THE EFFECTIVENESS OF A MULTI-SENSORY PHONOLOGICAL AWARENESS AND LETTER KNOWLEDGE TRAINING PROGRAMME FOR DISADVANTAGED FIRST GRADERS

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DECLARATION

I, Elizabeth Nadler-Nir, hereby declare that the work on which this thesis is based is my original work (except where acknowledgements indicate otherwise), and that neither the whole work nor any part of it has been, is being, or is to be submitted for another degree in this or any other university.

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ABSTRACT

The study aimed to determine the effectiveness of a multi-sensory phonological awareness and letter knowledge programme for disadvantaged first graders. One control group and one experimental group, each consisting of 20 children, were matched for age, gender, school readiness, socio-economic status and phonological awareness. Twenty-nine sessions of phonological awareness and letter knowledge training were administered to the experimental group while the control group received vocabulary stimulation activities for the same length of time. Results indicated that the programme was highly effective in improving phonological awareness, letter knowledge, reading and spelling skills. The experimental group scored significantly higher than the control group on simple phonological awareness tasks such as segmenting the sounds in a word, letter knowledge and in their ability to read and spell real and pseudowords. The results are discussed in terms of the importance of both phonological awareness and letter knowledge in the process of literacy acquisition.

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CHAPTER ONE
INTRODUCTION

The terms phonological processing, phonological awareness, phonemic awareness and phonological sensitivity have been applied interchangeably in the literature (Adams, 1990, Goswami and Bryant, 1990, Majsterek and Ellenwood, 1995 and Share and Stanovich, 1995). They refer to an important metalinguistic skill which is highly predictive of achievement in the early stages of literacy acquisition. Phonological awareness is "a conscious awareness of the sounds of a language (and) ... the ability to reflect on the sounds in words separate from the meanings of words" (Catts and Vartiainen, 1993, PG 6). Predictive studies have shown that phonological awareness difficulties are causally related to problems in acquiring the alphabetic principle in the early school years (Freebody and Byrne, 1988 in Byrne and Fielding-Barnsley, 1995 and Stuart and Masterson, 1989). The phonological awareness literature concludes that literacy difficulties occur as a result of a core phonological deficit (Share and Stanovich, 1995). These difficulties can be identified before children begin to experience failure in literacy (Lundberg, Frost and Peterson, 1988 and Lyytinen, 1997). Studies have found facilitative effects of phonological awareness training on literacy (Castle, Riach, and Nicholson, 1994 ; Ball and Blachman, 1991 ; Byrne and Fielding-Barnsley, 1991, 1993 & 1995, Lundberg, 1994 and Wise, Olson and Ring, 1997). A need for phonological awareness training has been identified, especially in the less advantaged communities in South Africa, but as far as the author is aware, no preventive phonological awareness training studies have been carried out as yet in any of these communities (Nadler-Nir, 1995 and Fisch, 1995).

The South African Department of Health states that the health care system should focus strongly on a primary health care model. The basic components of this approach are set out in the Draft Provincial Health Plan (1995) and include the following issues: A holistic view of health should be taken so that all South Africans have equal access to services ; a move towards preventive as well as curative and rehabilitative services should be made ; the community being served should be developed and empowered in the process of service delivery and service should be cost-effective, affordable and sustainable. Services which are preventive express values "which bring about the greatest good for the greatest number" (Dossetor, 1993, PG 185). Preventive approaches have potential for future savings in both health and remedial education. Phonological awareness training is highly amenable to group intervention, which means that it can reach more children than the traditional one-to-one therapy approaches. It is a skill which can be taught easily to teachers, thus empowering them with additional skills for their classroom teaching. By identifying and training children with poorly developed phonological awareness, early in their school career, many potential literacy and academic difficulties may be prevented. Preventive remedial approaches, such as phonological awareness training which have proven cost effective (Castle et al, 1994) need to be tested in the South African context, especially in the less advantaged communities. If the results follow the trends in the literature, then this type of training could be implemented as a matter of course for all at risk grade one children, or better still, at the pre-school level.

