PHONOLOGICAL AWARENESS IN CHILDREN WITH PHONOLOGICAL IMPAIRMENT: AN INTERVENTION STUDY

by

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ABSTRACT

The purpose of this study was to investigate the effects of training phonological awareness on six 4- to 6-year-old children with phonological impairments. Furthermore, this study sought to discover what individual difference factors play a role in the acquisition of phonological skills. Six phonological awareness skills were tested: rhyme and alliteration oddity, rhyme and alliteration production, and bisyllable and monosyllable division. The children's phonological skills were tested before, during, and after the phonological awareness intervention. Each of the children received training in analysis and synthesis skills, and one of either rhyming skills or alliteration skills. For most of the children, the training took place once a week over eight weeks. The results show that intensive training in phonological awareness for children with phonological impairments improves their scores on phonological awareness measures. Also, many factors play a role in phonological awareness outcome such as phonological impairment, memory, amount of school experience, and amount of home practice.

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This work is dedicated to E. Marian Barwick (Nonie), my grandmother,
who always believed I could do anything.

CHAPTER 1

INTRODUCTION

Phonological awareness is a subskill in phonological processing that involves the ability to recognize and manipulate phonological form. Much of the interest in this topic derives from observations of a strong relationship between level of phonological awareness attained and subsequent reading ability for people using oral languages (Wagner & Torgeson, 1987). This finding is consistent with models of reading acquisition for oral languages (e.g., Firth, 1985) that suggest that a critical step in the process is the discovery that particular phonemes correspond to particular graphemes (written letters). This "alphabetic principle" requires that the reader have alphabetic knowledge (letter names, sounds, and shapes) plus awareness of phonemes (Gillam & van Kleeck, 1996).

This thesis presents an intervention study in which children with phonological impairments are given training in phonological awareness. The motivation behind this study comes from the preliminary claims (Webster & Plante, 1992; Bird, Bishop, & Freeman, 1995; Magnusson & Naucler, 1990) that children with phonological impairments have lower levels of phonological awareness and are, thus, at greater risk for reading problems.

Phonological Awareness Tasks

Phonological awareness is difficult to test directly; therefore, a range of skills are tested to infer level of phonological awareness, from awareness of rhyme to phoneme deletion and substitution. Phonological awareness skills can be separated into two types of skills: phonological analysis (or segmentation) and phonological synthesis (or blending). Phonological analysis is the ability to be sensitive to, or explicitly identify, phonemes or substructures of words (e.g., "What sounds do you hear in *hot*?") (Yopp, 1988). Phonological synthesis is the ability to blend a succession of phonemes together to produce a word (e.g., "Combine these sounds: /k/ /æ/ /t/") (Yopp, 1988).

Developmental Progression of Phonological Awareness Skills

Many studies have examined the developmental progression of the acquisition of phonological skills. These studies have varied and inconsistent findings. Therefore, it is difficult to interpret the findings because of the individual differences. This should be kept in mind before drawing firm conclusions.

Chafouleas et al. (1997) tested 171 typical children in kindergarten, grade one, and grade two on various phonological awareness tasks. One of their purposes in doing this study was to determine whether performance on different phonological awareness tasks proceeded in a developmental fashion. The results of this study showed that phonological awareness tasks can be ordered in difficulty from easiest to hardest in this manner: rhyme, alliteration, phoneme blending, phoneme segmentation, and phoneme manipulation. The authors also found that the older the child, the better the child performed on all of these tasks. Stanovich, Cunningham, and Cramer (1984) supported this finding, their study showing rhyming tasks to be the easiest and a phoneme deletion

task to be the most difficult. (Phoneme deletion tasks are a type of phonological analysis skill which requires the child to state what remains when a phoneme is removed from a word, e.g. "say style without the /s/").

Because of the numerous phonological awareness studies being done without a consistent phonological awareness assessment tool, Yopp (1988) sought to determine the reliability and validity of tests that have been used to operationalize the concept of phonological awareness. She found that the easiest test for 96 children aged 5;4-6;8 was a rhyme identification test, while the most difficult test was the phoneme deletion test. Yopp (1988) performed a factor analysis on her data and found that the phonological awareness tests loaded onto two main factors. Yopp called Factor 1 *Simple Phonemic Awareness.* Tests that had high loading on this factor included segmentation, blending and phoneme counting; these tests require only one operation. Yopp called Factor 2 *Compound Phonemic Awareness.* Tests that had high loading on this factor included tests like sound deletion where there is a greater burden on memory. The author found that rhyming ability did not load onto either of these factors and she concluded that rhyming ability might actually "tap a different underlying ability than other tests of phonemic awareness" (p. 172). However, the subjects that participated in Yopp's study were at an age where typical children are able to rhyme; therefore, this could have had an effect on her findings. Along these lines, Muter et al. (1997) sought to determine whether rhyming and segmentation were independent subskills. The authors tested 38 children with a mean age of 4;3 three times over two years on various phonological awareness, reading, and spelling tests. Muter et al. (1997) found evidence for two distinct and independent phonological abilities using factor analysis: segmentation and rhyming. This finding supports Yopp's idea that rhyming might be a separate subskill in phonological

awareness abilities. Muter et al. (1997) also found that while segmentation was highly predictive of reading and spelling, rhyming was not. An earlier study by Lundberg, Olofsson, and Wall (1980) also supports this finding. These researchers administered a range of phonological awareness tasks and reading tests to 143 children in kindergarten (age 7 in Sweden). These children were retested in grade 1. Using a path analysis, "the most powerful determinant of reading achievement in grade 1 [was] the ability in kindergarten to analyze phonemes and reverse their order" (Lundberg, Olofsson, & Wall, 1980, p. 166). This earlier work reiterates the finding that segmentation skills are closely related to future reading level.

Muter et al.'s (1997) and Lundberg et al.'s (1980) finding is in contrast to many studies done regarding the importance of the ability to perform rhyme and alliteration tasks on subsequent reading acquisition. For instance, Bradley and Bryant (1983) measured 403 children's skills in sound categorization before learning to read and followed the children's progress in reading and spelling for four years. The sound categorization task required the children to pick the word that was the "odd one out" out of a group of possible words. The other two words matched on the basis of the first, medial, or final phoneme. For example, the children were asked which word was the odd word out of "pin pig *hill*, lot cot *hat* pot" (Bradley & Bryant, 1983, p. 420). Thus, these examples would be regarded as types of alliteration and rhyming tasks, respectively. The authors found that there were "high correlations between the initial sound categorization scores and the children's reading and spelling over three years later" (p. 419). A later study by Bryant et al. (1989) supports the view that knowledge of rhymes is strongly related to later success in reading and spelling. Sixty-four children with an average age of 3;4 (range 2;10-3;9) at the beginning of the study were tested on various measures of

nursery rhyme knowledge, phonological sensitivity, and reading and spelling. The phonological sensitivity measure was composed of different rhyme and alliteration tasks plus an object naming task. These children were followed over three years. Results suggested that "knowledge of nursery rhymes affects children's sensitivity to rhyme, which in turn has an effect on their success in reading and spelling" (Bryant et al., 1989, p. 422). The authors then performed a path analysis to determine how nursery rhyme knowledge and subsequent reading related to each other. The results of this analysis provide evidence for a link from nursery rhyme knowledge to rhyme and phoneme sensitivity to children's success in learning to read. Bradley and Bryant (1991) stated that rhyme scores of preschool children prove to be reliable predictors of later reading ability.

Goswami (1990) also sought to determine how rhyming skill relates to reading ability. One hypothesis states that children learn to read by using orthographic analogies. This is the ability to infer that similarities in sound relate to similarities in spelling. A more specific form of this hypothesis is that children's experience with rhymes may help them to make orthographic analogies when they begin learning to read. Therefore, a child who can recognize that *pig, wig*, and *big* rhyme can recognize that these words share the same spelling pattern at the end and then may use this knowledge when learning to read. Goswami (1990) sought to test this hypothesis. Thirty-five children aged from 6 to 8 years participated in the study. The goal of this study was to determine whether children who made more analogies in reading were those who were better at rhyming. The results showed that after regression analysis, rhyming measures (using the Bradley (1980) rhyming measures) were strongly related to the use of orthographic analogies at the ends of words. However, it was also found that there was not a strong relationship

between alliteration skills and analogies between the beginnings of words. More generally, Treiman (1992) suggested that if children gain knowledge of onsets and rimes - the two primary parts of the syllable - they may proceed from syllable awareness to phoneme awareness.

When examining whether rhyme knowledge is an important precursor to learning to read, one has to look at the age of the subjects in each of these groups of studies. The studies by Bradley and Bryant (1983) and Bryant et al. (1989) both used subjects who were younger than the subjects in studies that showed no direct link from rhyming to reading. The research presented above suggests that there is a direct link from segmentation skills to reading ability, while there is an indirect link from rhyming skills to reading ability. It could be that children use rhyme and alliteration to begin to access the knowledge that words are made up of different sounds, which leads them to the knowledge of segmentation, which then leads them to the ability to read. A longitudinal study (starting at age six) with 111 Swedish children by Magnusson and Naucler (1990) found that rhyming and phoneme identification correlated most highly with spelling and both decoding and comprehension in measures of reading.

There is somewhat contradictory evidence about young children's (prior to age 5) ability to attend to individual phonemes within words. This is demonstrated experimentally by Maclean, Bryant, & Bradley (1987), who found that most 3-year-olds could detect and produce rhymes and alliteration. However, the children were not able to perform segmenting tasks: 55 out of 60 children gave no correct answers at all. The task required the children to segment words into phonemes. This result is also supported by Treiman and Zukowski (1991). On the other hand, Fox and Routh (1975) found that 3-

year-olds were able to segment at the phonemic level 25% of the time with a monosyllabic word.

This brings up the difficulty of interpretation with some phonological awareness tests. With the complexity of some of the demands of the tests, it is difficult to determine whether children are phonologically unaware or whether they are struggling with the various demands of the tasks. Spector (1992) demonstrated the effectiveness of using the principle of dynamic assessment in the study of phonological awareness. The dynamic assessment component consisted of providing "corrective feedback in increasingly supportive prompts and cues" when the children had difficulty segmenting a word correctly (Spector, 1992, p. 355). She compared performance on a phoneme segmentation task with and without a dynamic assessment component. She found that the best predictor of year-end reading scores was performance on phoneme segmentation in dynamic assessment.

Effects of Reading on Phonological Awareness

There has been a controversy over whether phonological awareness skills facilitate reading or whether reading facilitates phonological awareness skills or if reading and phonological awareness have a reciprocal relationship. Given the research presented above, it is clear that phonological awareness is an important factor when learning to read. However, Morais et al. (1979) found that illiterate adults were unable to delete or add a phoneme at the beginning of a nonword. These authors suggest that phonological awareness is manifested *by* learning to read. Perfetti et al. (1987) sought to determine the contribution that phonological awareness brings to reading and the contribution that reading brings to phonological awareness. This study followed 82

children in first grade for nine months. The children were tested in analysis and synthesis skills and were divided into different reading programs. The deletion task (an analytic skill) was found to be the best predictor of word reading. The authors also demonstrated, using correlational data, that the ability to perform *synthesis tasks* "enable[s] gains in reading more than vice versa" (Perfetti et al., 1987, p. 315). However, it was found that once skill in *deletion tasks* reached a certain level, reading achievement enabled higher-level deletion tasks. Therefore, a reciprocal relationship exists between some phonological awareness tasks and reading.

There are many factors that are important for performing phonological awareness tasks; these are presented in the following section.

Factors Affecting Phonological Awareness Abilities and Reading

A number of variables apart from phonological skills may impact on phonological awareness. McBride-Chang (1995) suggested that there are three other variables. First, general cognitive ability is needed for reasoning and thinking about the stimuli that are presented. Second, a significant short-term memory component is needed to store the information temporarily while the stimuli are being manipulated in working memory. A third component is the ability to perceive the stimulus. A study by McBride-Chang (1995) used structural equation modeling to test the effects of cognitive ability, memory, and speech perception on the construct of phonological awareness. All three components studied were "strong predictors of phonological awareness, each explaining unique variance in this construct" (McBride-Chang, 1995, p. 186). Presented below is an examination of different types of abilities involved in phonological awareness skills and subsequent reading acquisition.

Memory

Phonological working memory is an important factor for performing phonological awareness tasks. Phonological working memory is "a process in which verbal information is coded and kept immediately accessible through activation and reactivation operations" (Gillam & van Kleeck, 1996, p. 73). According to Gillam and van Kleeck (1996), phonological working memory is made up of two components: phonological coding and phonological recoding. *Phonological coding* is the process by which a sensory trace (made up of *acoustic*, temporal, and sequential parts of sounds) is turned into a phonological representation. *Phonological recoding* is the process by which *visual* information (printed or pictured words) is turned into phonological representations. For phonological awareness tasks to be performed, phonological working memory is essential. For example, if a child is asked what the first sound is in *cat*, the child must have a representation of *cat* as a sequence of sounds. Then representation must be kept "alive" in order to determine the sequence of phonemes needed to answer the question (Gillam & van Kleeck, 1996). When children are reading using the indirect route (sounding out the words), "phonological coding and recoding processes enable readers to bond sequences of orthographic representations with sequences of phonemic representations in memory" (Perfetti, 1992, as cited in Gillam & van Kleeck, 1996, p. 75; Wagner, Torgesen, & Rashotte, 1994). Digit span and word span tests are usually used to test verbal working memory.

It has been a common finding in research with children with reading problems that they have deficits in phonological working memory. Poor readers generally do not perform well on tasks such as digit span (Gathercole & Baddeley, 1993). Brady (1991)

suggested that poor readers do not suffer from a general impairment in memory functioning, but that the problem lies in their ability to remember linguistic material. She states that the difficulty may be "related to phonological processes involved in encoding and storing verbal information" (Brady, 1991, p. 132). The author offered a hypothesis as to why children with reading problems also show associated memory difficulties. She described the memory system as a limited capacity system: Resources may be limited for retaining information because of the inefficiency in encoding and retrieving verbal information. She posited "that the difficulty observed in encoding phonological information is not restricted to memory tasks but also occurs at a more abstract level, whenever it is necessary to create and maintain a phonological representation" (Brady, 1991, p. 135). It has also been found that children with language disorders have poor phonological working memories. Gathercole and Baddeley (1993) suggested that this may result from poor encoding mechanisms which, in turn, would result in phonological representations that are not sufficiently discriminable. These authors also suggested that the capacity of the phonological store may be diminished in children with language disorders. A final hypothesis they make is that children with language impairments may have rapidly decaying phonological traces, therefore making storage of phonological information difficult.

Speech Perception Ability

A second relevant variable may be general phonological perception; this is also described as speech perception. McBride-Chang (1995) examined the relationship between speech perception and phonological awareness using three tasks. All three tasks used an identification, forced-choice paradigm. In the first two tasks, voice onset time was manipulated (the children had to identify when *bath* or *path* or *slit* or *split* was

spoken by a male computer voice). The final speech perception task required that the children identify the correct nonword (either *ba* or *wa*) with the manner of articulation manipulated. She found that speech perception to be "associated with phonological awareness even after more complicated verbal abilities such as vocabulary and verbal short-term memory . . .[were] accounted for" (McBride-Chang, 1995, p.187). This finding may account for many studies that have found that children who are poor readers are also poor on various speech perception tests (e.g., Brandt & Rosen, 1980; Godfrey et al., 1981; Werker & Tees, 1987; DeWeirdt, 1988; Reed, 1989; and Manis et al., 1997).

General Cognitive Ability

There is some disagreement about the role of general cognitive ability in phonological awareness. Tunmer, Herriman, and Nesdale (1988) noted that children who performed well on a Piagetian measure of concrete operations profited from phonological awareness training and subsequent reading more than children who performed poorly. Fowler (1991) proposes that "children must attain some minimal threshold of cognitive development before they can grasp and refer to abstract concepts of word, syllable, or phoneme" (p. 100). This quotation is in agreement with a study done by McBride-Chang (1995), who examined the relationship between phonological awareness and three variables, among them general cognitive ability. She found that that general cognitive ability (as measured by the picture completion, block design, vocabulary, and similarities subtests on the Wechsler Intelligence Scale for Children (WISC) (Wechsler, 1974)) was among one of the components of the construct of phonological awareness. She found that general cognitive ability was a strong predictor of phonological awareness. However, some researchers have not shown a strong association between phonological

awareness and cognitive development (Treiman & Zukowski, 1991; Fox & Routh, 1975; Bryant et al., 1989). Further, Magnusson and Naucler (1990) found no correlations between nonverbal cognitive level and linguistic awareness in groups of language-disordered and normally developing preschool children; however, the same authors in a later study (1993) found that cognitive level was more important for children who have language disorders than it was for typically developing children. Magnusson and Naucler (1993) concluded that only for the segmentation tasks did cognitive level have an effect and that "linguistic factors still play a more prominent role" (p. 109).

Language Ability: Syntax and Morphology

Other authors have examined the relationship between language and phonological awareness abilities. For example, a study by Chafouleas et al. (1997) sought to examine the extent of the relationship between phonological awareness tasks and variables such as general language ability and reading ability. The measures administered were the Peabody Picture Vocabulary Test - Revised (Dunn & Dunn, 1981), a letter-word identification test, and letter names and letter-sounds tasks. All of the tests administered "were found to be highly predictive of Total Phonological Score" (Chafouleas et al., 1997, p. 345). This shows that vocabulary comprehension at least may have an effect on the level of phonological awareness attained, and this brings up the question of how a child with a deficient language system would perform on measures of metaphonology.

The goal of a study by Kamhi, Lee, and Nelson (1985) was to evaluate the awareness of words, syllables, and sounds in children with language disorders. Forty-five children between the ages of 3 and 6, one group with and two groups without a language disorder, participated in this study. There were three types of segmentation

tasks: dividing sentences into words, dividing words into syllables, and dividing monosyllabic words into speech sounds. The children with language disorders performed significantly more poorly than the mental age matched *and* the language-age matched normally developing children on all three tasks. The 5- to 6-year-old children with a language disorder performed worse than typically developing 3- to 4-year-olds on awareness of words, syllables, and sounds. The authors noted that the language-disordered children had "particular difficulty dividing monosyllabic words into smaller sound units" (Kamhi, Lee, & Nelson, 1985, p. 211). Along the same lines, Warrick and Rubin (1992) aimed to compare the linguistic awareness abilities of 4- to 5-year-old children with and without language delay. Twenty-eight children were tested on a range of tasks that included phoneme judgement (judging whether a word in a spoken sentence was "silly"/had a substitution of an initial or final sound), rhyme production, phoneme segmentation, and initial phoneme isolation. They found that the children without language delay performed better on these phoneme analysis tasks. The more explicit the level of analysis required, the lower the scores for the language-delayed children. (It is interesting to note that neither group of children could perform the most explicit level of analysis, namely, explanation of the repair given by the examiner. This would indicate that at 4- to 5-year-old children do not yet have fullly developed metalinguistic awareness.) Another finding showed that the children with language delay followed the same developmental pattern in acquiring these phonological awareness abilities (Warrick, Rubin, & Rowe-Walsh, 1993). However, the authors stated that "the differences between the groups may not disappear over time without intervention" (Warrick et al., 1993, p. 159). This finding compliments Kahmi et al. (1985), who found that children with language disorders performed worse than language-age matched typically developing

children. This would indicate more than a simple delay in the acquisition of awareness skills. Another study supporting the above findings that children have "given" phonological awareness abilities is Torgeson, Wagner, and Rashotte (1994). They concluded that "the findings from our longitudinal research provide powerful support for the conceptualization of phonological skills as stable, enduring individual-difference characteristics, at least across the early elementary period" (Torgeson, Wagner, & Rashotte, 1994, p. 283). However, it must be emphasized that because of the reciprocal nature of phonological awareness, the "stability" of the *young* child's phonological skills may change once reading instruction and/or phonological awareness training is instituted (Muter & Snowling, 1998; Warrick et al., 1993)

A longitudinal study by Magnusson and Naucler (1990) examined the relationship between phonological and other aspects of linguistic awareness, language competence (comprehension and production), and reading and spelling. These authors tested 111 children, including those with and without language disorders five times, starting before the children formally learned how to read. They found that two phonological awareness tasks (rhyming and phoneme identification) correlated with language competence. Further, Magnusson and Naucler concluded that syntactic competence may be an important linguistic prerequisite for the development of reading and spelling. Rhyming and phoneme identification were also tasks that were found to have the high correlations with reading and spelling ability. Overall, rhyming and phoneme identification proved to be the "most important aspects of linguistic awareness and the best predictors of reading and spelling achievements in the first grade" (Magnusson & Naucler, 1990, p. 60). An interesting finding of this study was that not all the children with language disorders had difficulties with the phonological awareness tasks or with the reading and spelling tests

which agrees with Torgeson et al. (1994) that there are notable individual differences on these skills. The authors found that the children with intact syntactic and morphological abilities but deviant phonological systems performed better on the phonological awareness tasks and in the reading and spelling tests. A study by Major and Bernhardt (1997) also lend support to these findings. The results of their study showed that the children with better morphosyntactic skills tended to have better phonological awareness skills.

