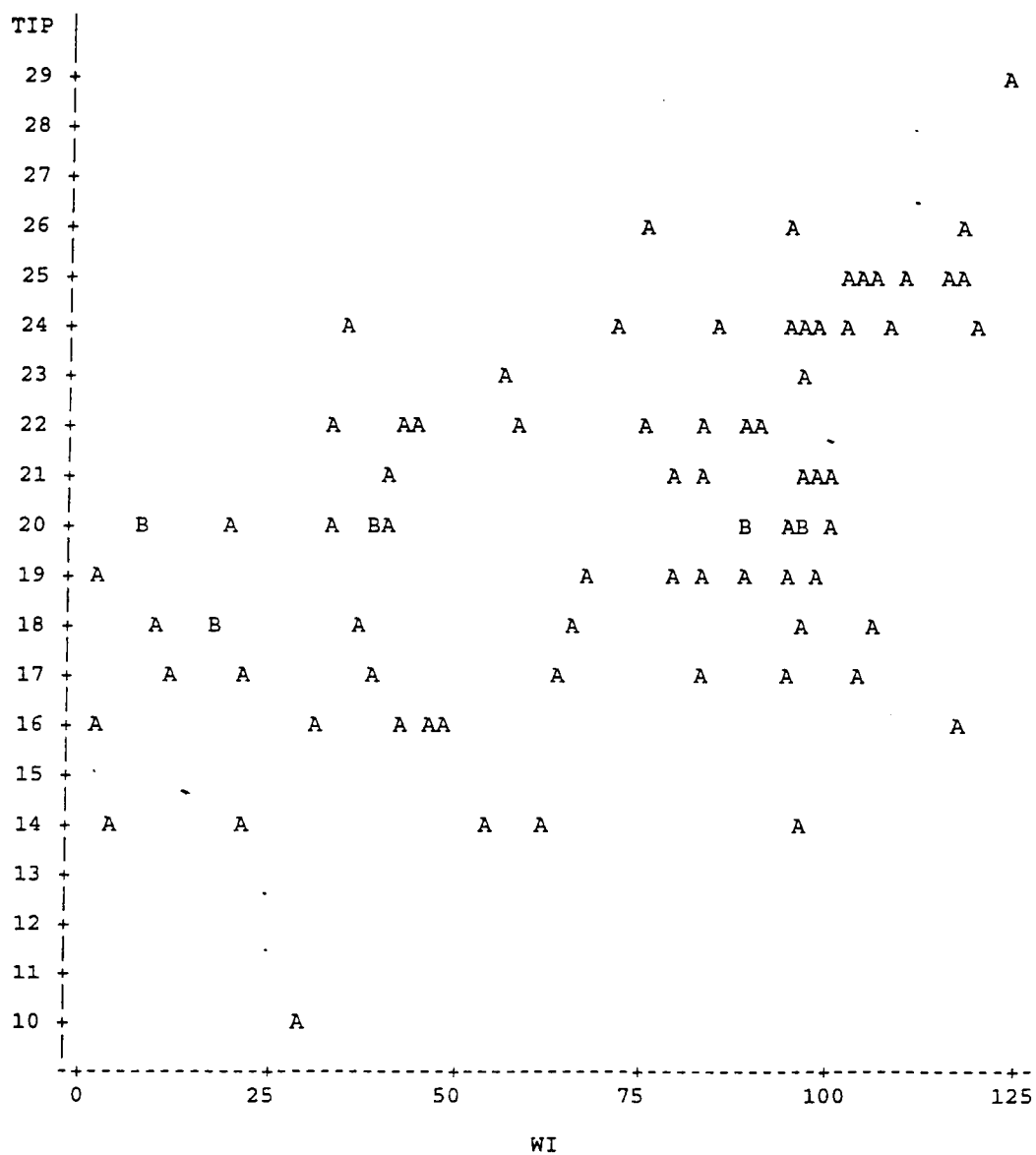
Scatter Plot of the TIP by the Word Attack Subtest