The introduction begins with a review of a number of phonological awareness training studies undertaken in other countries. The links between phonological awareness and two models of literacy development will follow to show that phonological awareness is an integral part of developing literacy skills. The construct and developmental progression of phonological awareness is discussed as a rationale for the choice of the specific phonological awareness components chosen for training in the present research. Assessment of both phonological awareness and reading and spelling skills are discussed to highlight the need for tests which take into account the relationships between the two in the process of becoming literate.

1. A review of the training studies and their effectiveness

1.1 Kindergarten training studies

Bradley and Bryant (1983) were amongst the first to demonstrate the strong correlation between reading and two components of phonological awareness, namely, early rhyming and alliteration skills. They tested over four hundred non-reading, pre-school children, aged between three and four years, measuring the children's ability to hear rhyme and alliteration in spoken words. Following testing, the children were identified either as poor or good rhymers. These children were re-tested three years later. Results indicated that those who had scored well on rhyme and alliteration at pre-school, could read and spell significantly better than those who had scored poorly.

In addition to the predictive study the researchers undertook a training study, with the same children, in which they divided the poor rhymers into four groups, two experimental and two control. The first control group received semantic categorisation exercises and the second received no intervention. The first experimental group received sound categorisation training, which involved teaching children how to categorise words on the basis of initial, medial and final phonemes. The second experimental group received sound categorisation training together with exposure to plastic alphabet letters. The training took place over a two-year period, for a total of forty, ten-minute sessions, starting when the children began formal literacy instruction, at about five years of age. The children were trained on an individual basis.

Both sound categorisation groups made good progress in literacy, but the group which made the greatest gains was the one which received sound categorisation training paired with exposure to letters. A five-year follow-up indicated that this group still showed significantly better literacy performance than the untrained group.

At follow-up, there was no longer a training effect for the group which had received sound categorisation training alone. This indicates that the effects of phonological awareness training alone may eventually "wash out" but more lasting effects on literacy are noted if the training is paired with stimulation in letter knowledge. Many researchers have since come to accept that phonological awareness training must be paired with exposure to letters for optimal gains in literacy (e.g. Lundberg, 1994 and Muter, 1994).

It could be argued that it is the contribution of letter knowledge, and not phonological awareness training that causes improvements in literacy skills. Ball and Blachman (1991) tested this hypothesis by designing a training programme with the following three conditions: phonological awareness paired with letter knowledge training, letter knowledge paired with language training, and a control condition which received no training. They trained groups of five children, aged 5,7 years for a shorter, yet more intensive period than the sixty hours over two years administered by Bradley and Bryant. Ball and Blachman administered twenty-minute sessions, four times a week for a total of seven hours. Another departure from the Bradley and Bryant design was the administration of training in small groups.

Results indicated that the group in which letter knowledge was paired with phonological awareness training made significantly larger gains on two tests of word identification and one test of word spelling, than the groups receiving letter knowledge paired with language stimulation and no training. The researchers concluded that letter knowledge training is necessary but not sufficient to improve early reading and spelling skills. Phonological awareness training needs to be included to improve literacy skills optimally.

The studies mentioned above indicate that phonological awareness and letter knowledge training administered by a specialist, has beneficial effects on literacy regardless of whether the children are trained individually or in small groups. Lundberg et al (1988) showed that the beneficial effects were also obtained by trained classroom teachers who taught groups of 15 - 20 six year old pre-readers, from lower middle and working class families, for fifteen minutes daily, over an eight-month period. The Lundberg et al (1988) phonological awareness training programme did not include letter knowledge.

The researchers tested the children at regular intervals for three years after the phonological awareness training was completed and found that the experimental group performed significantly better on reading and spelling in grades one and two, although the differences for reading in grade one were small.

The effects of the phonological awareness training were greater for reading in grade two. For reading, the experimental group outperformed the control group over the first three years of school. For spelling, the group difference diminished over the three years. The phonological awareness programme did not include letter knowledge stimulation, which may be essential to observe robust effects on spelling.