These findings however, are contradicted by Bird, Bishop, and Freeman (1995), who found that their 31 male subjects with phonological impairments, both with and without concurrent language disorders in other language domains, did equally poorly on their phonological awareness tasks. This finding could be due to the fact that the subjects in the Bird et al. (1995) study had more severe phonological impairments than those in the Magnusson and Naucler (1990) study. However, their result could be due to the fact that one of the language tests that were given to children may not have been a true reflection of their abilities. For instance, for one of the tests, children were required to add grammatical morphemes to show their understanding of language; however, if these children with phonological problems had difficulty with word final consonants, these children would have been inappropriately classified as having problems with morphology. However, vocabulary and receptive language ability were also tested.

Language Ability: Phonology

Webster and Plante (1992) compared the phonological awareness ability of children with persistent phonological impairment to that of phonologically normal children. Webster and Plante (1992) theorized that because phonological awareness

depends on the ability to code phonological information in working memory, children with phonological impairment may have difficulty with phonological awareness. The authors hypothesized that a subvocal speech rehearsal process is used to "hold and manipulate linguistically codable information in working memory" (Webster & Plante, 1992, p. 176). A phonological impairment may disrupt this subvocal speech rehearsal process, thereby disrupting the input of information to working memory, which is crucial for phonological awareness tasks. To test their hypothesis, Webster and Plante (1992), compared results for 22 children ages 6;5-8;6, 11 of whom were phonologically normal and 11 of whom had a persistent moderate-to-severe phonological impairment. These children were identified, on average, at age 4 and had received and were currently receiving intervention. All children had normal nonverbal intelligence and were tested using the Peabody Picture Vocabulary Test-Revised (Dunn & Dunn, 1981), the Test of Auditory Comprehension of Language –Revised (Carrow-Wollfolk, 1985), a Word Recognition Test from the Stanford Achievement Test (1972), and the Test of Awareness of Language Segments (TALS) (Sawyer, 1987). The TALS consists of three subtests: segmenting sentences into words, segmenting words into syllables, and segmenting words into phonemes. The child is required to represent the words/syllables/sounds spoken by the examiner with blocks. Results indicated that phonologically normal children significantly outperformed the children with phonological impairment on segmenting words into phonemes, pseudoword segmentation, and sentence-to-word segmentation. There was no significant difference found between the two groups for segmentation from words into syllables and in the word recognition scores. Therefore, the authors suggested that phonological awareness can be closely associated with productive phonological ability independent of mental age and educational experience. It

was noted that as intelligibility of the children increased, their segmentation skills improved. Webster and Plante (1992) posited that the reason why there were no significant differences between the two groups on word recognition was that the children with phonological impairment were perhaps using a whole word reading approach rather than a phonetic approach. Although the sample size of this study is small, this experiment provides preliminary evidence for the differences in phonological awareness abilities between children with a phonological impairment and those without.

Webster, Plante, and Couvillion (1997) conducted a follow-up study to examine children with phonological impairment longitudinally for progress in phonological processing ability and prereading ability. The authors compared performance of 29 children with phonological impairments and 16 phonologically normal children with a mean age of 3;6 years on various reading and phonological awareness tasks. The PPVT-R and the Test for Auditory Comprehension of Language-Revised were administered to all participants. The children were deemed phonologically impaired if they achieved a developmental process rating of 3 or higher on the Khan-Lewis Phonological Analysis test (KLPA) (Khan & Lewis, 1986). This test uses a 5-point scale in which 0 indicates completely intelligible and 4 indicates unintelligible. Further tasks included rhyme and alliteration detection tasks, a pseudoword segmentation task (children were directed to lay out one block representing each phoneme that they heard), a sentence memory task, and a letter identification task. At the beginning of the study, all of the children with phonological impairment were receiving intervention. By the time the children were 6 years old (at the end of the study) only 44% of them still required intervention. All of the children were tested every three months from a mean age of 3;6 to a mean age of 6;0. Comparisons were made between the children with phonological

impairment and the phonologically normal children. The phonologically normal children outperformed the children with phonological impairment on sentence memory, pseudoword segmentation, and letter identification. No significant differences were found for rhyme nor alliteration detection. The authors performed regression analyses and found that (a) productive phonology was a significant predictor of letter knowledge and (b) that there was a strong relationship between productive phonology and verbal working memory. In addition, the authors showed that verbal working memory was the single best predictor of letter identification. The authors concluded that the "children with phonologic impairment lacked refined phonological representations, which hampered their ability to phonologically code in memory" (Webster et al., 1997, p. 372).

Bird, Bishop, and Freeman (1995) also suggested that incomplete phonological representations may affect phonological processing abilities. The authors examined the development of phonological awareness and literacy in children with expressive phonological disorders with and without comorbid disorders of morphosyntax or other language systems. Eighteen boys with "pure" phonological impairments and twelve boys with a phonological impairment and an additional language impairment (aged 5;0-7;4) participated in the study. These subjects (plus the chronological and reading-matched controls) were evaluated on the basis of nonverbal ability, phonology, morphosyntax, vocabulary, phonological awareness, and literacy. Phonological awareness was tested in a nonverbal manner (a) by having the children match the rime and the onset of given words and (b) by segmenting and matching the onset of given words. The authors found that both groups had extreme difficulty with the phonological awareness tasks. Furthermore, when the majority of children with phonological problems were assessed at time 3, they were found to have significant problems with reading. Compared to age and

reading-matched controls, children with phonological impairments were found to have impaired knowledge of phoneme-to-grapheme correspondences as shown by their nonword reading and spelling. The authors suggest that children with phonological impairments may have difficulty categorizing speech sounds. Bird et al. (1995) posited that instead of analyzing syllables into their respective phonemes, these children may analyze syllables as whole chunks when performing tasks of phonological awareness. The authors posited further that these children might have holistic representations of words, making it difficult for them to proceed to the alphabetic reading stage, the next stage in reading acquisition.

Bishop and Adams (1990) examined the language and literacy skills of 83 children age 8;6 who had impaired language development at 4 years of age. One of the findings of this study was that "phonological processing accounted for measurable variance in reading outcome after allowing for the powerful effects of other language measures" (Bishop & Adams, 1990, p. 1045). However, it should be noted that the effects were small and, on the whole, if a child had only "pure" phonological difficulties (i.e., without any other language problems) then it should be anticipated that typical progress in reading and spelling would occur. This study reflects the inconsistency in studies of children with phonological impairments and reading skills. In 1993, Magnusson and Naucler also examined the relationship between language ability (syntax and phonology), linguistic awareness, and learning to read. This was a longitudinal study (started in 1984) so their subjects were tested from age 6 to 11 years old. All of the children had varying degrees of phonological impairment, and more than half of the children had concurrent morphosyntactic problems. Different phonological awareness tests were administered over the course of the study. Overall, it was found that children

with a language disorder were shown to be less phonologically aware than children with typically developing language systems. Further, children who had more severe phonological problems were more likely to be phonologically unaware. Again, however, many individual differences were noted

A recent study by Larrivee and Catts (1999) sought to examine the relationship between phonological disorders and early reading achievement. Thirty children with phonological disorders served as subjects in this study. The average age of the children at the beginning of the experiment was 6;2. The children's phonological disorders were found to be moderate to severe. Importantly, many of the children with phonological disorders also had semantic-syntactic language deficits. These children were compared to a phonologically normal group of children. All of the children were tested on various measures of phonological awareness, language skill, and word recognition in kindergarten and in the first grade. Results of this study showed that children with a poor outcome in reading (decoding skill) had more severe phonological disorders (as measured by a multisyllabic word and nonword repetition task), poorer phonological awareness, and poorer language skills in kindergarten than those children with a good reading outcome.

When reviewing the literature, there are varied findings. What can be concluded is that there are many individual differences that need to be taken into account when examining the effects of a language impairment, specifically a phonological impairment, on phonological awareness and beginning reading. Another conclusion that can be drawn is that most of the children with severe phonological impairments also have difficulties with phonological awareness skills. Given the relationship between phonological awareness and reading, these results lead to the conclusion that these children with severe

phonological impairments are at a higher risk for developing reading problems. Numerous treatment studies have been done with typical children and a lesser number of studies have been done with children with language disorders (morphosyntactic and/ or phonological impairments). These will both be reviewed below in separate sections.

Training Phonological Awareness

Treatment Studies with Typical Children

One of the first studies to demonstrate the efficacy of phonological awareness treatment was by Bradley and Bryant (1983) who conducted a study utilizing two different methods with the aim of demonstrating a causal relationship between sound categorization skills and subsequent reading ability. The authors conducted a longitudinal study in which they measured 403 children's skills in sound categorization before they had started to read. These skills were then related to their progress in reading and spelling over 4 years. The results of the longitudinal study showed high correlations between the initial sound categorization scores and the children's reading and spelling over 3 years later. (See Table 1 for a summary of the treatment studies below.)

Table 1: Summary of Phonological Awareness Treatment Studies with Typical Children

Studies:	Subjects	Training Program(s)	Frequency and type of Treatment	Results
Bradley & Bryant (1983)	65 Preschool Children	Exp. Group I-sound categorization Exp. Group II-sound categorization and linking letters and sounds Control Group III-classifying words semantically Control Group IV-no training	-40 times over 2 years -individual treatment	POSITIVE RESULT. Children from Groups I and II outperformed the control groups in reading and spelling. Group II surpassed Group I's scores.
Fox & Routh (1984)	41 kg children (age 5)	Exp. Group I-segmenting and blending skills Exp. Group II- segmenting skills Control Group III- no training	-daily for 15 minutes for 5 weeks -groups of 5-6	POSITIVE RESULT. Children in Group I outperformed Groups II and III in segmenting and blending. Also, on a word learning task, the children in Group I made significantly fewer errors than in Groups II and III.
Lundberg, Frost, & Petersen (1988)	390 preschool children (age 7)	Exp. Group I- listening games, rhyming games, segmentation of sentences and words, and awareness of syllables and phonemes Control Group II- no training	-daily for 15-20 minutes for 9 months -groups of 15-20	POSITIVE RESULT. Children in Group I showed substantial treatment effect on the metaphonological tasks.
Cunningham (1990)	48 kg children (age 5;11) 48 Grade 1 children (age 7;2)	Exp. Group I- "skill and drill" segmentation and blending Exp. Group II- "metalevel" segmentation and blending with explicit reference to the use of segmentation and blending. Control Group III- story reading	-twice a week for 15-20 minutes for 10 weeks -groups of 4-5	POSITIVE RESULT. Groups I and II outperformed Group III in both phonemic awareness tasks and reading performance. Children in Grade 1 in Group II performed significantly higher in reading than Grade 1 children in Groups I and III.

Ball & Blachman (1991)	89 kg children (age: 5;7)	Exp. Group I- segmenting phonems and letter name and sound Exp. Group II- language activities and letter name and sound Control Group III- no training	-4 times a week for 20 minutes over 7 weeks -groups of 5	POSITIVE RESULT. Group I performed significantly better on the phoneme segmentation test than Groups II and III. Groups I and II had significantly higher letter sound scores than Group III. Group I had significantly higher word identification and spelling scores than groups II and III.
Torgesen, Morgan, & Davis (1992)	51 kg children (age 5) who performed in the 15th and 50th %iles on the Screening Test of Phonological Awareness (STOPA) (Torgeson and Bryant, 1994)	Exp. Group I- segmenting and blending Exp. Group II- blending Control Group III- language experience	-3 times a week for 20 minutes for 7-8 weeks. -groups of 3-5	POSITIVE RESULT. Group I was significantly better in segmenting and blending skills than Groups II and III. In the reading analog test, Groups I and II required fewer numbers of trials to reach criterion than Group III.

The second method employed intensive training in sound categorization from a subgroup of the larger group. Sixty-five children from the larger group participated in the training component of this study. These children performed at least two standard deviations below the mean on scores in sound categorization. This group was then divided into four subgroups. Two groups received training in categorizing sounds over 40 individual sessions spread over a two-year period. Training included teaching the children that the "same word shared common beginning, middle, and end sounds with other words and thus could be categorized in different ways" (Bradley & Bryant, 1983, p. 420). Group I received only sound categorization training while Group II received, in addition to the sound categorization training, training emphasizing the link between letters and the sounds that they made. Groups III and IV functioned as control groups; Group III training included teaching children to classify words in terms of their semantic categories. Group IV did not receive training. The results of the study suggest a causal relationship between sound categorization ability and reading and spelling ability. Results showed that both Groups I and II outperformed the control groups in standardized reading and spelling measures, with Group II surpassing Group I's scores. The authors concluded that training in sound categorization is more effective when it is linked with the letters of the alphabet and their sounds. Based on these results, the authors posited that awareness of rhyme and alliteration are crucial for subsequent reading and spelling ability. This study also shows the importance of training children in rhyming and alliteration.

In Denmark, Lundberg, Frost, and Petersen (1988) conducted a training study to stimulate preschool children to discover and attend to the phonological structure of language. One of the goals of this study was to evaluate the effect of metalinguistic

training. Children do not start school until the age of 7 and usually have not had any "informal literacy socialization by parents or older peers" (Lundberg et al., p. 266). This means that a prereading child in Denmark has reached a more advanced stage of general cognitive development by the time that formal schooling takes place. The experimental group consisted of 235 children and the control group consisted of 155 children; all the children averaged 6 years of age and lived in separate areas of Denmark. Both of the groups were pretested with metalinguistic and linguistic tasks. From September to May, the children in the experimental group participated in a training program occurring daily for 15- to 20-minute sessions. The program consisted of metalinguistic games and exercizes such as listening games, rhyming games using nursery rhymes, segmentation of sentences and words, awareness of syllables and phonemes. Training occurred in groups of 15-20 children. The control group participated in the regular preschool program that avoids formal linguistic and cognitive training. In May, both of the groups were post-tested. The following September, the children's level of phonological awareness was assessed and after 7 months, another assessment was completed. The results of the training showed that there was a substantial group treatment effect shown on the metaphonological tasks. The authors concluded that metaphonological training over an extensive period of time at the preschool level had a positive effect on metaphonological skills, especially the skills for which manipulation of phonemes is required. This type of training did not seem to promote general language comprehension or informal letter learning. This study shows that metaphonological training can be beneficial for the acquisition of phonemic segmenting skills; children in the experimental group also appeared to have "a clear advantage in earning to read and spell in school" as a result of the training (Lundberg, et al., 1988, p. 283).

In 1984, Fox and Routh examined the effects of training kindergarten children in segmenting and blending skills. The goal of this experiment was to investigate the relationship between phonemic blending, segmenting, and performance on a reading analog task. Forty-one kindergarten children served as participants. The children were divided into three groups: a no-training control group, a segmenting training group, and a segmenting and blending training group. The training took place over five weeks in groups of five or six for 15 minutes four to five times a week. Segmenting training focussed on identification of the beginning and ending sounds of words. Blending training worked on identification of segmented words. All of the children were then given letter-sound training where they were taught to correspond letterlike forms (not real letters) to letter sounds. After the letter-sound training, the children were given a word learning task. The children were required to read the letterlike forms that were combined to produce words. In both segmenting and blending post-tests, the segmenting and blending training group significantly outperformed the segmenting alone training group. In the word learning task, the children trained in segmenting and blending made significantly fewer errors than those trained in segmenting alone. The authors suggest that phonemic segmenting alone is not sufficient to facilitate the decoding of written words to speech. Fox and Routh recommend that future research examine the effect of training only blending skills to assess its efficacy. The following study by Torgeson, Morgan, and Davis (1992) attempted to answer this question.

A phonological awareness training study by Torgesen, Morgan, and Davis (1992), contrasted two types of phonological awareness training, one that involved training in phonological analysis and synthesis skills, and one that involved training in solely phonological synthesis skills. Fifty-one kindergarten children participated in this study.

Children included in this study were those who obtained scores on the Screening Test of Phonological Awareness (STOPA) (Torgeson & Bryant, 1994) between the 15th and 50th percentiles, who had good attendance, and no behavioural problems, and who did not attend special classes. Pre-test measures included a phoneme segmentation test, a phoneme blending test, the Word Analysis subtest from the Woodcock Reading Mastery Test (Woodcock, 1973), and the vocabulary subtest from the Stanford-Binet Intelligence Scale: Fourth Edition (Terman, L.M., 1973). The post-test measures included the phonological segmenting and blending measures administered in the pretest and a reading analogue test. These authors used a tool for testing ability to acquire reading similar to Fox and Routh (1984): a reading analogue test. Therefore, the children were required to learn sound-symbol associations; this consisted of teaching the children letter sounds that corresponded to six different novel, letter-like forms (Torgesen, Morgan, & Davis, 1992). Three groups were formed: two experimental groups, an AB group (analysis and blending), a B group (blending), and one language experience control group (C). Training was performed in groups of three to five children in 20 minute sessions three times a week for seven to eight weeks. The results of the training show that children in the AB group were significantly better at segmenting and blending skills than the children in the C group, and the B group performed significantly better on the blending test than the C group. The authors suggested that training in both segmenting and blending may "lead to a more complete, decontextualized concept of the phonological structure of words than training on a single type of task" (Torgesen, Morgan, & Davis, 1992, p. 368). This would enable children to generalize their learning for the phonological structure of words. For the reading analogue test, the only significant difference found between the experimental and control group was the difference on the

number of trials needed to reach criterion. The AB group required fewer trials than the C group. The difference was not significant between the B group and the C group. The authors concluded that the children in the AB group were able to generalize their learning of analysis and synthesis tasks to the task of reading new words. Torgesen et al. (1992) stressed the importance of training both phonological analysis and synthesis skills for a more complete, generalizable concept of the sound structure of words. Finally, the authors suggested that training should begin with synthesis skills, then proceed to analytic skills. To sum up thus far, not just one of segmentation or blending training needs to be completed for increased phonological awareness ability and reading ability; rather, both types of skills need training.

Ball and Blachman (1991) conducted a phonological awareness training study with kindergarten children. There were three goals: (1) to examine whether children can be taught to segment words into phonemes; (2) to explore whether segmentation training has an effect on the children's early spelling and reading ability; (3) to determine the effects of training letter names and letter sounds on segmentation ability and early reading and spelling ability. Eighty-nine children with a mean age of 5 years participated in the training. Pre-testing included a phonological segmenting test and a test of letter name and sound knowledge. The children were then separated into three groups. Group I received the phoneme awareness training. This included a game called "Say it-Move it" where the children were instructed to move a token to represent a sound while saying that sound. Another component of this training included segmentation related activities and letter name and letter sound training. Group II was the language activities group, which received training in general vocabulary development, story listening, semantic categorization, and letter name and letter sound knowledge. Group III was a control

group and received no special training. Training Groups I and II worked in groups of five children for 20 minutes four times a week for seven weeks. After the seven training weeks, the children were given post-tests, which included the phoneme segmentation test, the letter names and sounds test, and the Woodcock Reading Mastery Word Identification subtest (Woodcock, 1973). The children were also asked to read a list of phonetically regular words and to spell a list of five words. The authors found that the children in Group I performed significantly better on the phoneme segmentation test than Groups II or III. Results also show that the children trained in phoneme awareness were able to generalize the segmentation training to novel items. There were no significant differences between the groups for letter name knowledge. However, there were significant post-test differences on letter sound knowledge. Groups I and II had significantly higher letter sound scores than the control group. These results suggest that letter name and letter sound knowledge do not ameliorate segmentation skills. Results of the Woodcock Word Identification subtest and the spelling test showed that the scores of the children in Group I were significantly higher than the scores of the children in Group II or Group III. A conclusion that can be drawn from these results is that letter name and letter sound training alone does not improve reading or spelling ability but that it needs to be complemented with training in *both* analysis and synthesis skills.