Appendix J continues

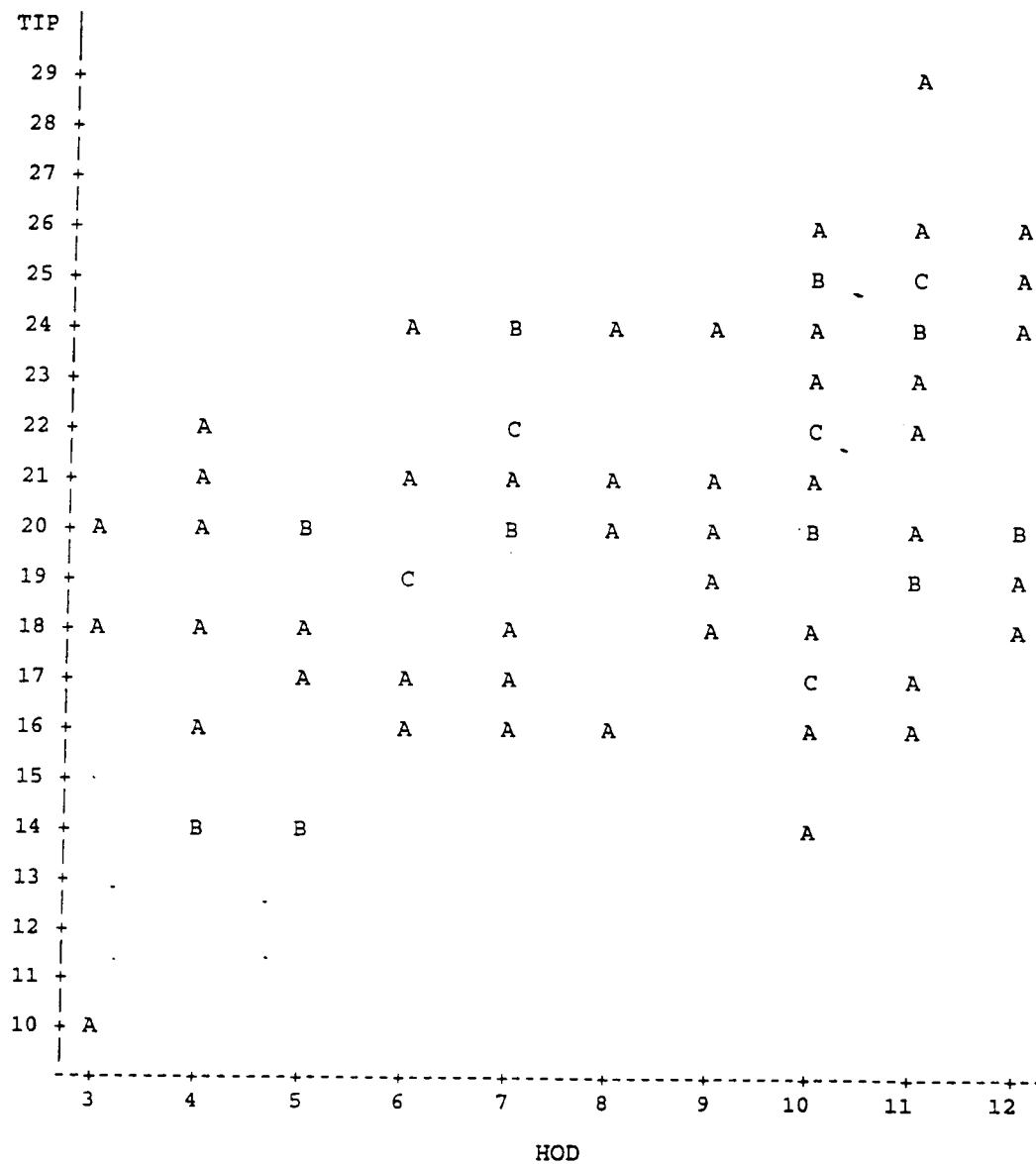
Appendix J cont.

Scatter Plot of the TIP by the Word Identification Subtest



Appendix J continues

Appendix J cont.

Scatter Plot of the TIP by the Multisyllabic Word
Production Task

Appendix K

Appendix K

Stem and Leaf Plots

Stem and Leaf Plots for the TIP

Stem	Leaf	#
29	0	1
28		
27		
26	000	3
25	000000	6
24	0000000000	9
23	00	2
22	000000000	8
21	000000	6
20	0000000000000000	13
19	0000000	7
18	0000000	7
17	0000000	7
16	000000	6
15		
14	00000	5
13		
12		
11		
10	0	1

-----+-----+-----+-----+

Appendix K continues

Appendix K cont.