An additional part of the Lundberg et al (1988) study demonstrated that it was possible to prevent reading failure through phonological awareness training. This provided confirmation of Bradley and Bryant's (1983) earlier findings. From both the experimental and control conditions, Lundberg and his colleagues selected twenty-five of the pre-school children who showed poor phonological awareness and letter knowledge. These children were termed "at risk" for developing literacy difficulties, and their progress in literacy skills was monitored. The "at risk" children who received no training showed far slower literacy development than the "at risk" children who underwent the phonological awareness programme. From this result Lundberg et al (1988) concluded that if children who are at risk for developing literacy difficulties can be identified early and given the appropriate intervention (in this case phonological awareness training), their potential literacy difficulties can be prevented.

Byrne and Fielding-Barnsley (1995), using their phonological awareness training programme, "Sound Foundations," taught groups of pre-schoolers how to identify the initial and final sounds in words and included incidental letter knowledge training. The control group received the same materials as the experimental group, but the materials were used for vocabulary stimulation. The children were trained in small groups of about four to six, once a week for twenty-five to thirty-minute sessions, for a total of twelve sessions.

On completion of the programme, at pre-school, the experimental group performed significantly better on both the phonological awareness tests and on a structured test of printed word decoding. Both groups were tested again in grade one on a number of reading and spelling tests. The experimental group scored significantly higher than the control group for pseudoword reading. A smaller, yet significant difference was also noted on real regular word reading, in favour of the experimental group. Regular words are ones where each letter in the word represents its most common sound There are no silent letters and no digraphs representing single phonemes (Freebody and Byrne, 1988 in Byrne and Fielding-Barnsley, 1995, e.g. "pat" would be a regular word and "laugh" would be considered as irregular). Byrne and Fielding-Barnsley (1995) created pseudowords by changing one or more of the letters in real regular words (e.g. "pat" -> "pab") and considered them to be the purest measure of converting printed letters to speech (decoding), especially for novice readers. They found no significant differences between the groups for irregular word reading and spelling. By grade two, the experimental group scored significantly better on one- and two-syllable pseudoword reading, and in reading comprehension. There were no differences in spelling of real regular words and irregular word reading. The lack of explicit letter knowledge training may have been responsible for the lack of a training effect on spelling. This is supported by the fact that both Bradley and Bryant (1983) and Ball and Blachman (1991) found improvement in spelling for the conditions which included explicit letter knowledge training.

1.2 Training studies with children who have entered formal schooling

The previous kindergarten studies indicated that phonological awareness training has a facilitative effect on literacy development and, that a lack of phonological awareness may be one of the causal factors for poor literacy skills . The relationship between literacy development and phonological awareness skills is however reciprocal (Lundberg, 1994). Phonological awareness skills also improve as a result of literacy instruction. A number of researchers have looked at the relationships between phonological awareness training and emerging literacy skills in children who are already engaged in formal literacy instruction. Most of these studies have shown that training phonological awareness skills during the first few months of formal literacy instruction does get children off to a better start and may reduce the need, in some children, for further reading recovery programmes (Castle, et al 1994).

Torneus (1984) trained a group of first graders in phonological awareness skills for eight sessions while a control group received general language activities. She noted that the children with the lowest pre-treatment phonological awareness skills showed significantly better spelling performance than those with higher pre-treatment phonological awareness skills and those who had received the general language stimulation activities.

Lie (1991) was among the first to study the effects of different types of phonological awareness training on first graders' literacy development. In addition he looked at the effects of this training on children of low intelligence. The children were on average 7,2 years of age and were divided into two experimental (positional and sequential) groups and one control group. The treatment schedule was carried out by classroom teachers and was intensive with the experimental groups receiving daily ten- to fifteen-minute sessions, for one semester. The positional analysis group was first taught to identify phonemes at the beginning of words, and later word final phonemes were identified. Finally the children were taught how to identify the phoneme in the middle of words. The sequential analysis group were taught to identify each sound in the word, one after the other, in order. No letter knowledge and written language activities were included.