Cunningham (1990) sought to examine the role that phoneme awareness plays in reading development and different training methods in phonemic awareness. Forty-eight kindergarten children (mean age 5;11) and 48 grade one children (mean age 7;2) participated in this study. The children were divided up into three groups. Group I was a "skill and drill" group that worked on phonemic segmentation and blending *without* explicit reference to the direct use or application of segmentation and blending. It is also

interesting to note in light of Ball and Blachman (1991) above, that Cunningham (1990) specifically did not include training for letter-sound correspondences; the children represented each sound with wooden chips. The core of the training programs for Group I and Group II were identical except for the emphasis placed on how explicitly the segmentation activities related to the task of reading. Group II was the "metalevel" group; the children were "directed to reflect upon their own thinking regarding phoneme awareness and explicit discussion of the goals and purposes of learning phonemic awareness to improve overall reading" (Cunningham, 1990, p. 435). Group III was a control group to whom a story was read and talked about. A reading achievement test was administered along with three measures of phonemic awareness (phoneme deletion, phoneme oddity, and phoneme discrimination). The experimental and control training groups were small groups of four or five children; each student received 15-20 minutes of training twice a week for 10 weeks. Children in both of the experimental groups ("skill and drill" versus metalevel) performed significantly better than the control group on all three measures of phonemic awareness. The author also found that reading performance was facilitated by training in phonemic awareness for children in both kindergarten and grade 1. The type of instruction ("skill and drill" versus metalevel) did not show a significant difference in the children's level of phonemic awareness. However, for the children in grade one who received the metalevel training approach, there was a significant difference in their level of reading achievement. The author suggests that "the knowledge learned via a metalevel approach generalized to a more global measure of reading achievement" (Cunningham, 1990, p. 438). This study shows the benefits for training young children in phonemic awareness. An interesting added component to this study was the addition of different types of phonemic awareness training. Giving the

older (grade 1) children more explicit training in phonemic awareness facilitated their reading achievement. The author suggests that improved reading achievement was not shown in the younger children because they had fewer opportunities in the classroom to apply their new knowledge. Another interpretation could be the younger children were not developmentally ready to apply this knowledge. Given the findings of Ball and Blachman (1991) on the importance of explicitly training letter-sound correspondences, it would be interesting to know if the children in these experimental groups would have achieved greater benefits with that additional training.

Training in metaphonology appears to be beneficial for typical children; it is important to determine, however, whether this type of training is helpful for children with language disorders.

Metaphonological Treatment Studies with Language-Disordered Children (Deficits in Syntax, and/or Morphology, and/or Phonology)

A recent study by Major and Bernhardt (1998) examined the relationship between children's moderate to severe phonological disorders and their abilities in metaphonology. These authors studied these children's outcomes in their development of metaphonology after both phonological and metaphonological intervention. Nineteen preschool children aged 3;0-4;11 participated in this study. Metaphonological intervention focussed on phonology, with an emphasis on rhyming and alliteration and drawing children's attention to onsets, rimes, and individual sounds. Seven different tasks were employed to test the children's level of phonological awareness. The results of this study indicated that children with phonological disorders have difficulty with metaphonological tasks, although much individual variation was noted. Generally, it was

found that the children who scored higher on the metaphonology tasks had better developed syllables and wordshapes. A moderate correlation was found between the few morphosyntactic skills tested and metaphonological skills. Thus, the children with good syntactic production abilities tended to perform better on the metaphonological tasks than children with poorer syntactic production abilities. Major and Bernhardt also state that the syntactic skills of the children were related to the degree of phonological impairment. This indicates that children with less severe phonological impairment had better syntactic production scores. It was hypothesized that such children have the skills that are important for the phonological awareness tasks. Another finding of this study was that phonological intervention was not sufficient to promote phonological awareness, although this depended on the individual characteristics of the children. In conclusion, the individual characteristics of the children in most part determined the level of phonological awareness that they attained.

A study by van Kleeck, Gillam, and McFadden (1998) sought to determine if phonological awareness could be effectively trained in preschool children with phonological disorders and/or additional language disorders. This intervention took place in a classroom setting with 24 children between the ages of 3;9 to 7;9. The experimenters divided the children into two groups, based on their ages; therefore, there was a preschool group and a prekindergarten group. Control data were obtained from historical data from children who had previously been in the prekindergarten group. Nine children had both phonological disorders and other language disorders, four children had morphosyntactic disorders without phonological disorders, one child had a phonological disorder, and two children had pragmatic language disorders. The training took place over two 12-week semesters. The children were seen in groups of three to four twice

weekly for 10-15 minutes. The training was conducted by graduate students in speech-language pathology. In the first semester, training focussed on rhyming skills (rhyme recognition, identification, judgment, and generation). The second semester's training focussed on phoneme awareness skills. The goal was to acquire an awareness of sounds at the beginnings and ends of words. Rhyming and phoneme awareness tests were administered before and after the training. The results indicated that both younger and older children in both classrooms made significant gains in rhyming and phoneme awareness between the pre- and post-test dates. However, when compared with the control group children, children receiving the rhyming training did not improve in rhyming. Nonetheless, phoneme awareness training did contribute to gains in phoneme awareness. It could be that the training in rhyming supported the acquisition of phoneme awareness also. Furthermore, as suggested by Gillon (1999), training at the phonemic level may require explicit instruction and be less likely to improve by maturation alone.

A recent study by Gillon (1999) examined the efficacy of metaphonology training on metaphonology, reading, and phonological production for children with phonological impairments. Sixty-one children with spoken language difficulties and 30 children with typical speech and language development age 5;6 to 7;6 participated in this study. The children with spoken language difficulties displayed delayed or unusual phonological development and some also exhibited semantic and syntactic language delay. The children with phonological impairments were divided into three different experimental groups (Group 1-experimental treatment, Group 2-treatment control, Group 3-minimal intervention control). The children with typical speech and language skills were placed in Group 4, which was the normal comparison group. The children in the experimental groups had percent consonant correct (PCC) in the range from mild-moderate to

moderate-severe. The Group 1 program focussed both on phonemic analysis skills and on training the connection between speech and print, and was conducted in two, one-hour individual therapy sessions per week for ten weeks. Training concentrated on rhyming, phoneme discrimination, manipulation of isolated phonemes, phoneme identity, phoneme segmentation and blending, and linking speech to print. The Group 2 program was also conducted individually for two, one-hour therapy sessions for 10 weeks. This group received "traditional therapy," where children were given intervention for phonological and morphosyntactic production. The Group 3 program was consultative: once a month a speech-language pathologist provided families with suggestions to improve the children's speech production skills. The phonological awareness training program had positive effects on the phonologically impaired children's level of phoneme awareness, speech production, reading accuracy, and reading comprehension skills in comparison to the other groups. The children in Groups 2 and 3 showed improvement in their speech production skills over the intervention period; however, they showed no improvement in word recognition skills. Intensive phonological awareness therapy appears to be beneficial for those children who are at risk for delayed literacy development.

The Present Study

As can be seen from the preceding discussion, development of phonological awareness abilities appears to be crucial for development of literacy skills. Further, children with language disorders such as phonological impairments appear to be generally at a higher risk for development of phonological awareness. This leads to the conclusion that children with phonological impairments are also at a higher risk for acquisition of literacy skills. Fortunately, preliminary training studies focussing

specifically on phonological awareness with children with phonological impairments show positive results.

The present study seeks to add to the information on phonological awareness training in children with phonological impairments, specifically when a combination of analysis and synthesis skills are trained in a one-to-one setting over a short period.

When examining the research focussing on the phonological awareness skills of children with phonological impairments, it was noted that there were many individual differences in performance. Consequently, it is important to know which individual factors play a role in the acquisition of phonological awareness skills.

Research Question 1- Will children with phonological impairments improve in phonological awareness tasks as a result of training in phonological awareness?

Research Question 2- What are the individual difference factors that have an influence on level of phonological awareness attained after training?

Research Question 3- Does training in one component of phonological awareness help to improve performance in untrained components?

CHAPTER 2

METHOD

Participants

Participants in this study were six children between the ages of 4;0 and 6;10 with a history of moderate-to-severe phonological disorders. Five boys and one girl participated in this study. See Tables 2 and 3 for a list of the children and their previous language and metaphonology scores.

Table 2: Previous Language Comprehension and Production Scores (Percentile Ranks)

Child	Age at beginning of previous study (months)	Age at end of previous study (months)	PPVT-R[a] (1981)	Basic Concepts *	Sentence Structure *	SPELT-P[b] (1983) at beginning	SPELT-P (1983) at end
Michelle	58	65	26	75	91	0**	0**
Cameron	40	51	55	63	63	0**	0**
Duncan	42	52	37	75	75	0**	10
Scott	50	58	14	63	16	0**	0**
Edward	43	46	N/A	98	50	N/A	N/A
Cass	54	57	N/A	75	50	N/A	N/A

* = from the CELF-P (Wiig, Secord, & Semel, 1992), ** < 1%ile

[a] = *Peabody Picture Vocabulary Test-Revised* (Dunn & Dunn, 1981)

[b] = *Structured Photographic Expressive Language Test-Preschool* (Werner & Kresheck, 1983)

Table 3: Previous Metaphonology Scores

	AO (/6)				RO (/6)				AP (/6)				RP (/6)				BSD (/6)				MSD (/6)			
	Ba	Be	M	E	Ba	Be	M	E	Ba	Be	M	E	Ba	Be	M	E	Ba	Be	M	E	Ba	Be	M	E
Michelle	2	2	4	4	4	2	5	*	0	0	0	*	0	0	0	*	0	0	0	*	0	0	0	*
Cameron	3	1	1	2	1	3	0	3	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	1
Duncan	3	2	4	4	3	0	4	5	0	1	0	0	0	1	0	1	1	3	?	5	0	2	5	5
Scott	3	6	2	1	2	0	1	4	0	0	0	0	0	1	3	4	0	4	4	6	0	0	0	0
Edward		1		2		NR		2		NR		0		NR		0		NR		0		NR		NR
Cass		2		4		4		5		NR		4		6		6		5		6		4		6

AO = *Alliteration Oddity*, RO = *Rhyme Oddity*, AP = *Alliteration Production*, RP = *Rhyme Production*, BSD = *Bisyllable Division*, MSD = *Monosyllable Division*, Ba = *Baseline*, Be = *Beginning*, M = *Middle*, E = *End,* NR = *No Response,* * = *No data available*

These particular children were selected for this study because they had already participated in similar studies focussing on phonological intervention and metaphonological intervention and continued to show needs for metaphonological development. The children were from monolingual English-speaking homes and were free from any physical handicap or permanent hearing impairment. All of the children were receiving additional speech production intervention during this study from other speech-language pathologists.

Description of Previous Studies

Four children participated in a direct nonlinear phonological intervention study which sought to investigate the phonological and metaphonological skills of preschool children with moderate-severe phonological impairments, and examine the effects of phonological intervention and phonological plus metaphonological intervention on metaphonological development. The children's metaphonological skills were tested five different times. This research was a field-based study conducted in health centres around British Columbia. Therefore, different speech and language pathologists performed the testing and training with support from a team at the university.

The remaining two children (Edward and Cass) and their parents participated in a similar shorter-term group study in which parents were trained to help their children to work on phonology and phonological awareness skills.

Baseline Assessments

A phonological sample based on the Photo Articulation Test (Pendergast et al., 1984) was collected and analyzed in terms of a nonlinear phonological framework. This is a test designed to assess spontaneous articulation of consonants, vowels, and diphthongs through the use of coloured photograph picture cards, that was administered before and after the training sessions. The test was scored in terms of the percentage of consonants correctly produced. The reading test given was the Peabody Individual Achievement Test- Revised (PIAT-R) (Markwardt, 1989). This was done to obtain information about the children's levels of literacy. The reading recognition, reading comprehension, and spelling subtests were administered to the children. This test was

administered to five out of the six children because one child was too young for the PIAT-R. Two subtests from the Test of Auditory Processing Skills (TAPS; Gardner, 1996) were administered: a) the word discrimination subtest, which requires the children to listen to two similar-sounding words and indicate whether they were the same or different, and b) the forward and backward digit span subtests, which requires the children to listen to digits and repeat them back in the same order or in the reversed order.

Phonological Awareness Measures

The phonological awareness tasks that were used for the previous studies were also used in this investigation. This test was composed of six different tasks: rhyme identification and production, alliteration identification and production, and bisyllable division and monosyllable division. If children were able to perform the bisyllable and monosyllable division tasks with ease, initial and final phoneme deletion tasks were administered. A description of the tasks is presented below. Each child was given two examples before being asked to respond to the six test questions.

Rhyming

1.) Rhyme Oddity. This task requires the child to determine which word out of three words does not rhyme. The words are paired with pictures of the words, e.g., "Show me the one that does not rhyme. *Cap . . . fish . . . dish*?"

2.) Rhyme Production. This task requires the child to produce rhyming words, e.g., "I want you to say something that rhymes with *may*."

Alliteration

1.) Alliteration Oddity. This task requires the child to determine which word out of three does not start with the same sound. The words are paired with pictures of the words, e.g., "Show me the one that does not start the same *bat* . . . *book* . . . *teeth*."

2.) Alliteration Production. This task requires the child to produce words that start the same, e.g., "I want you to tell me some things that start the same as *moon*."

Segmentation

1.) Bisyllable Division. This task requires the child to delete one word of a compound word, e.g., "Say *cowboy*. Say it again but don't say *cow*."

2.) Monosyllable Division. This task requires the child to say only part of the sounds in a word that is given, e.g., "Say a little bit of *boat*."

3.) Initial Consonant Deletion. This task requires the child to delete the initial sound from a given word, e.g., "Say *stop*. Say it again without /s/."

4.) Final Consonant Deletion. This task requires the child to delete the final sound from a given word, e.g., "Say *beak*. Say it again without the /k/."

After two weeks of training on a certain phonological awareness skill, an intermediate probe was administered to the children. This probe measured rhyme production, alliteration production, initial consonant deletion (with and without consonant clusters), and final consonant deletion (with and without consonant clusters).

Intervention Program

The children received one hour of training once a week for eight weeks. On weeks 3, 5, and 7, the training probes were administered; thus, on those weeks actual

metaphonology training lasted 40 minutes. The training took place in the children's homes with a parent present and was conducted by a speech-language pathology student (the author of this thesis). Each of the children received two two-week blocks of training in phonological analysis and synthesis skills. In addition, the children received two two-week blocks of either rhyming or alliteration training, depending on which skill was determined to be the most deficient upon baseline testing. If skill on both rhyming and alliteration was equal, training skill was determined quasi randomly. Thus, phonological synthesis and analysis skill training alternated with rhyming or alliteration training every two weeks. Training elements were balanced across subjects by age. See Table 4 for an outline of the training weeks.

Table 4: Outline of Training Weeks for Individual Subjects

Subjects	Weeks 1-2	Week 3 Probe	Weeks 3-4	Week 5 Probe	Weeks 5-6	Week 7 Probe	Weeks 7-8	Week 9 Probe
Michelle	Rhyming Training	Rhyming Probe	A and S Training	A and S Probe	Rhyming Training	Rhyming Probe	A and S Training	A and S Probe
Scott	A and S Training	A and S Probe	Alliteration Training	Alliteration Probe	A and S Training	A and S Probe	Alliteration Training	Alliteration Probe
Cameron	A and S Training	A and S Probe	Alliteration Training	Alliteration Probe	N/A	N/A	N/A	N/A
Duncan	Rhyming Training	Rhyming Probe	A and S Training	A and S Probe	Rhyming Training	Rhyming Probe	A and S Training	A and S Probe
Edward	A and S Training	A and S Probe	Rhyming Training	Rhyming Probe	N/A	N/A	N/A	N/A
Cass	Alliteration Training	Alliteration Probe	A and S Training	A and S Probe	Alliteration Training	Alliteration Probe	A and S Training	A and S Probe

A and S=*Analysis and Synthesis*

General Outline of the Lessons

An example of one lesson is given in the Appendix. Each of the lessons comprised several components. First, each lesson began with a story being read to the child. The story contained the element of focus for the week. Thus, if the child was working on rhyming, then rhyming books were read to the child. A list of the books that were used for the rhyming and alliteration lessons is given in the Appendix. Because no books were found that used analysis and synthesis, the author produced four books that used analysis and synthesis in the story. During the reading of the stories, the children were encouraged to participate. For example, the child was invited to find words that rhymed or words that started with a certain sound. The second component of the lessons was the metaphonological training in the form of games. The training words or sounds were taken from the words or sounds that were used in the stories that were read to the child. Six words or sounds were taught during each lesson. An important part of this study was parent participation. After each of the training lessons, the games that were used throughout the session were left with the parent to play with the child over the course of the week.

Rhyming training consisted of:

- Being read a rhyming book and identifying the rhymes in the book
- Being explicitly taught what makes words rhyme (they sound the same at the end)
- Being explicitly taught how to make rhyming words (change the sound at the beginning of the word)
- Identifying rhyming words (e.g. "Do *may* and *say* rhyme?")
- Producing rhyming words (e.g. "What rhymes with *may*?")

Alliteration training consisted of:

- Being read books that focussed on alliteration as part of the story and identifying the words that began with certain sounds (two of these stories written by the speech pathologist)
- Identifying the beginning sounds of words (e.g., "What is the first sound in *big*?")
- Identifying words that sounded the same at the beginning (e.g., "Do *big* and *bar* start with the same sound?")
- Producing words that sound the same at the beginning (e.g., "What's another word that starts the same as *big*?")

Segmentation training consisted of:

- Being read books that focussed on sound or word segmentation as part of the story (these books written by the speech pathologist)
- Recognizing words when the sounds are separated (e.g., "What word am I saying? /b/ . . . . /æt/ and /m/. . . . /o/ . . . . /m/ ")
- Breaking apart compound words into their component words (e.g., "*hot* . . . . *dog*")
- Saying a word and then deleting a given word from that compound word (e.g., "Say hotdog. Say *hotdog* without *hot.*")
- Breaking apart words into their constituent sounds
- Saying a word and then deleting a given *sound* from that word (e.g., "Say *car*. Say *car* without the /k/.")

CHAPTER 3

RESULTS AND DISCUSSION

Group Results

The data from the present study were analysed across subjects using the nonparametric statistic Wilcoxon Matched Pairs Signed-Ranks. Overall, the training effect was significant ($\alpha = 0.01$). What this reflects is that, in general, the scores on the post-tests were higher than the scores on the pre-tests. A Mann-Whitney U test was performed comparing amount of change from the present study to amount of change from the previous study. The results indicate a non-significant difference between the amount of change between the two studies. This result may reflect the brevity of the present study and the small number of subjects.

Individual Results

Because of the small number of subjects, and the small number of items on each task and individual differences, most results are presented individually. Graphs are presented with each child's profile. The graphs depict the children's scores on the metaphonology pre- and post-test, plus the scores from the intermediate probes that were administered during the study. Scores from the previous study are included on the graphs to track the development of the children in these skills over time. Each of the children participated in the previous study at a different time, and this is noted beside the graphs. The number of items on each of the subtests from the metaphonology assessment tool is six. Therefore, a score of five out of six is necessary to be above chance.

Key for Graphs:

PP-Ba = Previous Project – Baseline

PP-Be = Previous Project – Beginning

PP-M = Previous Project – Middle

PP-E = Previous Project – End

M-Be = Metaphonology Project – Beginning

M-E = Metaphonology Project - End

Michelle

Michelle's age ranged from 6 years 9 months to 6 years 11 months during the study. Her results are summarized in Table 5 and in Figures M-1 to M-12.