Stem and Leaf Plots for the Phoneme Deletion Task

Stem	Leaf	#
28	0	1
26	00000000	8
24	0000000	7
22	0000000000	10
20	00000000	8
18	00000000000000	14
16	000000000	9
14	0000000	7
12	00000	5
10	0000	4
8	00	2
6	000	3
4		
2		
0	000	3
-----+-----+-----+-----+		

Appendix K continues

Appendix K cont.

Stem and Leaf Plots for the Yopp-Singer Segmentation Task

Stem	Leaf	#
22	000000	6
21	00000000000	10
20	00000000000	10
19	0000000000	9
18	00000000000	10
17	000000000	8
16	00000000	7
15	00000	5
14	00000	5
13	00	2
12	00	2
11	0000	4
10		
9		
8	0	1
7	0	1
6		
5		
4		
3	0	1
-----+-----+-----+-----+		

Appendix K continues

Appendix K cont.

Stem and Leaf Plots for the Phoneme Blending Task

Stem	Leaf	#
23	0000000000000000	15
22		
22	0000000000000000000000000000	25
21		
21	000000000000	11
20		
20	00000000000000	12
19		
19	0000000	7
18		
18	000000	6
17		
17	00	2
16		
16	00	2
15		
15	0	1

-----+-----+-----+-----+-----+

Appendix K continues

Appendix K cont.

Stem and Leaf Plots for the Word Attack Subtest

Stem	Leaf	#
5	03	2
4	778	3
4	1333444	7
3	55779	5
3	012333	6
2	567799	6
2	0112233344444	13
1	56668999	8
1	011233334	9
0	566799	6
0	0000000001111224	16

-----+-----+-----+-----+

Multiply Stem.Leaf by 10**+1

Appendix K continues

Appendix K cont.

Stem and Leaf Plots for the Word Identification Subtest

Stem	Leaf	#
12	4	1
11	67889	5
11	0	1
10	568	3
10	001233	6
9	556667777899	12
9	1444	4
8	8888	4
8	23334	5
7	5589	4
7	2	1
6	68	2
6	23	2
5	58	2
5	3	1
4	78	2
4	01224	5
3	57999	5
3	022	3
2	9	1
2	022	3
1	78	2
1	1	1
0	789	3
0	123	3

-----+-----+-----+-----+

Multiply Stem.Leaf by 10**+1

Appendix K continues

Appendix K cont.

Stem and Leaf Plots for the Multisyllabic Word
Production Task

Stem	Leaf	#
12	0000000	7
11		
11	0000000000000000	14
10		
10	000000000000000000	17
9		
9	00000	5
8		
8	0000	4
7		
7	000000000000	11
6		
6	0000000	7
5		
5	000000	6
4		
4	0000000	7
3		
3	000	3
-----+-----+-----+-----+		

Appendix L

Appendix L

Table 14

ANOVA Table for Group by Complexity

Source	df	ANOVA SS	Mean Square	F-Value
<u>Between Sub.</u>				
<u>Effect</u>				
Source				
Grade	1	70.39	70.39	12.97*
<u>Error</u>				
Sub. Within Grade	81	439.74	5.42	
<u>Within Sub.</u>				
<u>Effect</u>				
Complexity	1	184.04	184.04	47.33*
Grade x Complexity	1	.14	.01	.00
Complexity X Sub.				
Within Grade	81	314.99	3.88	

Note. Complexity=IE1 and IE2 and Group=first- and second-graders.

*p < 0.05

Vita

Dee Misenheimer Lance was born in Chandler, Arizona, on September 19, 1964. She attended a private elementary school in Los Angeles, California, and the public junior high and high schools in Mountain View, Arkansas, where she graduated in 1982. She attended the University of Central Arkansas in Conway, Arkansas, from 1982 until 1988, graduating with a Master's degree in communication disorders. Following this she worked as a speech-language pathologist for the school districts of Duval County, Florida, and Dardanelle, Arkansas, and then later for a home health agency in Knoxville, Tennessee. In 1992 she entered the doctoral program in speech and hearing science at the University of Tennessee, where her degree was completed in 1996. Following this she will join the faculty of the University of Central Arkansas in Conway, Arkansas.