The children were tested at the end of grades one and two. Results indicated that both positional and sequential analysis training groups had better reading and spelling skills than the control group. At the end of grade one, the sequential group outperformed the positional group on the literacy tests. However, this difference disappeared by the end of grade two. The experimental groups performed significantly better than the control group for reading at the end of grade one, but not at the end of grade two. The training effects were more robust for spelling in that the experimental groups performed significantly better than the control at the end of both grades one and two. The children who had the lowest intelligence profited the most from the phonological awareness training.

All studies reviewed thus far have found that phonological awareness training improves literacy skills, but it is not clear whether the statistical differences noted in controlled research studies are educationally significant or if the effects of the training eventually "wash out." It is also not clear whether reading or spelling benefit more from training. Lie (1991) pointed out that following two years of intensive training in sound categorisation, only a three- to five-month gain on standardised reading and spelling tests was found by Bradley and Bryant (1983) for their treatment group. The difference in reading between the experimental and control group was only marginally significant in the Lundberg et al (1988) study. Others however, have found robust effects lasting at least two years (Lie, 1991 and Byrne and Fielding-Barnsley, 1995). Results on the specific effects of phonological awareness training on reading and spelling are less conclusive. Lie (1991) noted more robust effects on spelling than reading, despite the lack of explicit letter knowledge training. The twenty sessions of phonological awareness and letter knowledge training administered by Castle et al (1994) also resulted in significant gains in spelling acquisition. Byrne and Fielding-Barnsley (1995) and Lundberg et al (1988) found robust effects for reading. Ball and Blachman (1991) found effects for both reading and spelling. The type of effects observed may be as a result of an interaction between the type, length and intensity of training, and the age at which children are trained. Because phonological awareness and literacy instruction have a relationship of reciprocal causation (Lundberg et al, 1988), it may be that the way in which a child is taught to read interacts in a specific manner with the way in which the phonological awareness skills are taught. Finally, it may be that the potentially dyslexic child, the child with low intelligence and the understimulated child all show similar pre-treatment scores, but respond in different ways to training.

Hatcher, Hulme and Ellis (1994) allocated seven-year-old poor readers, matched for intelligence and reading age, to one of four groups. The first group received training in both reading and phonological awareness. The second received phonological awareness activities alone. The third received training in reading and letter knowledge. The fourth group acted as a control group and followed normal classroom curriculum. The children received forty sessions of individual instruction, twice a week, over twenty weeks.

The results indicated that the group which obtained reading instruction paired with phonological awareness training scored significantly higher than all the other groups. The training effects were maintained nine months later. It appears that phonological awareness training is beneficial for most children who have a deficit in this skill, regardless of intelligence or reading ability. Optimal gains are observed when the training is paired with other literacy based activities such as letter knowledge and reading instruction.

Research has found that children from low income families have poorer reading and arithmetic performance than those from more advantaged communities (Bowey, 1995). The fact that phonological awareness skills are so closely linked to literacy development, suggests that children from lower socio-economic groups have poorer phonological awareness than those children from more advantaged communities. Research in South Africa and elsewhere in the world has confirmed this to be the case (Worrall and Nadler-Nir, 1994 ; Fisch, 1995 and Bowey, 1995). Castle et al (1994) carried out an experiment with children from a mid to low socio-economic status. They chose children with low phonological awareness skills and taught them in groups of three to four, once a week for twenty-minute sessions, for a total of five hours. Phonological awareness training was paired with letter-sound correspondences. Two control groups were included, one that received no training and the another that received semantic classification , letter recognition and story writing. The experimental group performed significantly better than the control children on dictation and pseudoword reading tests, confirming that disadvantaged children also benefit from phonological awareness training.

2. The Relationship between phonological awareness and two models of literacy acquisition

2.1 Stage models

Various models have been developed to help conceptualise the complex process of literacy acquisition. Stage models imply that children need specific skills at critical times within the development of literacy. Frith (1985, in Snowling, 1992) indicates that if children do not have access to these specific skills, progress to the next stage will be hampered. Stackhouse (in Snowling, 1992) has extended Frith's stage model, to incorporate four stages : preliterate, logographic, alphabetic and orthographic stages. In the ensuing discussion phonological awareness skills will be shown to be of critical importance, especially in preparation for and during the alphabetic stages of literacy development.