Table 5: Summary of Michelle's Pre-Test Scores

Test at age 6;9	Standard Scores (Mean=100 +/- 15)	Description
Percent Consonant Correct (PCC)	85.9%	Mild residual phonological disorder
Word Discrimination	89	< 1 SD below mean
PIAT-Reading Recognition Subtest	88	< 1 SD below mean
Digit Recall	82	> 1 SD below mean *
Digit Backward Recall	88	< 1 SD below mean

*Significant result

MICHELLE

Study	Duration
PP-Ba to PP-E	6 months
PP-E to M-Be	15 months
PP-E to M-Be	2 months

Fig. M-1 Alliteration Oddity

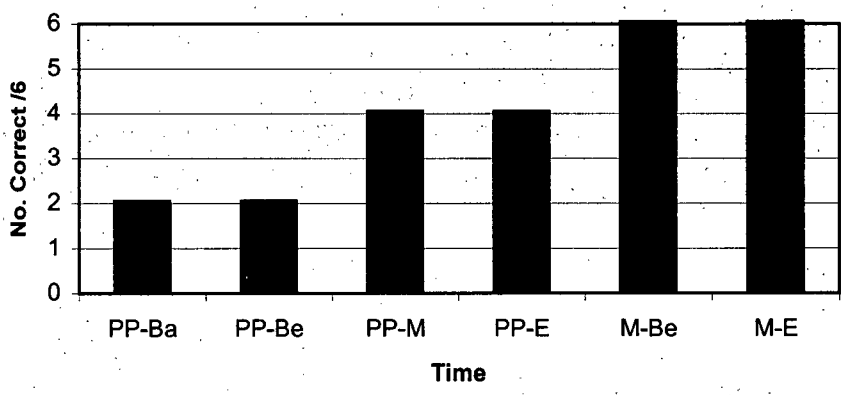


Fig. M-2 Alliteration Production

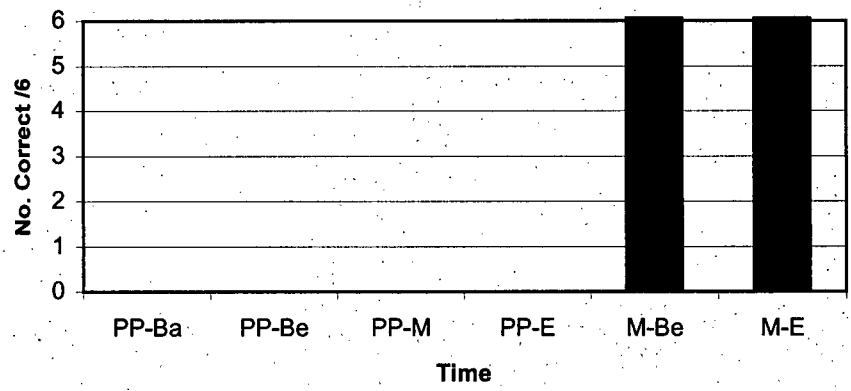


Fig. M-3 Rhyme Oddity

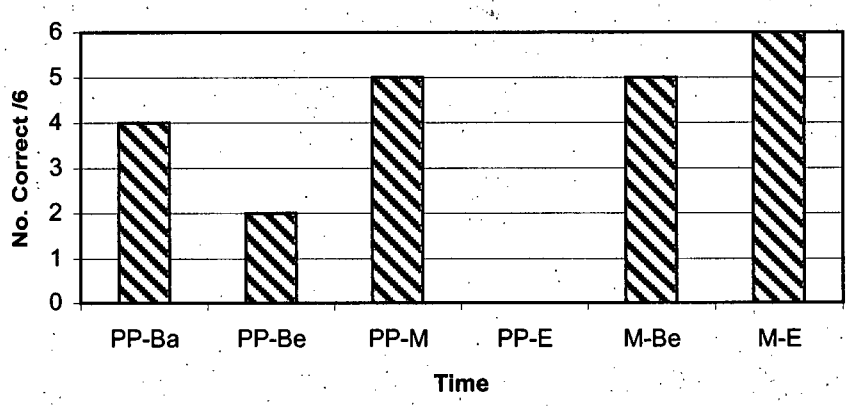


Fig. M-4 Rhyme Production

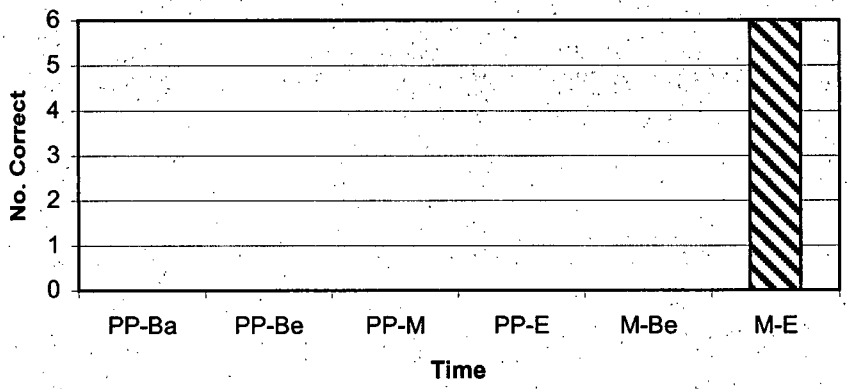
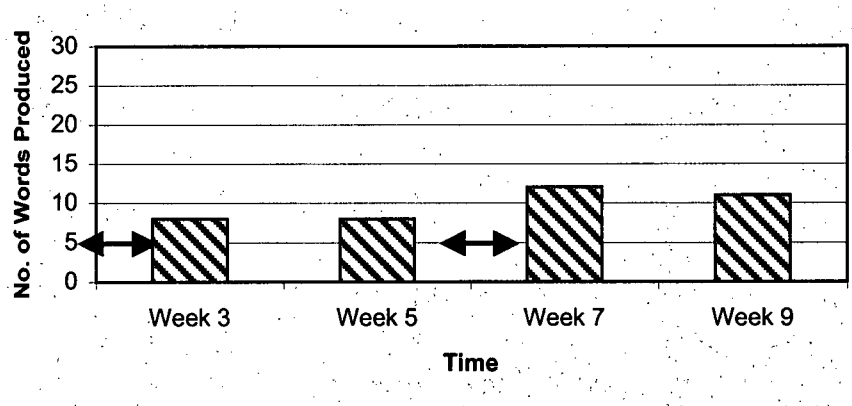


Fig. M-5 Intermediate Probes: Rhyme Production



↔ denote training period for graphed element

Fig. M-6 Intermediate Probes: Alliteration Production

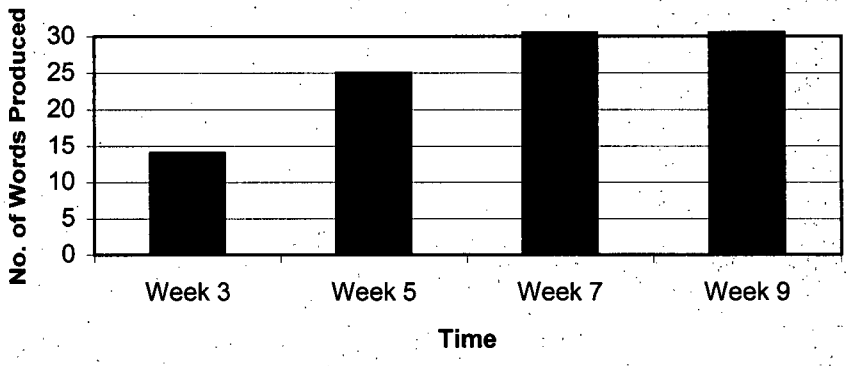


Fig. M-7 Rhyme and Alliteration Production

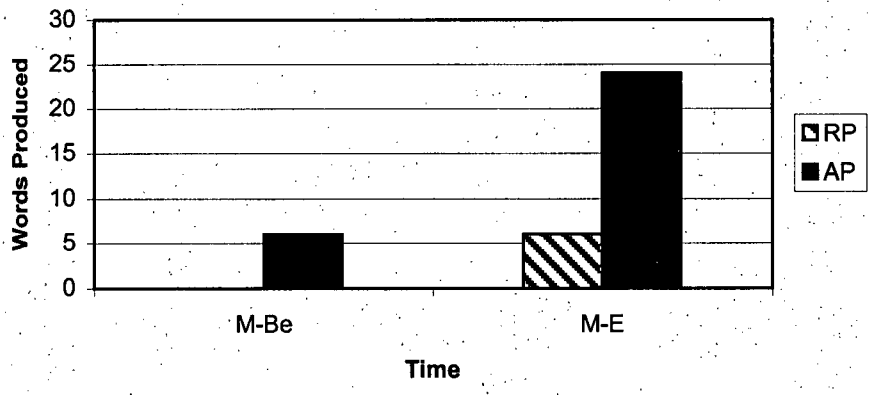


Fig. M-8 Bisyllable Division

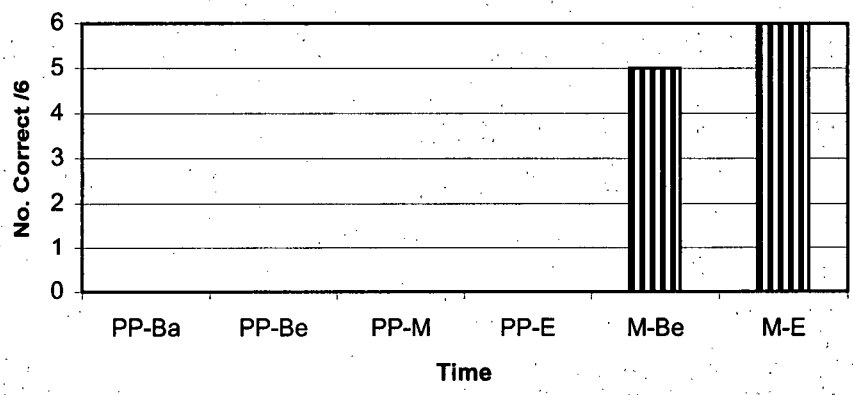


Fig. M-9 Monosyllable Division

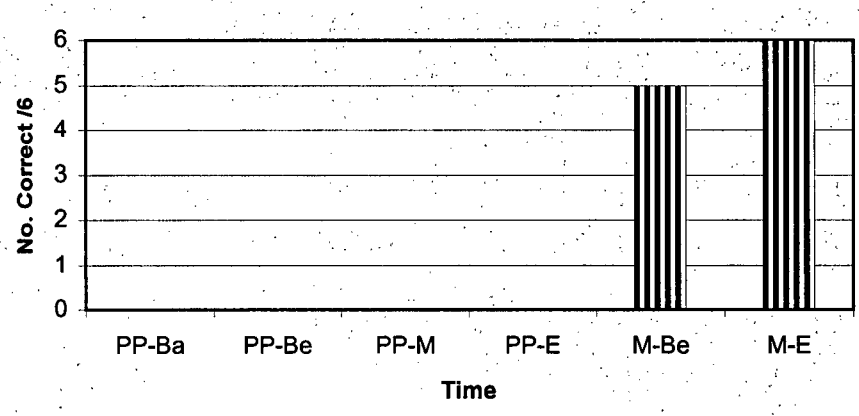


Fig. M-10 Intermediate Probes: Word Initial Segmenting

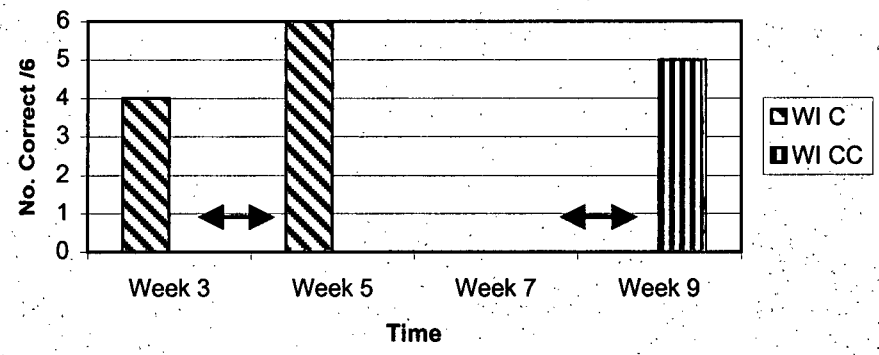


Fig. M-11 Intermediate Probes: Word Final Segmenting

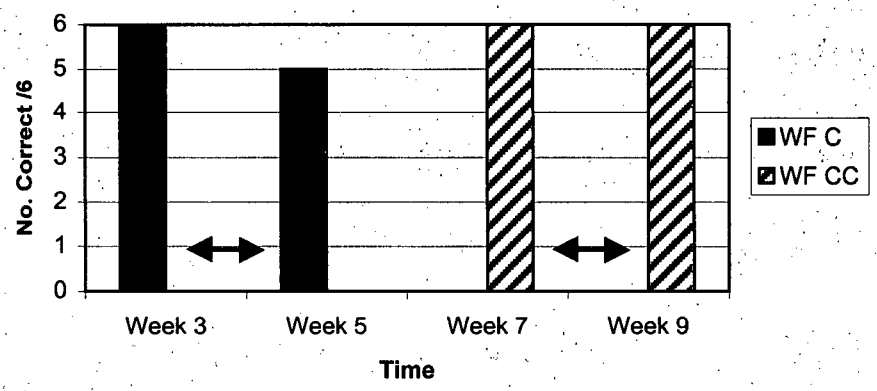
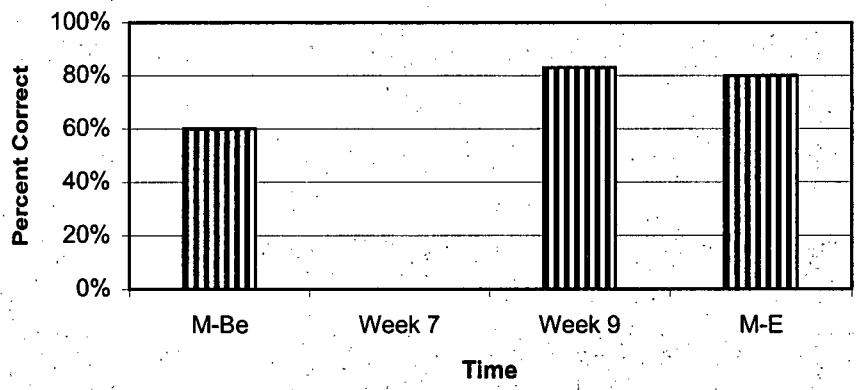


Fig. M-12 Beginning, Probe, and End Results: Segmenting Word Initial Consonant Clusters



Michelle received rhyming training, and analysis and synthesis training focussing on segmenting and blending of individual phonemes.

Rhyme Oddity

Between pre-test and post-test, Michelle showed a slight increase in rhyme oddity, where she reached the ceiling of six (she had five correct pre-treatment).

Rhyme Production

Rhyme production showed the greatest improvement. Michelle increased her rhyme production scores from zero to the ceiling of six. The intermediate probes also showed change, with increases in the number of rhyming words produced at each assessment time (eight words at week 3, eight words at week 5, twelve words at week 7, eleven words at week 9).

Alliteration Oddity

Both the pre-test and post-test scores were at ceiling. Therefore, it was not possible to demonstrate change.

Alliteration Production

Both the pre-test and post-test scores were at ceiling. Over the course of the training, Michelle was able to produce more and more words that started with the same sound. This is shown in the intermediate probe results.

Bisyllable Division and Monosyllable Division

A slight increase in bisyllable division and monosyllable division was noted (from five to six correct). For the post-test, Michelle's scores were at ceiling.

Initial Consonant Deletion

Improvement in word initial consonant deletion was shown in both single consonants and in consonant clusters on the intermediate probes. During weeks 3 and 4, analysis and synthesis training was conducted. The probe in the following week (week 5) shows an improvement in single consonant deletion. The results from weeks 7 to 9 show a stronger result. When tested with deletion of consonant clusters on week 7, Michelle was not able to answer one question correctly; however, after training Michelle achieved a score of 5/6 correct.

Final Consonant Deletion

There was minimal change for word final consonant deletion, from six to five out of six. Both the single consonant deletion and the deletion of the first consonant in a consonant cluster showed ceiling or near ceiling effects.

Summary and Discussion of Michelle's Profile

Changes

Michelle showed the largest change (from zero to six) in rhyme production, probably due to intensive therapy focussing on rhyming. This result is supported by the intermediate probes; after receiving therapy, the number of words she produced increased (from zero to eight to twelve). Training also appeared to benefit Michelle in performing

the word initial segmenting, as shown in her performance on the intermediate probes. Michelle showed increases in her scores after having training in both analysis and synthesis.

Lack of Change

Michelle's pre- and post-test scores on the monosyllable and bisyllable division tasks and on both of the alliteration tasks were at near ceiling levels. This was probably due to Michelle's attendance in kindergarten and grade one, where she was exposed to reading instruction. Michelle's results on the word final segmenting with both single consonant and consonant clusters show near ceiling and ceiling scores. This result could be due to training in analysis and synthesis but also training in rhyming, where the focus is on the sounds at the ends of words.

Positive Factors That May Have Had an Effect on Michelle's Outcome

- Mild phonological impairment
- Average reading recognition score
- Average word discrimination
- Low to moderate amount of home practice
- Eight training sessions.

Negative Factors That May Have Had an Effect on Michelle's Outcome

- Moderately low digit span (< 1 SD below mean)

Cameron's age ranged from 5 years 0 months to 5 years 3 months during the study. His results are summarized in Table 6 and in Figures CM-1 to CM-10.

Table 6: Summary of Cameron's Pre-Test Scores

Test at age 5;0	Standard Score (Mean=100 +/- 15)	Description
Percent Consonant Correct (PCC)	63.2%	Moderate to severe phonological disorder
Word Discrimination	91	< 1 SD below mean
PIAT-Reading Recognition Subtest	94	< 1 SD below mean
Digit Recall	84	> 1 SD below mean *
Digit Backward Recall	97	< 1 SD below mean

* Significant result

Study	Duration
PP-Ba to PP-E	13 months
PP-E to M-Be	6 months
PP-E to M-Be	3 months

Fig. CM-1 Alliteration Oddity

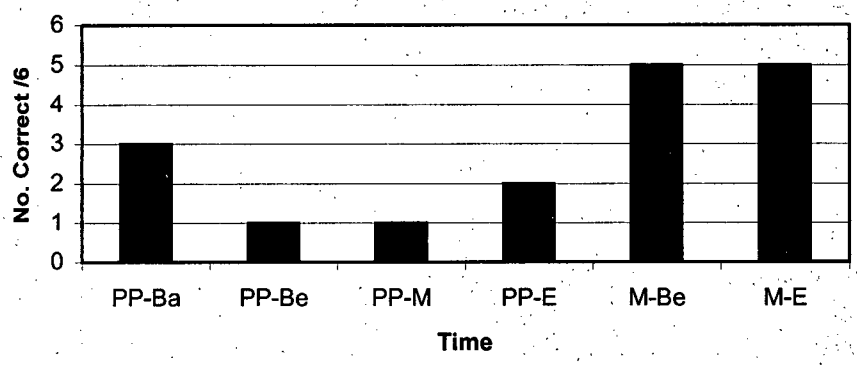


Fig. CM-2 Alliteration Production

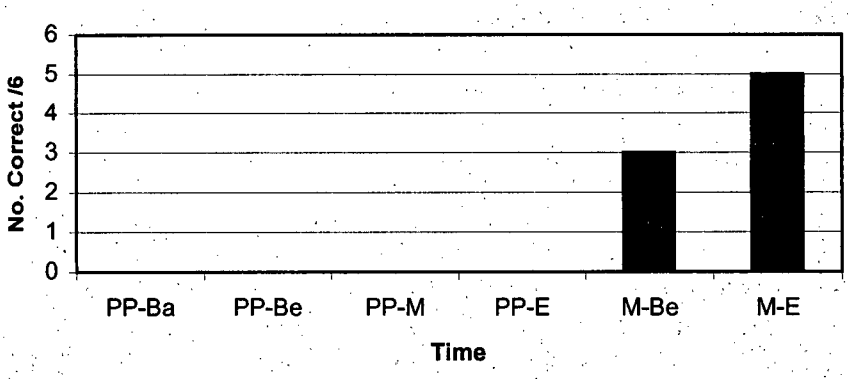


Fig. CM-3 Rhyme Oddity

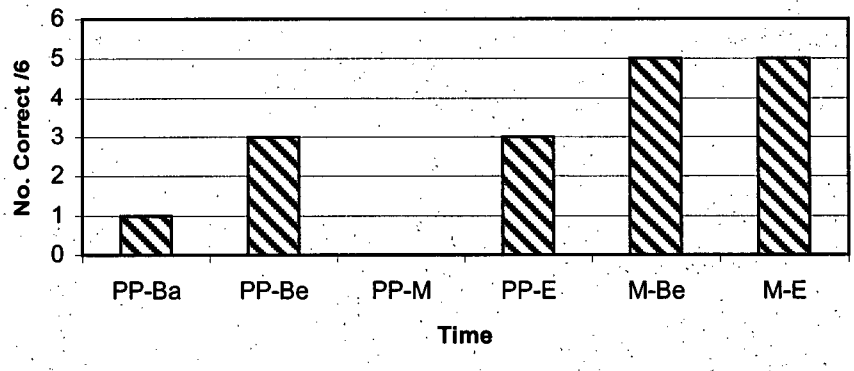


Fig. CM-4 Rhyme Production

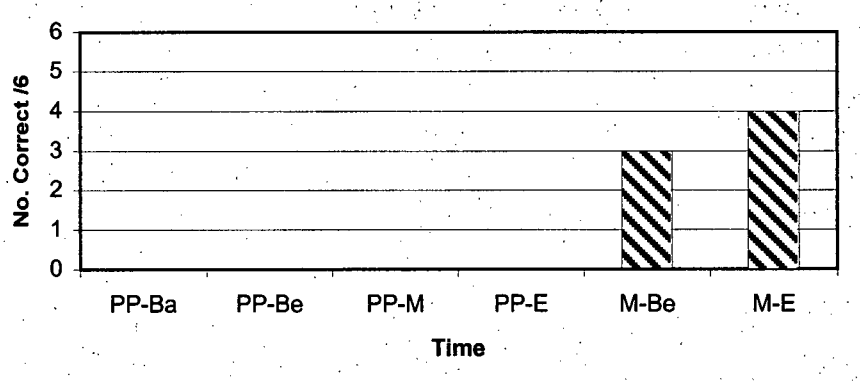


Fig. CM-5 Intermediate Probes: Rhyme and Alliteration Production

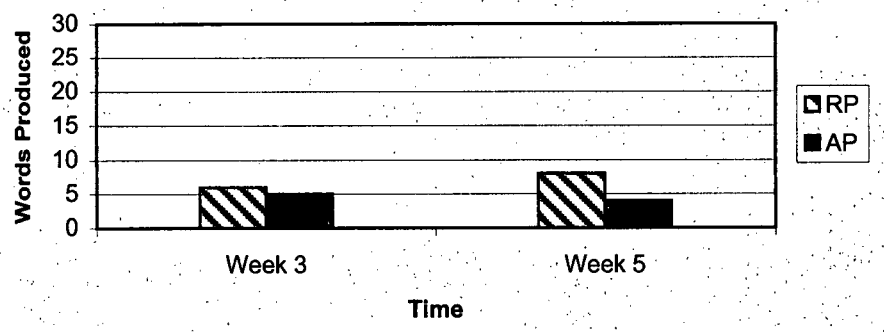


Fig. CM-6 Rhyme and Alliteration Production

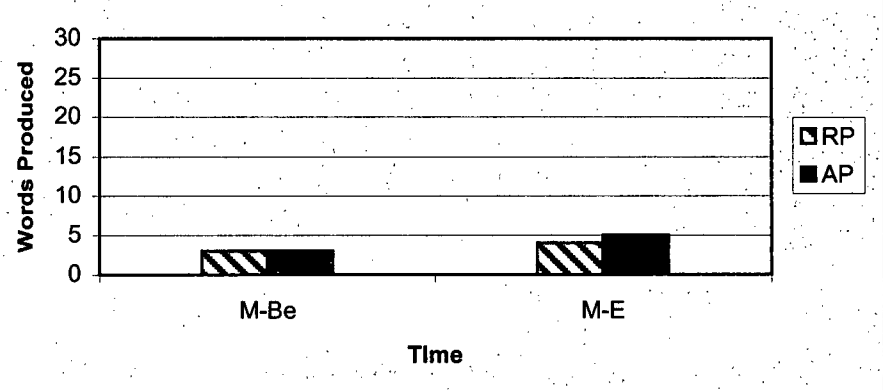


Fig. CM-7 Bisyllable Division

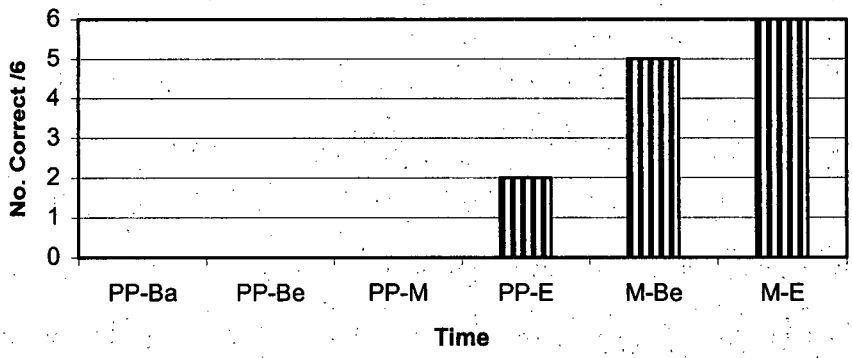


Fig. CM-8 Monosyllable Division

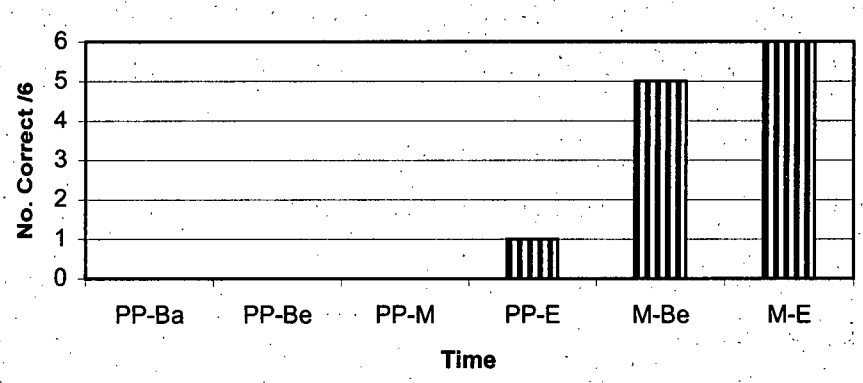


Fig. CM-9 Intermediate Probes: Word Initial Segmenting

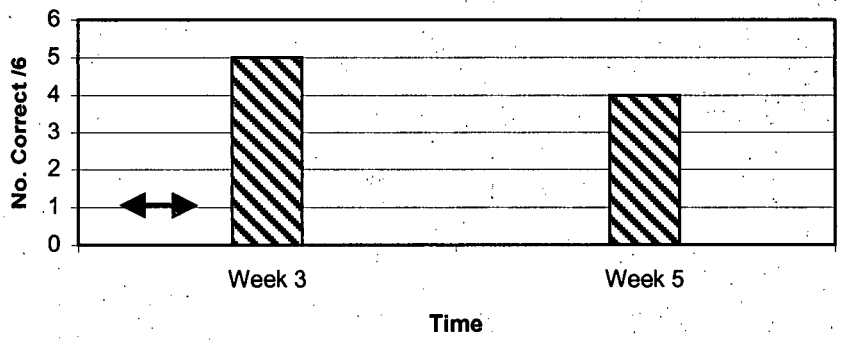
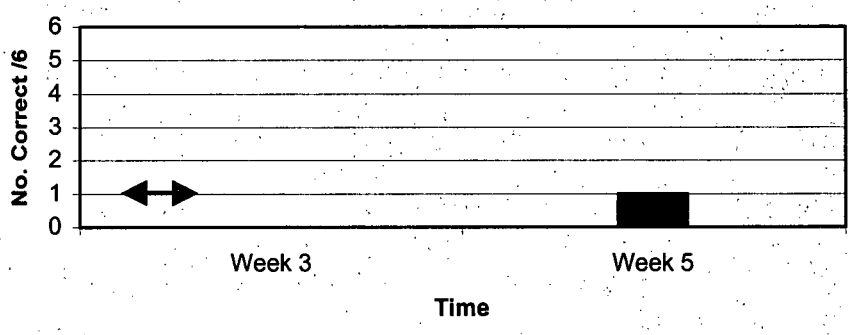


Fig. CM-10 Intermediate Probes: Word Final Segmenting



↔ denote training period for graphed element

Effects of Training on Phonological Awareness Scores

Cameron received training in analysis and synthesis and alliteration. Unfortunately, training lasted for only four weeks due to sickness and family obligations. The pre-test was performed four weeks before the training started and the post-test was performed four weeks after the training ended. Therefore, there was a significant time lag between training time and pre- and post-tests.

Rhyme Oddity

No change was noted between the pre- and the post-test in rhyme oddity; both scores showed possible above chance scores of five out of six.

Rhyme Production

A slight change was noted between pre- and post-testing in rhyme production. Cameron's score increased by one word.

Alliteration Oddity

No change was noted between the pre- and the post-test in alliteration oddity, both of which were possibly above chance at five out of six.

Alliteration Production

Improvement was noted in alliteration production on the phonological awareness tasks from, three to four out of six. However, Cameron showed no improvement in alliteration production on the intermediate probes.

Bisyllable Division and Monosyllable Division

A slight increase in bisyllable division and monosyllable division was noted (from five to six correct). On the post-tests, Cameron's scores showed ceiling effects.

Initial Consonant Deletion and Final Consonant Deletion

No change was noted between the pre- and the post-test on the intermediate probes in word-initial and word-final consonant deletion.

Summary and Discussion of Cameron's Profile

Lack of Change

The slight changes that were noted were likely due to maturation rather than to training. For example, the slight increase in Cameron's rhyme production score from three to four was most likely due to chance or maturation because there was no training in rhyming. Furthermore, when examining the results of the rhyme oddity task, it can be seen that Cameron's rhyme oddity scores increased over time, similar to his pattern of results in the previous study. The results of the alliteration oddity task also seem to indicate maturation and not be the result of specific training on alliteration. The slight increase in alliteration production (from three to five) does not correspond with a similar increase on the intermediate probes. This indicates no effect of training, with minimal change attributed to development.

Similarly, slight increases in both the monosyllable and bisyllable division scores were probably due to maturation. No effect of training was shown for either word-initial or word-final segmenting. The finding that Cameron showed increases rather than stable

scores or regressions in spite of a short training program bodes well for his future development.

Positive Factors That May Have Had an Effect on Cameron's Outcome

- Average reading recognition score
- Average word discrimination

Negative Factors That May Have Had an Effect on Cameron's Outcome

- Moderate to severe phonological impairment
- Average to low digit recall (> 1 SD below mean)
- No home practice
- Four training sessions only
- Three months between pre-test and post-test

Edward

Edward's age ranged from 4 years 2 months to 4 years 5 months during the study. His results are summarized in Table 7 and in Figures E-1 to E-9.

Table 7: Summary of Edward's Pre-Test Scores

Test at age 4;2	Standard Score (Mean=100 +/- 15)	Description
Percent Consonant Correct (PCC)	41.2%	Severe phonological disorder
Word Discrimination	Could not test	
PIAT- Reading Recognition Subtest	Too young to test	
Digit Recall	77	> 1 SD below mean *
Digit Backward Recall	87	< 1 SD below mean

*Significant result

EDWARD

Study	Duration
PP-Be to PP-E	3 months
PP-E to M-Be	4 months
PP-E to M-Be	2 months

Fig. E-1 Alliteration Oddity

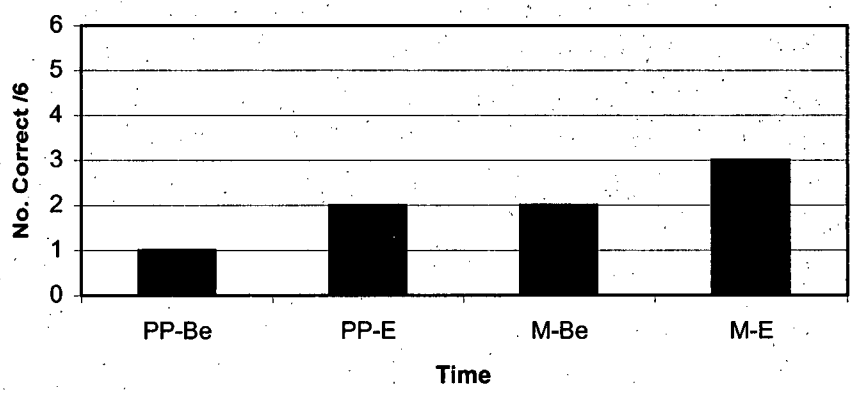


Fig. E-2 Alliteration Production

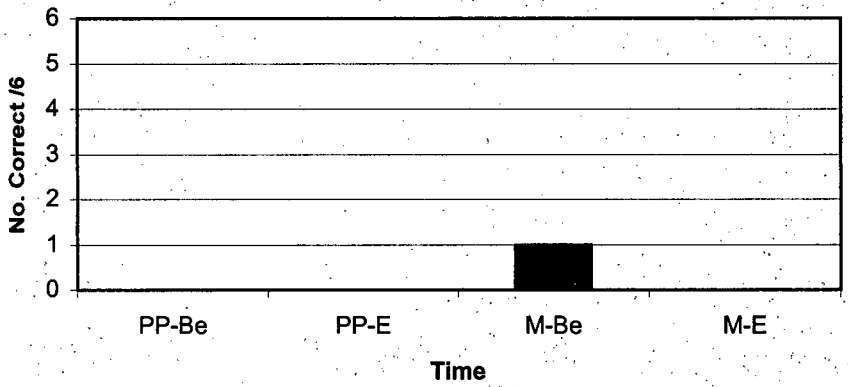


Fig. E-3 Rhyme Oddity

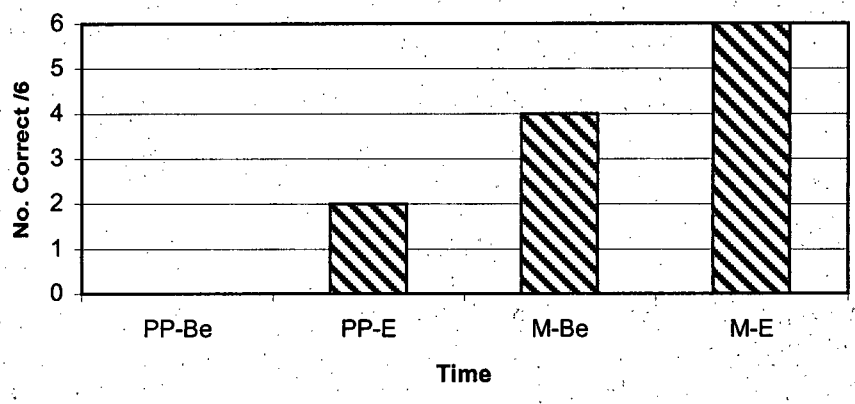


Fig. E-4 Rhyme Production

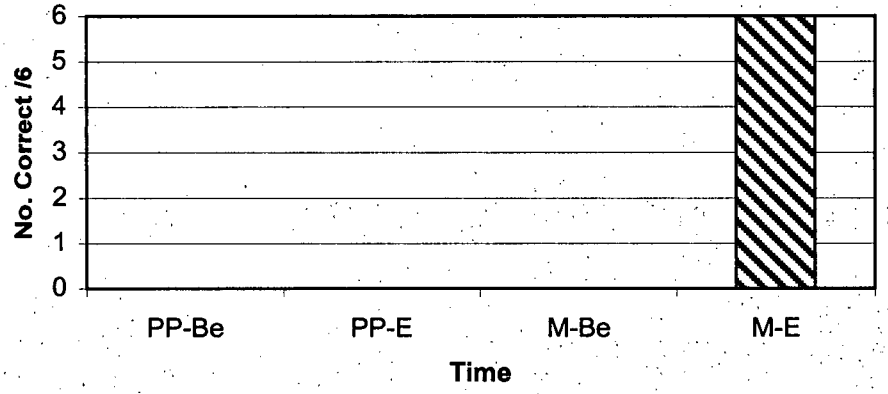
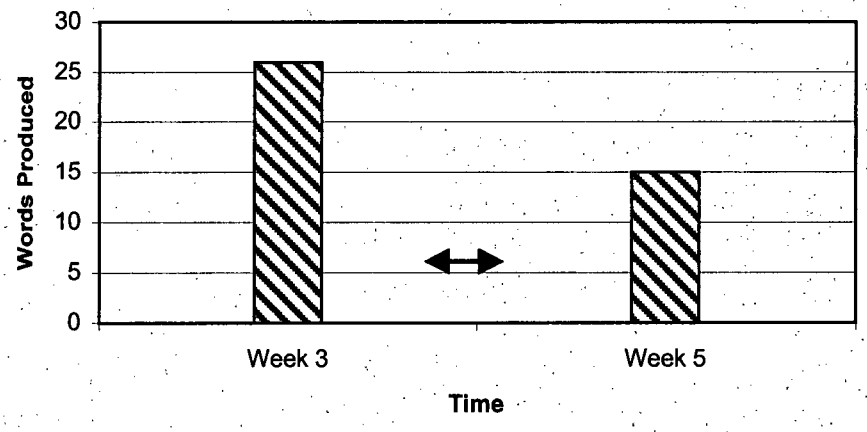


Fig. E-5 Intermediate Probes: Rhyme Production



↔ denote training period for graphed element

Fig. E-6 Rhyme and Alliteration Production

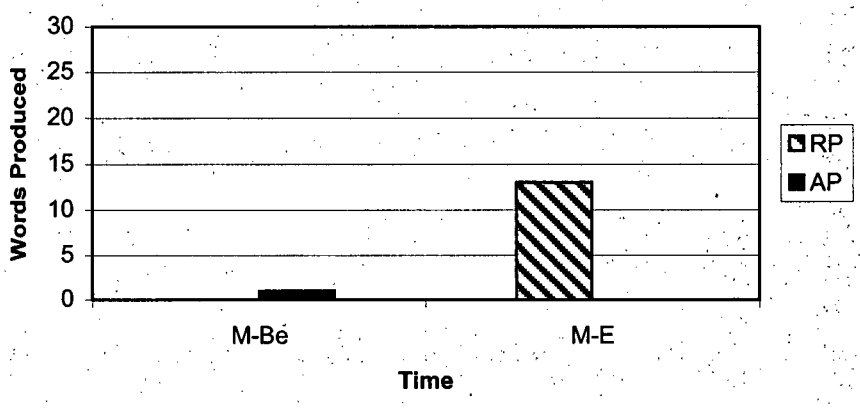


Fig. E-7 Bisyllable Division

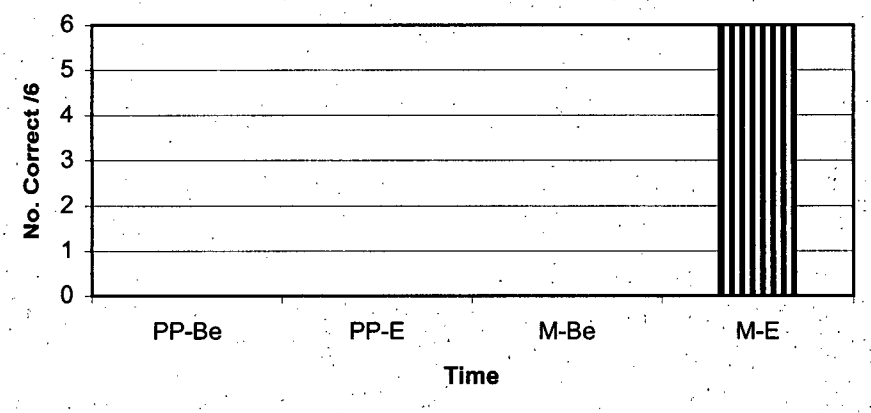
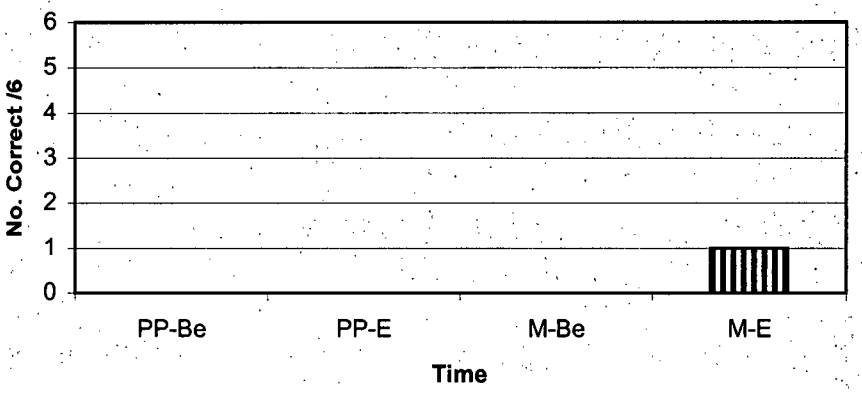


Fig. E-8 Monosyllable Division



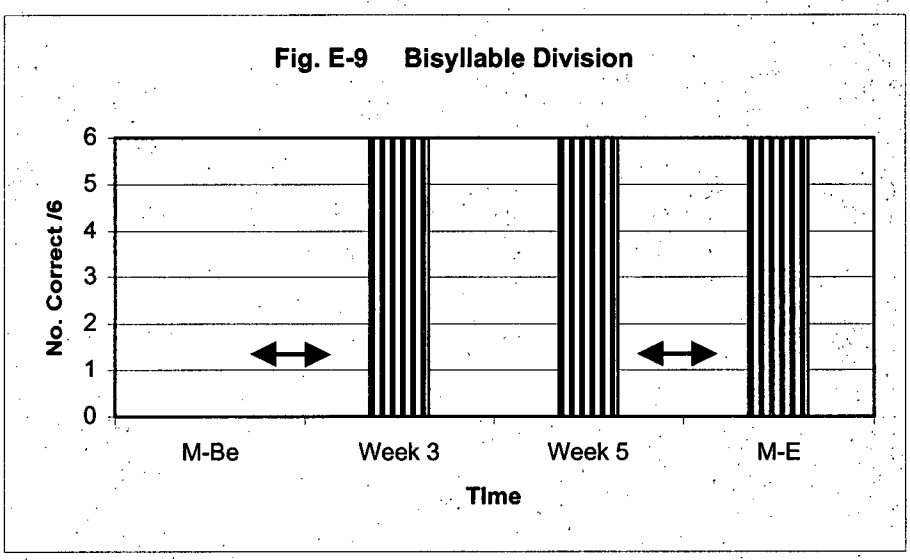


Fig. E-9 Bisyllable Division
No. Correct /6
6
5
4
3
2
1
0
M-Be
Week 3
Week 5
M-E
TIme

Edward was given training in analysis and synthesis and rhyming. Unfortunately, training lasted for only five weeks due to sickness and family obligations.