2.1.1 The pre-literate stage

Pre-reading or emergent literacy coincides with the development of expressive and receptive language. It therefore spans the pre-school years and ends once a child is able to read print independently. In a literate culture children learn the uses of written language through watching people in their environment. They model these behaviours and engage in pretend reading and writing. They learn about the conventions of print - the way to hold books and turn the pages (Ehri, 1992). They learn the schema of a story, and their vocabulary and articulation skills improve rapidly. Awareness of letters may emerge through exposure to alphabet songs and posters. Lundberg (1994) stresses the impact that this stage has on literacy, and warns researchers not to ignore it in the light of the recent emphasis on phonological awareness. The development of emergent literacy necessitates an environment which contains books and literate parents. Within this stage, the earliest levels of phonological awareness are emerging, through nursery rhymes and spontaneous rhyming games. The bridges are being built for the crossing to deeper phonological awareness skills.

2.1.2 The logographic stage

During this stage a child learns to recognise instantly familiar written words, thus demonstrating the beginnings of "sight word" reading (Snowling, 1992). Children attend to contextual cues. The child in this stage is unable to read words which are not already in his/ her logographic store. Logographic readers and spellers pay no attention to sound segmentation or letter order (Stuart and Coltheart, 1988). Nonsense word responses when attempting to read a new word will be absent during this stage as they are indicative of an attempt to decode phonologically (Share and Stanovich, 1995). Share and Stanovich (1995) report on research which required a group of five-year olds to learn sets of words written on flash cards. The researchers deliberately marred one card with a thumb print. During testing, when the children were shown the "thumb printed word" on a clean card, only half could identify the word correctly. However, almost all of them produced the word correctly when the thumb print was replaced. It is the context which cues them to read the word correctly. The requirements of the logographic stage are that a child be able to integrate visual and verbal material.

Although phonological awareness skills and letter knowledge may be developing during the logographic stage, proponents of stage models maintain that they are not used for logographic reading or spelling. Share and Stanovich (1995) argue that if children have phonological skills and even rudimentary letter knowledge, then they are likely to use them and may skip this stage altogether.

2.1.3 The alphabetic stage

As preparation for entry into the alphabetic stage, children require rudimentary letter knowledge and phonological awareness skills. This stage corresponds with school entry at about six years of age. Children need letter-sound knowledge to tackle new words. A phonic cue reading strategy now becomes available.

If children enter school with poorly developed phonological awareness skills (i.e. segmentation and blending), they will have difficulty segmenting initial sounds in words and remembering the letter-sound correspondences. Children who have poorly developed phonological awareness will have to rely on a logographic reading strategy i.e. a rote association between the way a word looks and the way it sounds. The average fifth grader encounters about ten thousand new words per year (Nagy and Herman, 1983, in Share and Stanovich, 1995). A logographic strategy is clearly ineffective to cope with this "orthographic avalanche" (Share and Stanovich, 1995, PG 17). As the sight word memory store becomes saturated, children will need to rely on phoneme-grapheme and grapheme-phoneme translation. They will need to rely on advanced segmentation and blending skills if they are to attempt reading and spelling novel words within the alphabetic stage.

Spelling within the early alphabetic stage reflects reliance on segmentation skills. "stink" spelled as "sk" (Stackhouse 1985) shows an awareness of initial and final phonemes. Confusion between letter sounds and letter names are also a feature of early alphabetic stage spelling. "Chicken" spelled as "hn" indicates a knowledge of letter names and phonological awareness. The letter name "h" contains the (ch) sound ("aich"), indicating that the child is starting to make use of segmentation skills. As the child develops more phoneme-grapheme correspondences, spelling becomes more phonetic and the child is able to tackle new words.

2.1.4 The orthographic stage

By about ten years or earlier there is a realisation that the phoneme-grapheme relationship is not always a one-to-one correspondence. The child learns about spelling rules and the morphology of the language. Conversion of words into each phoneme is now no longer necessary and "words are instantly analysed into orthographic units"(Stuart and Coltheart, 1988, PG 143). An orthographic lexicon is built up through reading experience. These abstract representations of printed words become highly specified to allow for instant recognition (Snowling, 1992). The phonological conversion strategy, developed in the alphabetic stage, however, is still available for reading of unfamiliar words.