Rhyme Oddity

Edward's rhyme oddity score increased from four to the ceiling of six.

Rhyme Production

Edward's rhyme production score showed change, with an increase from zero correct to six correct (the ceiling).

Alliteration Oddity and Alliteration Production

No changes were observed.

Bisyllable Division

Edward increased his performance from zero in the pre-test to six (ceiling) in the post-test. This effect was upheld in the bisyllable division intermediate probes.

Monosyllable Division

No change was noted for the monosyllable division task.

Summary and Discussion of Edward's Profile

Changes

It appears as though training had an effect on the performance in rhyme oddity, with an increase from four to six correct. Edward's rhyme production score showed a large increase from zero to six correct. However, the *overt* rhyming training could not be attributed to the improvement of Edward's score because, looking at the intermediate probes, it can be seen showed that at week 3, Edward's scores increased suddenly, and this was before formal rhyming training occurred. It may be possible that the assessment tool, which has a teaching component to it (and was given over three sessions) may have provided Edward with sufficient information to learn how to produce rhymes. Further, Edward's mother reported that after the assessments, Edward was producing rhymes on his own. Also, it may be possible that training in analysis and synthesis had an effect on Edward's rhyme production. A large change was noted on Edward's bisyllable division scores (in both the assessment pre- and post-test and the intermediate probes). This result was most likely due to training in this task.

Lack of Change

A slight change was shown in the alliteration oddity score; however, this was most likely due to development, especially when the previous study is examined, where Edward's scores also increased slowly over the testing period. No change was noted in Edward's alliteration production score in this study. Similarly, no change was shown for the monosyllable division task, a typical result for a child of this age (Bernhardt, Edwards, and Rempel, 1996).

Positive Factors That May Have Had an Effect on Edward's Outcome

- Self-practice and interest in the topic
- Age

Negative Factors That May Have Had an Effect on Edward's Outcome

- Severe phonological impairment
- Low to low average digit span (< 1 SD below mean)
- Five training sessions only

Duncan

Duncan's age ranged from 5 years 1 month to 5 years 3 months during the study. His results are summarized in Table 8 and Figures D-1 to D-10.

Table 8: Summary of Duncan's Pre-Test Scores

Test at age 5;1	Standard Scores (Mean=100 +/- 15)	Description
Percent Consonant Correct (PCC)	89.2%	Mild phonological disorder
Word Discrimination	99	< 1 SD below mean
PIAT-Reading Recognition Subtest	102	< 1 SD above mean
Digit Recall	85	1 SD below mean *
Digit Backward Recall	95	< 1 SD below mean

*Significant result

DUNCAN

Study	Duration
PP-Ba to PP-E	13 months
PP-E to M-Be	6 months
M-Be to M-E	2 months

Fig. D-1 Alliteration Oddity

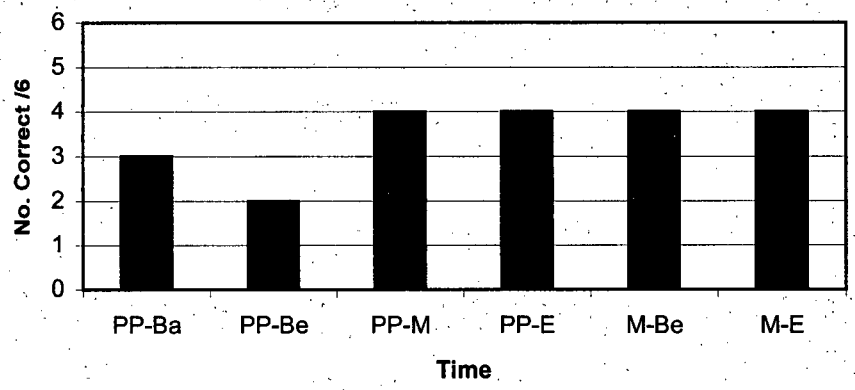


Fig. D-2 Alliteration Production

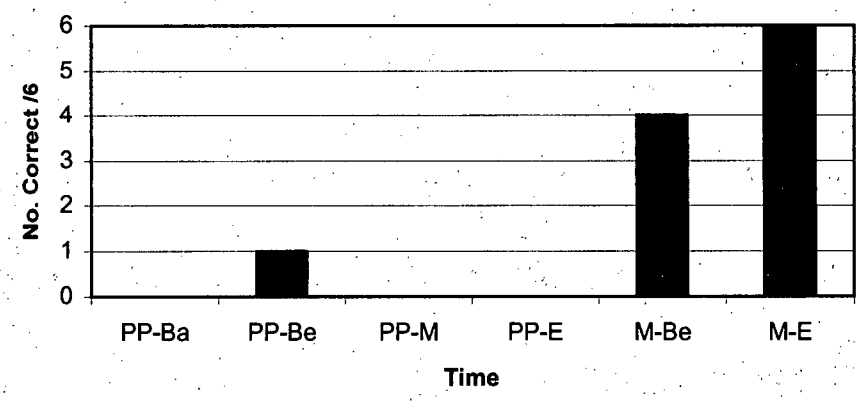


Fig. D-3 Rhyme Oddity

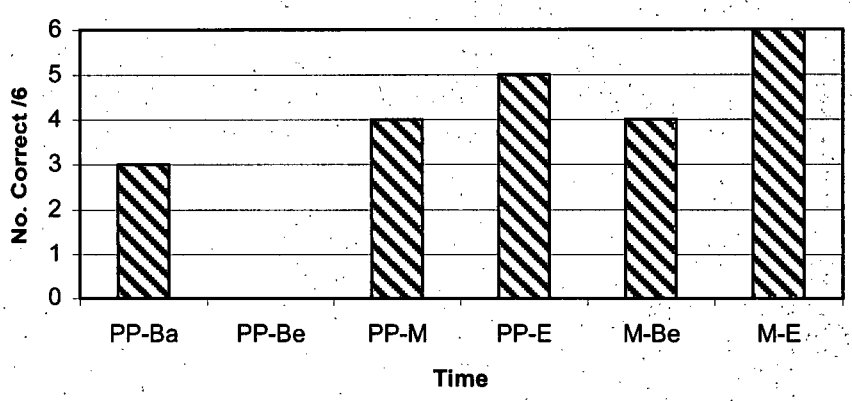


Fig. D-4 Rhyme Production

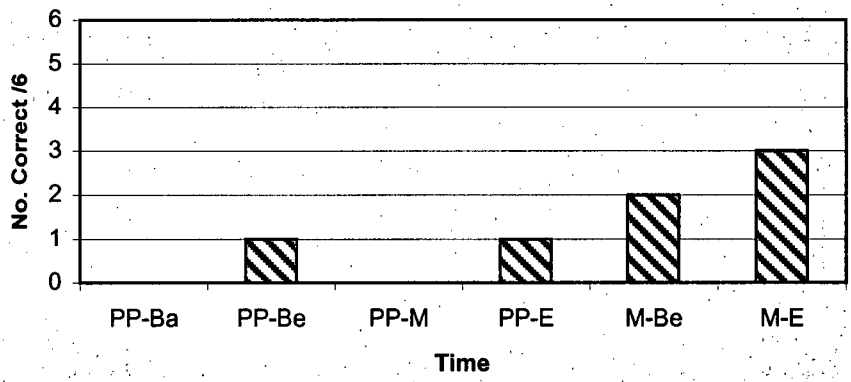
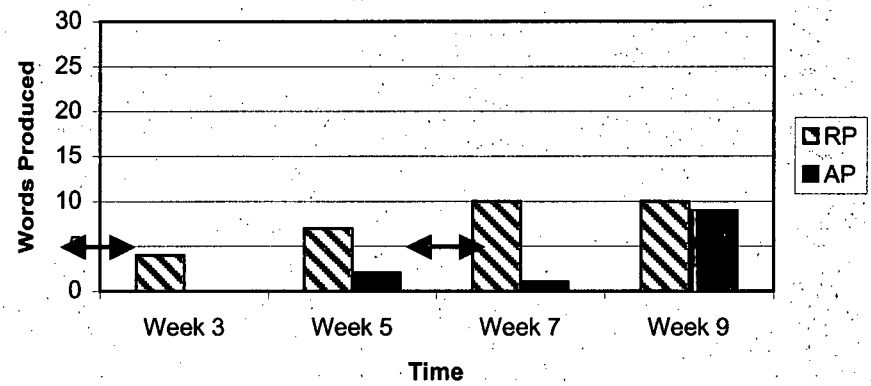


Fig. D-5 Intermediate Probes: Rhyme and Alliteration Production



↔ denote training period for graphed element

Fig. D-6 Rhyme and Alliteration Production

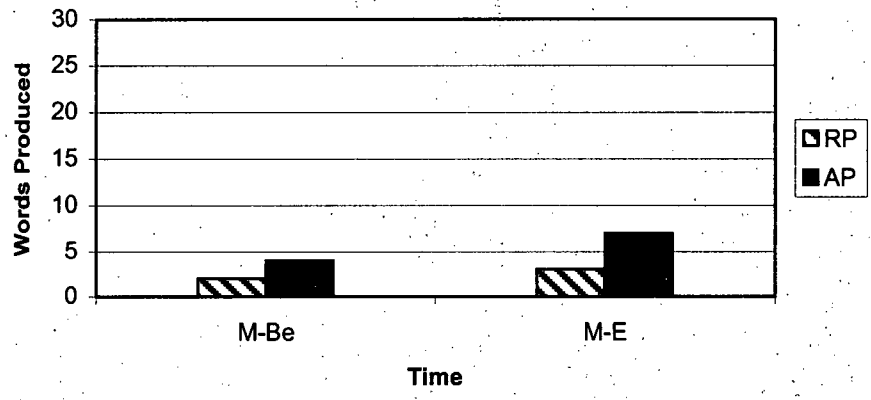


Fig. D-7 Bisyllable Division

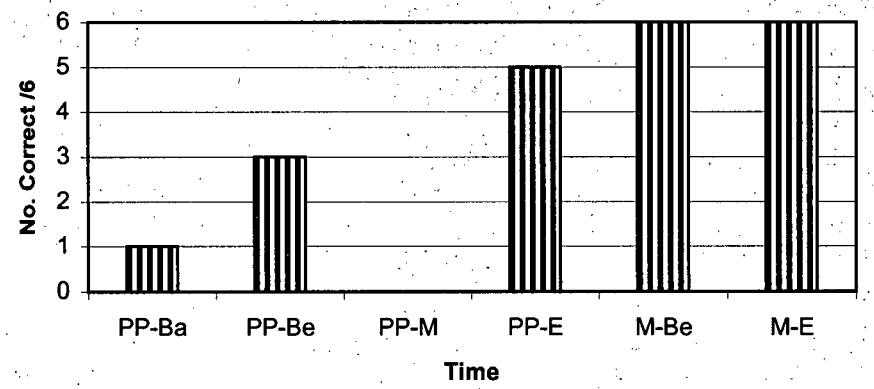


Fig. D-8 Monosyllable Division

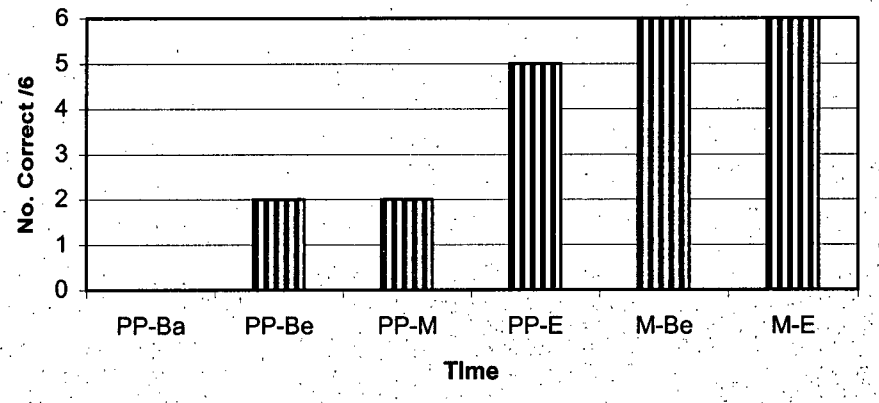


Fig. D-9 Intermediate Probes: Word Initial Segmenting

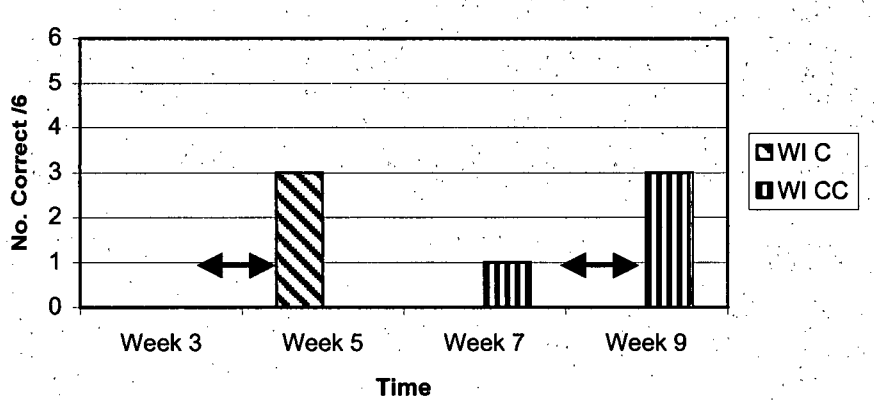
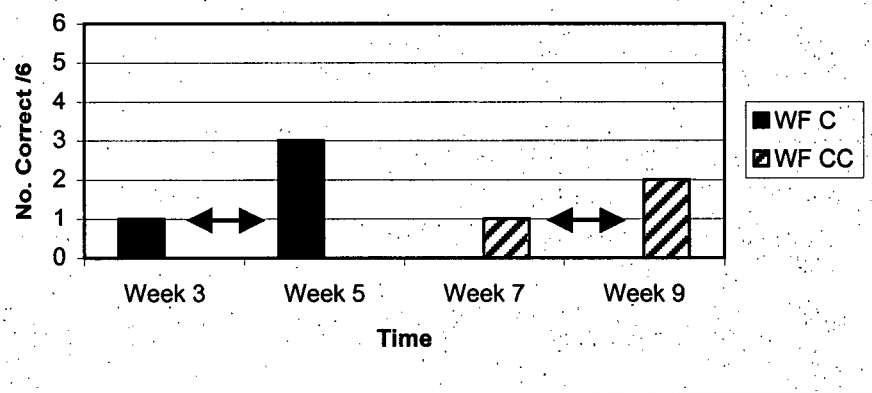


Fig. D-10 Intermediate Probes: Word Final Segmenting



Duncan was given training in rhyming and analysis and synthesis. Due to family obligations, Duncan's post-test was over two weeks after the end of training.

Rhyme Oddity

Duncan's rhyme oddity score showed a slight increase in a positive direction.

Rhyme Production

Duncan's scores showed a slight increase from two to three out of six. These scores are both below chance. However, the intermediate probes for rhyme production showed an increase over the course of the training, from four to ten words produced.

Alliteration Oddity

No change was noted in alliteration oddity scores from pre-test to post-test.

Alliteration Production

Production of alliteration showed a slight increase after training. Duncan's results on the intermediate probes support this finding. At week 9 of the intermediate probes, Duncan showed a large increase in his alliteration production scores, from zero to nine words produced.

Bisyllable Division and Monosyllable Division

Both the bisyllable and monosyllable division tasks showed ceiling effects.

Initial Consonant Deletion

When examining the effect of training on word initial consonant deletion (with both single consonants and consonant clusters), one can see change. Training in analysis and synthesis was performed on weeks 3 and 4 and Duncan's score on week 5 showed an improvement (from zero correct to three correct out of six). This was replicated: after training on weeks 7 and 8, there was a slight observable improvement in week 9 (from one correct to three correct out of six).

Final Consonant Deletion

The results for word final segmenting were very similar to the above. After training, Duncan showed a slight improvement in his word final deletion skills, with both single consonants, (from one correct to three correct out of six) and consonant clusters (from one correct to two correct out of six).

Summary and Discussion of Duncan's Profile

Changes

Upon first examination, Duncan's score on the rhyme production portion of the test appeared to show an effect of maturation. However, the intermediate probes showed an increase in rhyme production scores over the course of the training. Thus, it appears as though the training had an immediate, but short-lived effect.

The intermediate probes in word initial and final segmenting showed a slight effect of training. Duncan's scores increased slightly after training.

Lack of Change

Duncan's rhyme oddity score showed a slight increase in the positive direction; however, given the similar slight increase in the previous study, it appears that Duncan's oddity scores reflects maturation. Both the bisyllable and monosyllable division pre- and post-test scores showed ceiling effects.

Positive Factors That May Have Had an Effect on Duncan's Outcome

- Mild phonological impairment
- Average reading recognition score
- Average word discrimination
- Low-moderate amount of home practice
- Eight training sessions

Negative Factors That May Have Had an Effect on Duncan's Outcome

- Low to low-average digit span (1 SD below mean)

Scott

Scott's age ranged from 5 years 8 months to 5 years 11 months during the study. His results are summarized in Table 9 and in Figures S-1 to S-11.

Table 9: Summary of Scott's Pre-Test Scores

Test at 5;8	Standard Score (Mean=100 +/- 15)	Description
Percent Consonant Correct (PCC)	36.6%	Severe phonological disorder
Word Discrimination	97	< 1 SD below mean
PIAT-Reading Recognition Subtest	87	< 1 SD below mean
Digit Recall	80	> 1 SD below mean *
Digit Backward Recall	86	< 1 SD below mean

*Significant result

SCOTT

Study	Duration
PP-Ba to PP-E	8 months
PP-E to M-Be	10 months
Pp-e to M-Be	2 months

Fig. S-1 Alliteration Oddity

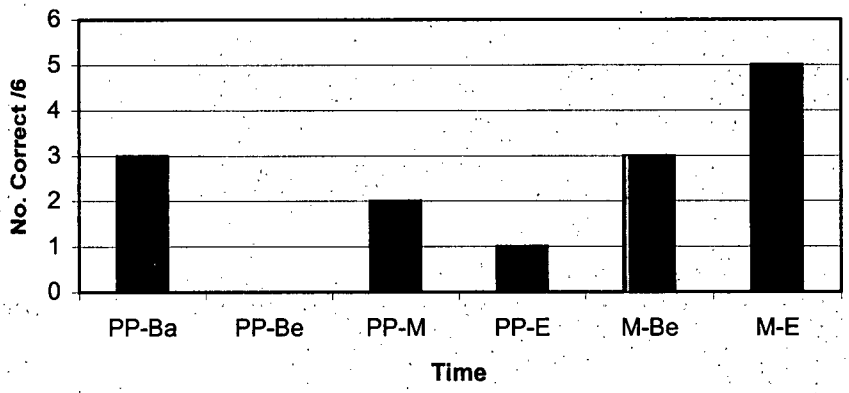


Fig. S-2 Alliteration Production

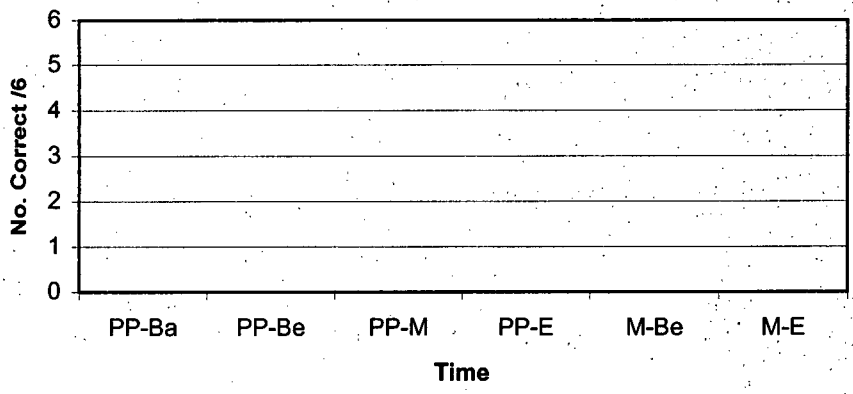


Fig. S-3 Rhyme Oddity

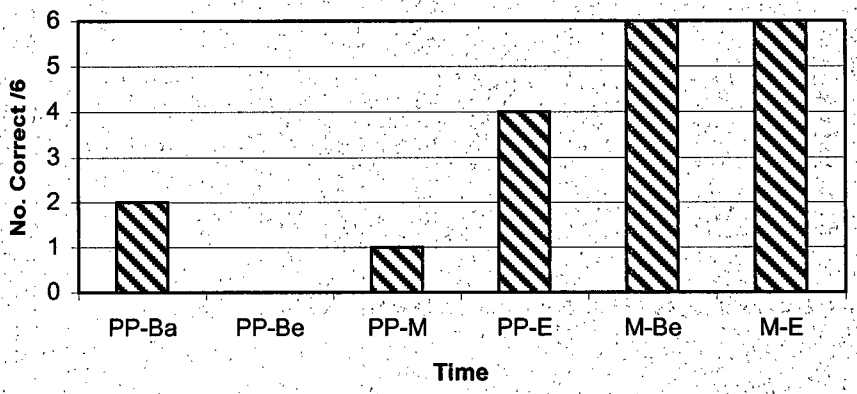


Fig. S-4 Rhyme Production

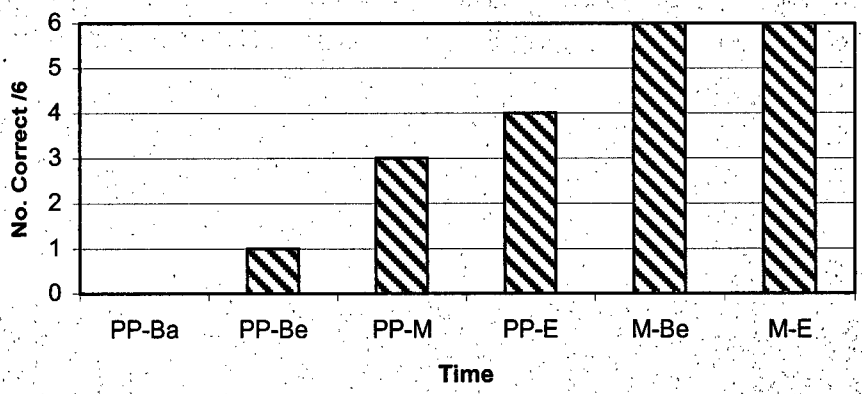


Fig. S-5 Intermediate Probes: Rhyme and Alliteration Production

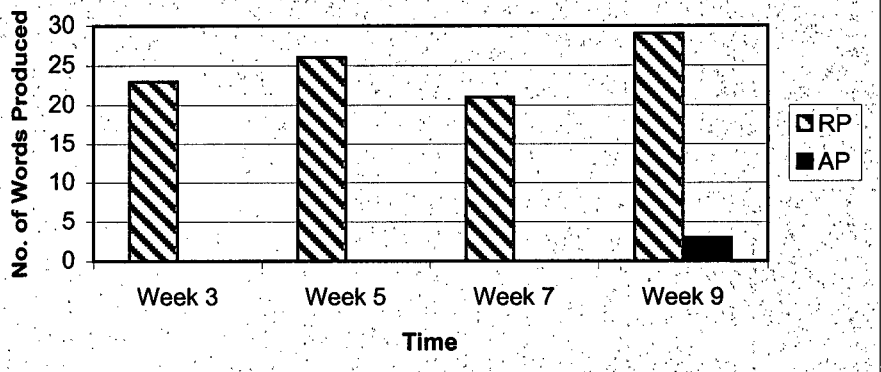


Fig. S-6 Rhyme and Alliteration Production

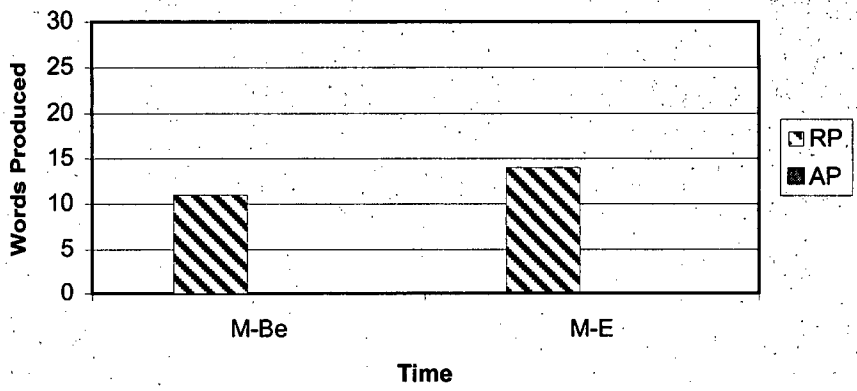


Fig. S-7 Bisyllable Division

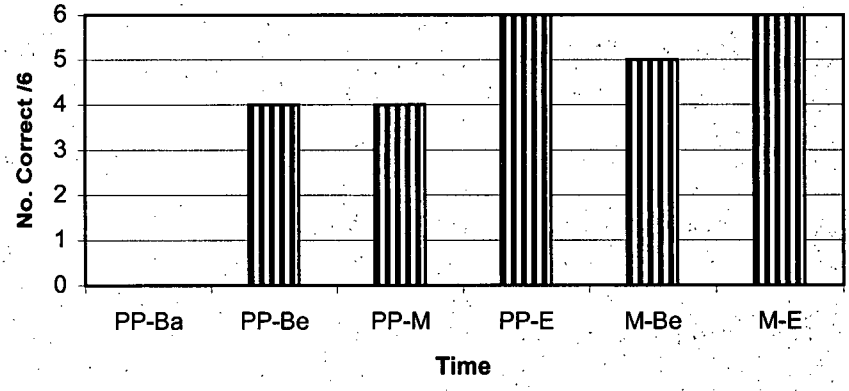


Fig. S-8 Monosyllable Division

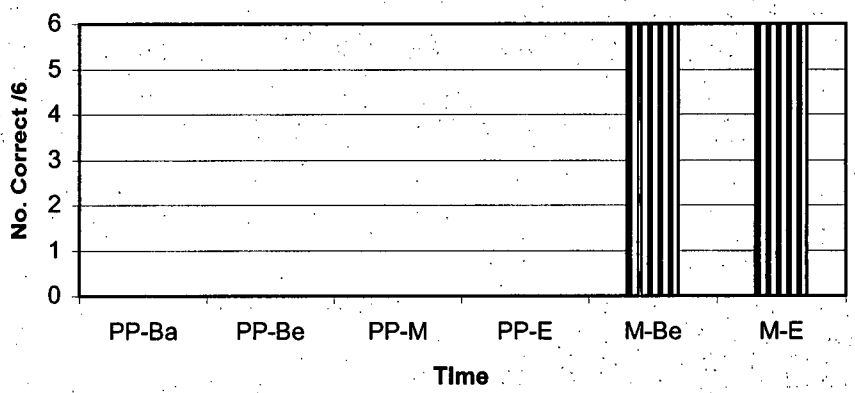


Fig. S-9 Intermediate Probes : Word Initial Segmenting

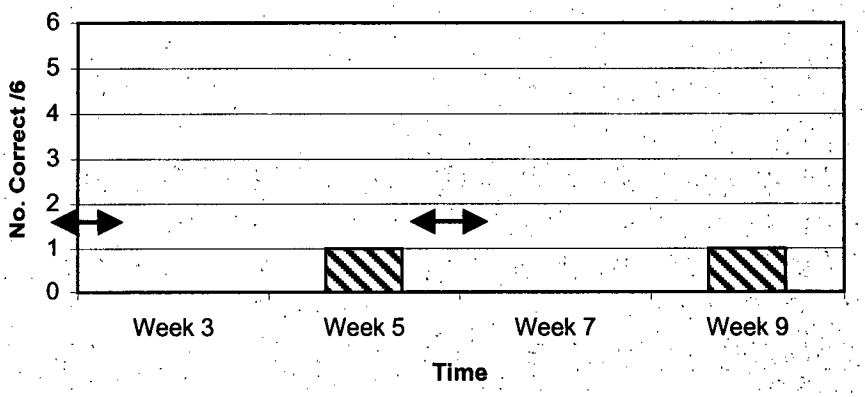


Fig. S-10 Intermediate Probes: Word Final Segmenting

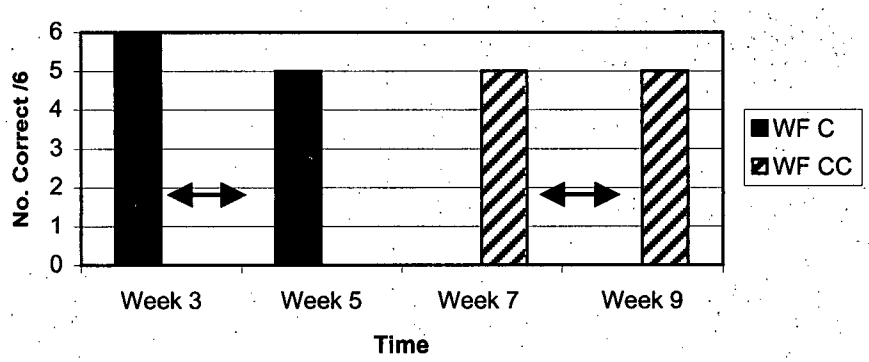
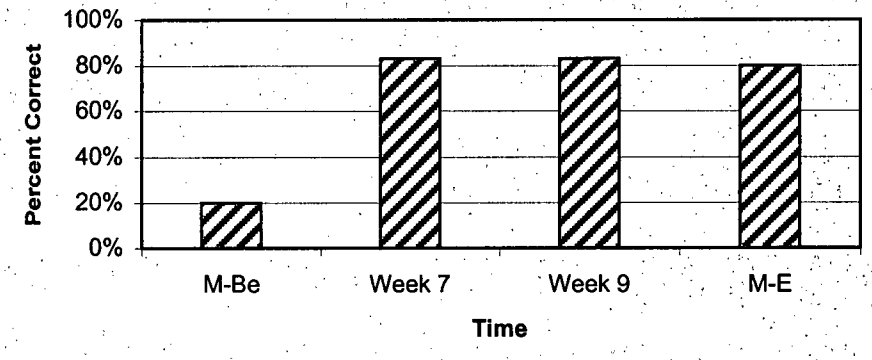


Fig. S-11 Baseline, Probe, and End Results: Segmenting Word Final Consonant Clusters



↔ denote training period for the graphed element

Scott was given training in alliteration skills and analysis and synthesis skills.

Rhyme Oddity and Rhyme Production

In both these skills Scott performed at ceiling level. The intermediate probes support the finding that Scott did well in rhyming. Scott produced over 20 words for each of the probes.

Alliteration Oddity

After training, Scott's scores showed slight improvement (from three correct to five correct out of six).

Alliteration Production

No change was shown for Scott's alliteration production scores. A very slight improvement could be seen in week 9 of the intermediate probes.

Bisyllable Division

Results of the bisyllable division tasks showed performance at near ceiling level (5/6, 6/6), with a slight increase.

Monosyllable Division

Scott performed at ceiling level for the monosyllable division task.

Initial Consonant Deletion

Scott had extreme difficulty performing initial consonant deletion. Scott's scores for weeks 3 and 7 showed performance at floor level (0/6) and performance at weeks 5 and 9 show a slight increase (1/6). Therefore, training in analysis and synthesis focussed on only single initial consonant and did not proceed to consonant clusters. No changes were observable as shown by the intermediate probes.

Final Consonant Deletion

Scott's performance on deletion of word final consonants (with both single consonant and consonant clusters) showed improvement after training in analysis and synthesis.

Summary and Discussion of Scott's Profile

Changes

Scott's scores on alliteration oddity from the previous study were somewhat inconsistent. However, after training in this study, Scott showed slight improvement (from three correct to five correct out of six).

On the word-final consonant cluster segmentation, Scott showed improvement between the pre-and post-test. This is most likely due to training in analysis and synthesis.

Lack of Change

In both rhyme oddity and production, Scott performed at ceiling level. This could be due to the fact that Scott had completed 8 months of kindergarten before the study

took place or the effect of his age. The intermediate probes support the finding that Scott did well in rhyming.

No change was shown for Scott's alliteration production scores. The intermediate probes support this finding, although a very slight improvement was noted in week 9. Given that Scott's alliteration oddity scores showed improvement, this could indicate that Scott was starting to understand alliteration but was not yet able to produce alliterations consistently.

Scott performed at ceiling level for the monosyllable and bisyllable division tasks. It is interesting to note that by the end of the previous study, Scott was not able to perform these tasks. Again, the effects of attending kindergarten or simple maturation were possibly shown in his performance in the present study.

Scott had extreme difficulty performing initial consonant deletion with only single consonants. The results of the intermediate probes support this finding. The difficulty that Scott had on this task was matched by his difficulty in alliteration. In the previous study, Scott deleted both consonants in word medial and word final positions. It could be that therapy concentrating on this position helped Scott focus on the word final consonant.

Positive Factors That May Have Had an Effect on Scott's Outcome

- Low-average reading recognition score
- Average word discrimination
- Eight training sessions

Negative Factors That May Have Had an Effect on Scott's Outcome

- Severe phonological impairment
- Low digit span (> 1 SD below mean)
- Low amount of home practice

Cass

Cass's age ranged from 5 years 1 month to 5 years 3 months during the study. His results are summarized in Table 10 and in Figures CS-1 to CS-11.

Table 10: Summary of Cass's Pre-Test Scores

Test at age 5;1	Standard Scores (Mean=100 +/- 15)	Description
Percent Consonant Correct (PCC)	40.3%	Severe phonological disorder
Word Discrimination	111	< 1 SD above mean
PIAT-Reading Recognition Subtest	91	< 1 SD below mean
Digit Recall	97	< 1 SD below mean
Digit Backward Recall	109	< 1 SD above mean

CASS

Study	Duration
PP-Be to PP-E	3 months
PP-E to M-Be	4 months
M-Be to M-E	2 months

Fig. CS-1 Alliteration Oddity

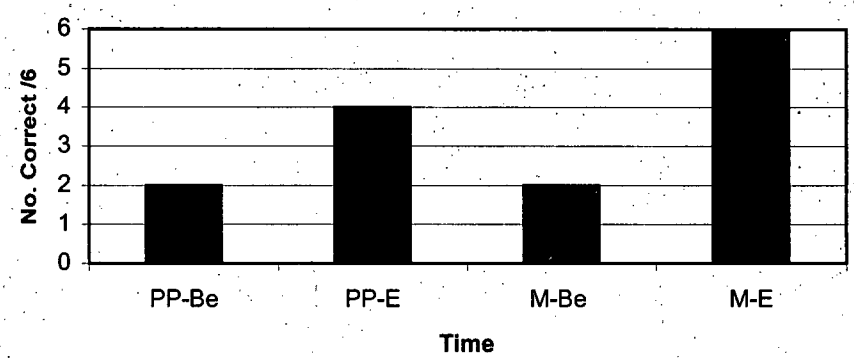


Fig. CS-2 Alliteration Production

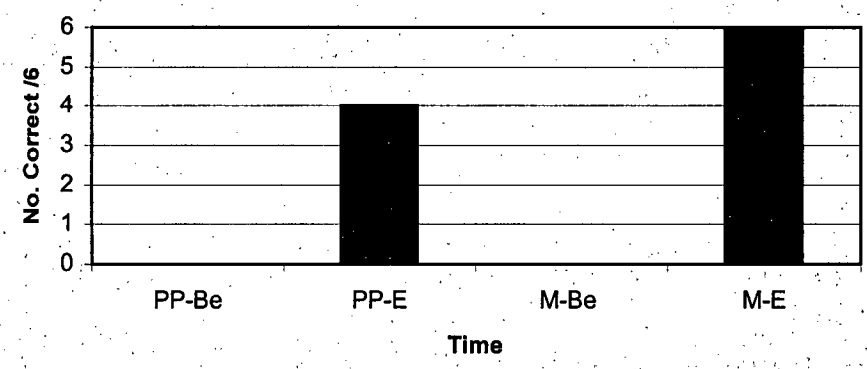


Fig. CS-3 Rhyme Oddity

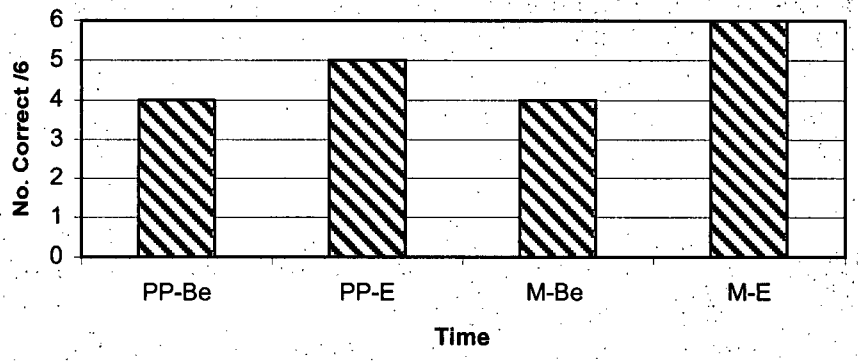


Fig. CS-4 Rhyme Production

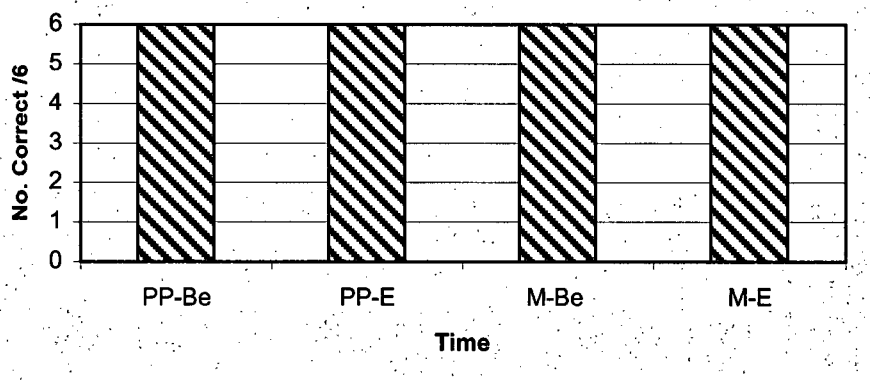


Fig. CS-5 Intermediate Probes: Rhyme and Alliteration Production

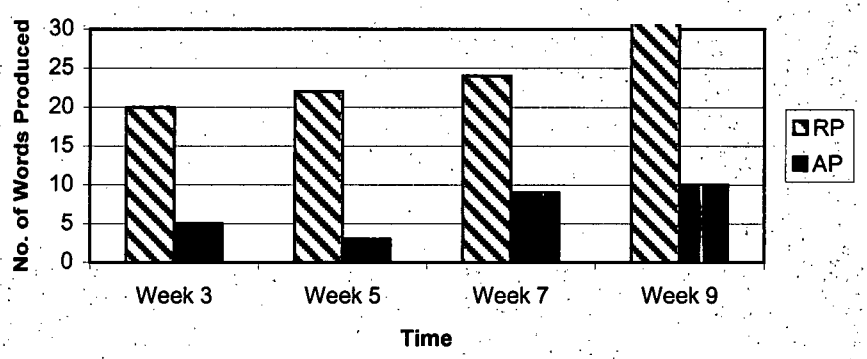


Fig. CS-6 Rhyme and Alliteration Production

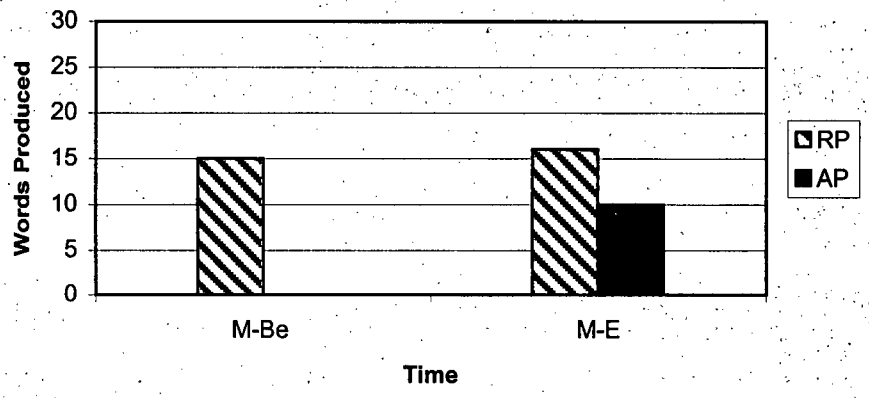


Fig. CS-7 Bisyllable Division

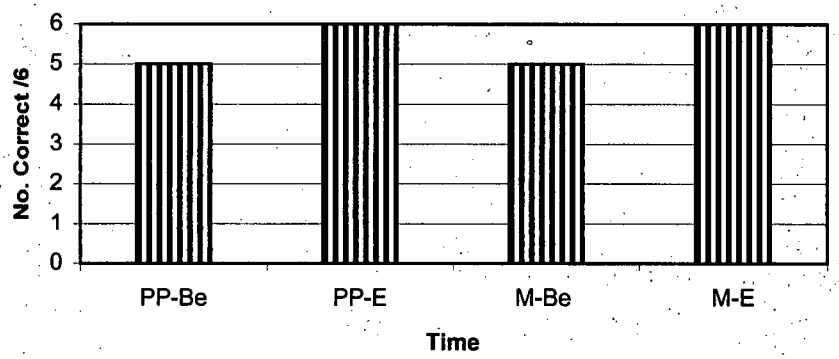


Fig. CS-8 Monosyllable Division

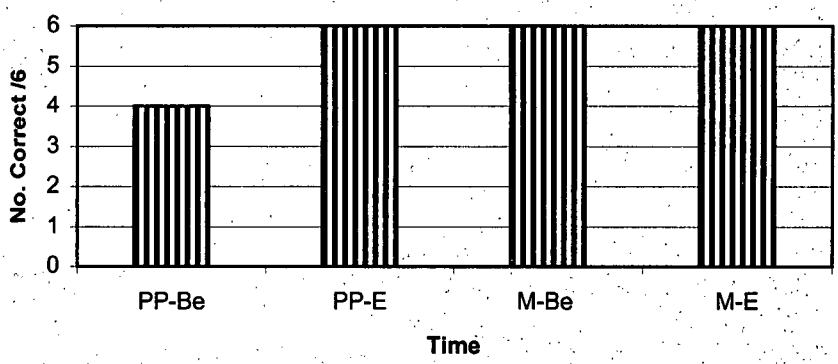


Fig. CS-9 Intermediate Probes: Word Initial Segmenting

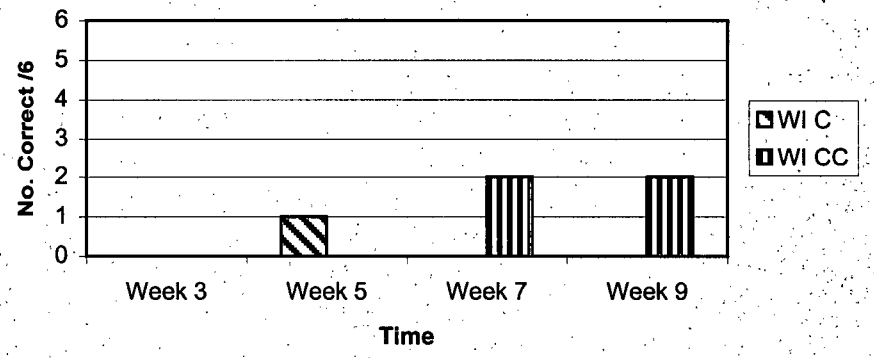


Fig. CS-10 Intermediate Probes: Word Final Segmenting

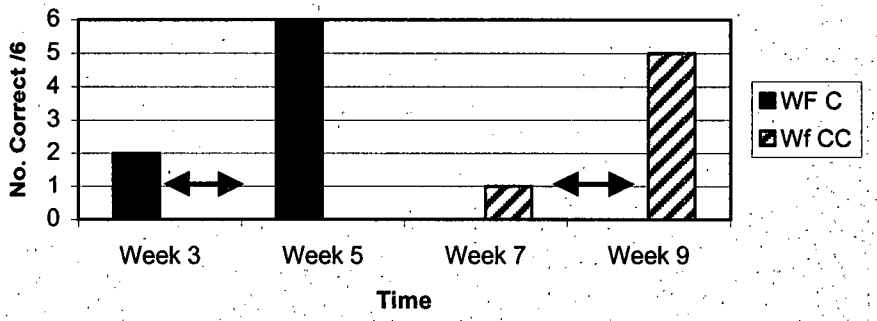
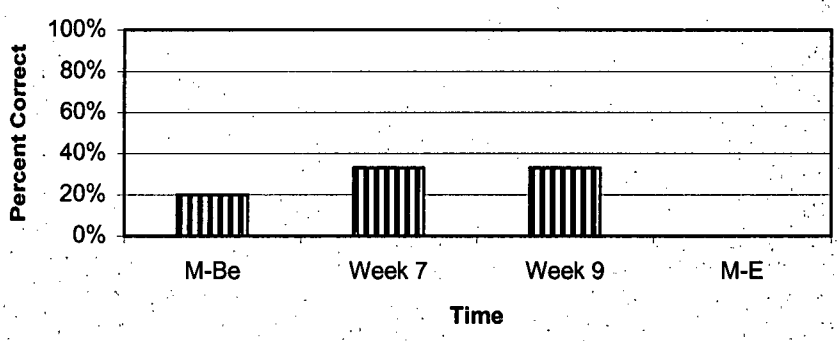


Fig. CS-11 Beginning, Probe, and End Results: Segmenting Word Initial Consonant Clusters



↔ denote training period for graphed element

Cass was given training in alliteration and analysis and synthesis.

Rhyme Oddity

Cass showed slight improvement in rhyme oddity.

Rhyme Production

On both this study and the previous study, Cass performed this task at ceiling level.

Alliteration Oddity

The pattern of results for Cass in alliteration oddity showed improvement. However, a decrease in performance when training was not occurring was also shown (comparing results at the end of the previous study and the beginning of this one).

Alliteration Production

Cass showed improvement in alliteration production (from zero correct to six correct) for the current study. As for the alliteration oddity results, there appeared to be a decrease in performance when training was not occurring.

Bisyllable Division

Cass performed at near ceiling levels in the bisyllable division task.

Monosyllable Division

Cass performed monosyllable division at ceiling levels for both the pre- and the post-tests.

Initial Consonant Deletion

Cass showed a very slight increase in word initial consonant deletion after training in analysis and synthesis as shown in week 5 of the intermediate probes.

Final Consonant Deletion

A large change was shown in word final consonant deletion both with a single consonant and with consonant clusters. On weeks 3 and 4 and weeks 7 and 8, analysis and synthesis training occurred; probes were given weeks 5 and 9. Both these weeks showed improvement, from two to six and one to five out of six respectively.

Summary and Discussion of Cass's Profile

Changes

Cass's scores for both the alliteration oddity and production showed a similar pattern. For the present study, Cass showed improvement in both of the tasks. However, when the results from the previous study are considered, it appears that Cass can lose the skills that he acquired.

Cass's scores for the word final segmenting with single consonants and consonant clusters showed an effect of analysis and synthesis training. This result corresponds with Cass's rhyming ability; Cass performed better with the ends of words than the beginnings

(as shown in his word initial segmenting scores). In the previous study, Cass deleted final consonants as well as substituted glottal stops or other default consonants in place of target consonants. It could be that because of therapy concentrating on the word final consonant position, Cass now focusses on this position.

Lack of Change

Cass's slight improvement in rhyme oddity resembles typical developmental progression. Cass's scores for the rhyme production task showed ceiling effects. It is interesting to look at his scores for both rhyme oddity and rhyme production. Rhyme oddity is typically a task that is mastered before rhyme production; however, Cass's scores for the rhyme production task are higher than the rhyme oddity task.

Cass performed at near ceiling levels in the bisyllable and monosyllable division tasks.

It appears that there was minimal effect of analysis and synthesis training on deletion of word initial consonant in consonant clusters. This finding could be the result of Cass's phonological impairment.

Positive Factors That May Have Had an Effect on Cass's Outcome

- Average digit span (< 1 SD below mean)
- High amount of home practice
- Low average reading recognition score
- High average word discrimination
- Eight training sessions

Negative Factors That May Have Had an Effect on Cass's Outcome

- Severe phonological impairment

Table 11: Individual Difference Characteristics that May Determine Effect of Training in Phonological Awareness Skills

Variables	Duncan	Michelle	Cameron	Cass	Scott	Edward
Age (at start)	5;1	6;9	5;0	5;1	5;8	4;2
Phonological Impairment	Mild (89.2%)	Mild (85.9%)	Moderate-severe (63.2%)	Severe (40.3%)	Severe (36.6%)	Severe (41.2%)
Memory (forward digit memory)	1 SD below mean	>1 SD below mean	>1 SD below mean	>1 SD below mean	>1 SD below mean	>1 SD below mean
No. of Training Sessions	8	8	4	8	8	5
Amount of Home Practice	Low-Moderate	Low-Moderate	None	High	Low	Low-Moderate
Alliteration Production	(Good improvement)	*	Slight improvement	Good improvement	No improvement	(No improvement)
Rhyming Production	Slight-good improvement	Good improvement	(Slight improvement)	*	*	Good Improvement
Segmentation skills	Good improvement	Slight improvement	No improvement	Good improvement	Improvement with only word final segmenting	Good improvement
OUTCOME:	Good	Good	Fair	Good-Excellent	Poor-Fair	Good-Excellent

*= *ceiling effect,* brackets = *untrained element*

CHAPTER 4

CONCLUSION

This study set out to (a) examine outcomes of an 8-week phonological awareness training program for six children with a history of severe phonological disorders and (b) to determine individual factors that played a role in the children's acquisition of phonological awareness skills. Because of the small sample size and quasi-experimental methodology, most outcomes were analysed descriptively for each participant, with some application of statistical procedures across subjects where feasible.

Overall, the children showed gains in phonological awareness skills after treatment, although maturational effects cannot be ruled out in all cases, particularly for Cameron and Duncan. Most of the children performed at ceiling or near-ceiling levels on the trained phonological awareness tasks after intervention. Even though the study was only eight sessions in length (or fewer, as for Cameron and Edward), the positive outcome is consistent with previous reports in the literature, both for typically developing children (e.g., Fox & Routh, 1984; Ball & Blachman, 1991; Torgesen, Morgan, & Davis, 1992) and those with phonological impairments (e.g., van Kleeck, Gillam, & McFadden, 1998; Gillon, 1999). The present study supports the findings of Gillon (1999), a study in which she trained phonological awareness in one group of children with phonological impairments. The author found that the phonological awareness program, like the present study, had positive effects on the children's level of phonological awareness. Unlike the present study, Gillon had three control groups, which allowed comparison between the

groups. She found that the positive effects for the children with phonological impairments remained even when compared to control groups. This provides support for the present study by demonstrating the effectiveness on intensive phonological awareness intervention for children with phonological impairments. The amount of change of the present study was compared with the amount of change of the previous study. It was found that there were no significant differences between them. This shows that the same amount of change is possible in a shorter period of time if the training is intensive and specifically focussed.

Phonological Awareness Tasks

Studies have shown that the acquisition of phonological awareness skills proceeds in a developmental pattern for typical children. For example, Chafouleas et al. (1997) ordered phonological awareness tasks from easiest to hardest in this order: rhyme, alliteration, phoneme blending, phoneme segmentation, and phoneme manipulation. Some of the results of the present study show some divergence from this general pattern. Michelle showed an interesting pattern, in that she was unable to produce any rhymes at the beginning of the study and yet she was able to delete word initial phonemes. This finding could be due to her phonological disorder (which was classified as severe in the previous study) or perhaps the result of intervention focussing on the initial consonant position in words or in school where activities involving word initial position are stressed in early reading instruction. Another finding that was in contrast to the Chafouleas et al. (1997) study was that Duncan showed better performance on alliteration production

rather than on rhyme production in the beginning of the study. This could also be due to intervention focussing on phonemes in word initial position. However, the remaining children follow the same general developmental pattern shown above.

Stanovich, Cunningham, and Cramer (1984) found that identification tasks were easier than production tasks. The results of this thesis study reflect this general pattern, with most of the children receiving higher scores overall on the identification tasks than on the production tasks. However, one child (Cass) performed better on rhyme production rather than the rhyme oddity. This finding is supported by a study done by Chafouleas et al. (1997); they found that, for typical children, production tasks were easier than identification tasks. A study by Dewhurst (1991) discovered the same result with children with phonological impairments.

Not all the children were proficient at all of the segmenting tasks. The segmenting tasks ranged in difficulty from bisyllable division (the easiest) to monosyllable division, to initial and final single consonant deletion, to initial and final consonant cluster deletion. Age and literacy instruction were factors that possibly influenced level attained in this area. For instance, Edward was the youngest (age 4;2). At the beginning of this study, he was unable to perform bisyllable division tasks until after the training was complete. Even after the training, Edward was not able to perform the monosyllable division task. All of the other children, who were older (age ranged from 5;0 to 6;9) performed at ceiling or near ceiling levels on their bisyllable and the monosyllable division pre-tests (six or five out of six). The older children (Michelle, Cass, Cameron, Scott, and Duncan) were trained in segmenting words into phonemes. They were given intermediate probes testing initial and final consonant deletion. It was

interesting to note that only Michelle showed improvement in both word final and word initial consonant deletion. Michelle was the oldest and had the most exposure to formal literacy instruction. Thus, it could be that Michelle's reading level affected her ability to perform these deletion tasks (cf. Perfetti et al., 1987). In a study in 1987, Perfetti et al. showed that the ability to read has an positive effect on performance in phonological awareness tasks such as deletion tasks. The authors demonstrated that phonological awareness ability and reading are reciprocally related: phonological awareness ability enables reading and vice versa. Cass, Scott, and Cameron performed better on either word final consonant deletion or word initial consonant deletion. For instance, Cass and Scott performed very poorly on word initial consonant deletion, while their performance on word final consonant deletion they scored at ceiling or near ceiling on the post-test. This may be due to the fact that both of the children had notable difficulty with initial consonant production in general (either using glottal stops or other default consonants in place of target consonants). In contrast, Cameron showed the opposite pattern; he was better able to perform the word initial deletion and was not able to perform the word final deletion. This again was consistent with Cameron's (previous) phonological patterns of word final consonant deletion.

An interesting finding is that the children that were having the most difficulty with word initial consonant deletion (Cass and Scott) were also the children who were struggling with alliteration production at the beginning of the study (and at the end of the study in Scott's case). Thus, it appears that both these children are focussing on the *ends* rather than the *beginnings* of words. However, it is difficult to determine whether word initial consonant deletion and alliteration production are related tasks. Both of these

children were trained in alliteration production. Cass showed an increase in alliteration production but not a corresponding increase in word initial consonant deletion while Scott showed no change in either alliteration production or word initial consonant deletion.

The data from this study indicate that skills or training in one component of phonological awareness does not necessarily translate into increases in all components. Therefore, within the construct of phonological awareness, there is a certain degree of independence between each of the tasks.

Factors Affecting Change

In the relevant research literature, it has been said that phonological working memory is an important factor for performance of phonological awareness tasks, although it may not predict outcome of training (Gillam & van Kleeck, 1996). Gillam and van Kleeck found that "children with better phonological working memory at the outset were no more responsive to phonological awareness training than children with poorer phonological working memory" (p. 80). With their sample of 24 subjects and this sample of only six children, there cannot be a conclusive difference between the performance of children with a low score on digit recall and children with an average score on digit recall. For example, Cass had an average digit recall score and Edward had a low digit recall score; however, both had good to excellent outcomes. Perhaps with a greater sample of children this factor may be found to have a more significant impact on phonological awareness outcome. Furthermore, working memory does appear to have

some effect on ability to perform phonological awareness tasks, because five out of six children had memory scores one standard deviation below the mean.

The degree of phonological impairment did not seem to have a bearing on the phonological awareness outcomes for the children. For example, both Edward and Cass continue to show severe phonological impairments and still showed good to excellent outcomes. This is in contrast to reports in the literature that children who have more severe phonological problems were more likely to be phonologically unaware (Magnusson & Naucler, 1993; Larrivee & Catts, 1999). For instance, Webster and Plante (1992) found that children who were the most unintelligible had the most difficulties with segmentation. Dewhurst (1991) showed that one of her subjects showed increased difficulty in alliteration oddity tasks and had had a previous severe phonological impairment. However, the results of Major and Bernhardt (1997) support the present study by showing that some children with a severe phonological impairment have no difficulties with phonological awareness activities.

Another general factor that has been shown to have an impact on intervention outcome is involvement of parents as facilitators (Broen & Westman, 1990). A study by Girolametto, Steig-Pearce, and Weitzman (1996) found that when mothers were trained to help facilitate language in their children with productive vocabulary delays, the children "made developmental gains in vocabulary, in the use of multiword phrases, and in grammatical complexity that were over and above the maturational changes made by the control group" (Girolametto et al., 1996, p. 1281). In the present study, parents observed and participated in the training sessions and were given material to work with their child over the course of the week. The children with the greatest amount of home

practice were found to have the best outcomes. Interestingly, Edward's mother reported that no parent-led practice occurred over the week; however, she reported that Edward was very excited about rhyming and spent a significant amount of time trying to find and produce rhyming words on his own. This suggests that sometimes direct, parent-led instruction may not necessarily be required as long as the child is interested and motivated, and practices on his or her own.

Limitations of the Present Study

This study was limited in its scope in terms of sample size, groups, and length, yet showed positive effects and individual differences, as have previous larger-scale studies. However, it would have been beneficial to have a larger sample size to determine which factors are most important in predicting outcome on phonological awareness tasks. It would have been optimal to have a control group so that maturational effects could be negated. This study could have been more robust statistically if there had been more items in each of the phonological awareness tasks. Furthermore, it might have been preferable to have ten to twelve weeks of training instead of eight weeks. The training may have been more effective if it lasted for only half an hour twice a week instead of one hour once a week. In addition, this study could have had a nonword task to test phonological encoding skills. Finally, it would have been beneficial to have a better way of tracking individual variables such as parent or child involvement, focus, and motivation.

Directions for Future Research and Clinical Implications

It would be interesting to follow the present children longitudinally and test their phonological awareness in one year to examine whether the phonological awareness training had a long- or short-lived effect. Furthermore, in a year, it would be interesting to test their reading levels to determine whether the phonological awareness training had an effect on reading level.

There are few phonological awareness training studies that focus on children with phonological impairments. It would be beneficial to examine whether some ways of training phonological awareness (e.g., Cunningham's (1990) "skill and drill"/ "metalevel" groups) are better for children with phonological impairments than others or whether more training time (or more frequent training time) is necessary for these children. Also, it would be important to examine the factors that most influenced level of phonological awareness attained by children with phonological impairments. Once more factors related to outcome are known, then a clinician working with a child with phonological impairment can examine the factors at play for a particular child and program intervention that would best suit his/her needs.

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APPENDIX

Example of One Phonological Awareness Lesson

Rhyming-Lesson 1

- Read *Goodnight Moon* (Wise Brown, 1947) (encouraging the child to listen for the rhyming words- prompting them (i.e., "I heard something that rhymes with chair" OR "chair and bear. Does that rhyme?")
- Fill in a rhyming book based on *Goodnight Moon* (Wise Brown, 1947). The book started with "goodnight house" and there were 3 other spaces for the child to fill in words that rhymed with the first word. The child's task is to tell rhyming words or nonwords to the adult who writes it and the child draws a picture representing that word or nonword (i.e. a name of someone). Rhyming words: House, Brush, Star, Clock, Bear, Moon
- Use the "rhyming machine" and get the child to guess the rhyming word from the story. A "rhyming machine" is a device made from a milk carton in which a strip of paper containing the rhyming word and a picture of that word is slipped into the "machine" and the strip of paper is magically turned over to reveal a rhyming word on the other side. (This "rhyming machine" can also be used as an "alliteration machine", and a "phoneme deletion machine.") Rhyming words and pictures include: Car-star, Sock-clock, Chair-bear, Mush-brush, Moon-spoon, House-mouse
- Make frogs out of paper bags and name them "Rock," "hair" etc. Draw bugs on pieces of paper that have names on them that rhyme with the frog's names. The frogs are starving and you must feed the frogs only the bugs with the name that rhymes.

Bring nameless bugs and get the child to think of names for the bugs for certain frogs to eat. After the frogs are done eating, open them up and see what the frogs ate.

- Make puzzles with the above rhyming words on them and get the child to put them together to make a rhyming puzzle strip. There is one blank piece that needs to have another rhyming word produced for it.

List of Children's Books Used For Phonological Awareness Lessons

Books Used for Rhyming Training

- *Goodnight Moon* (Wise Brown, 1947)
- *Zin! Zin! Zin! : A Violin* (Moss, 1995)
- *One Hungry Monster* (O'Keefe, 1989)

Books Used for Alliteration Training

- *Animalia* (Base, 1988)
- *Faint Frogs Feeling Feverish and Other Terrifically Tantalizing Tongue Twisters* (Obligado, 1983)