Share and Stanovich (1995) would argue that these abstract orthographic representations are being built up from the very earliest stages of literacy acquisition and that literacy acquisition is a process of expanding and specifying these orthographic entries. A large and well defined orthographic lexicon is essential for automatic reading and spelling within the orthographic stage. According to the stage model, visual memory skills (especially during the logographic and orthographic stages), phonological awareness, letter knowledge and experience with print are essential components in literacy acquisition.

2. 2 Self-teaching model

The self-teaching model was first proposed by Jorm and Share in 1983 and has since been expanded and applied by researchers such as Share and Stanovich (1995) and Byrne and Fielding-Barnsley (1995). The model describes how a child develops to a point where (s)he is able to read and spell words automatically. An ever increasing number of words are stored as well defined orthographic entries which can be accessed rapidly as whole units. The process by which a person builds up a large and ever expanding print lexicon (store) is termed lexicalisation.

The self-teaching model argues against the whole-word approach and contextual guessing as a means of printed word learning. Share and Stanovich (1995) argue that the process is item rather than stage based. The only viable way to acquire a well defined orthographic lexicon which will lead to automatic reading and spelling, is through phonological re-coding (print to sound translation). Teaching children to read and spell words in an item-by-item fashion or what is sometimes referred to as the whole-word approach, would allow for the acquisition of only a few hundred new words per year, far short of the annual number of words acquired in the early stages of literacy acquisition. Because the words are learned as whole units, it is unlikely that a child will become aware of the "detailed orthographic structure" (Share and Stanovich, 1995, PG 17) of the word. A weak visual memory will seriously hamper the number of whole units remembered. This logographic or whole-word approach is ineffective in teaching children how to learn novel words independently and is considered to be more a part of pre-reading than literacy acquisition.

The use of the context (syntactic, semantic and pragmatic) surrounding a word has been suggested as another way of learning novel printed words. A child is able to make a reasonable guess based on the surrounding text and so the unfamiliar word is learned and remembered. Studies reported by Share and Stanovich (1995) suggest that contextual guesses are twice as likely to be wrong than right. One of the reasons is that there are numerous synonyms in the English language. Although contextual guessing may not seriously hamper comprehension of the text, it is unlikely to assist in building and expanding entries in the orthographic lexicon. Individuals who show adequate reading but poor spelling may well be relying heavily on context at the expense of building up a well defined orthographic lexicon necessary for accurate spelling. Even before a child possesses any conventional decoding skills, (s)he may have rudimentary self-teaching skills which are used from the outset to develop incomplete or partial orthographic representations of words. Early self-teaching depends on three skills: 1) letter-sound knowledge, 2) phonological sensitivity and 3) "the ability to use contextual information to determine the exact pronunciations on the basis of partial word decodings" (Share and Stanovich, 1995, PG 21). Experience with print is essential throughout the self-teaching process.

2.2.1 Letter knowledge, phonological awareness and self-teaching

Letter knowledge alone is insufficient to self-teach. (Ball and Blachman, 1991). If a child knows that the letter "n" has the sound (n), it does not mean that this information will help to learn the word "nail." The child must also know that the spoken word "nail" starts with the phonological segment (n) and this corresponds to the letter "n". A child who is phonologically aware and who has some letter knowledge can generate words beginning with (n) and will be able to supply a plausible answer for an unfamiliar word. If a child has mastered all letter sounds, but has no knowledge that words can be segmented into phonemes, (s)he will be unable to provide a reasonable pronunciation of a novel word. A phonologically unaware child with good letter knowledge will make visually based errors which have a number of letters in common with the target word. Phonological reading errors which share the initial letter or the initial and final letter of the target word ("cot" for "cat") were found to be highly predictive of end of grade one reading ability.

Non-phonological or visual errors (those sharing no letters in common with the target word ("look" for "baby") or ones sharing letters with the target word, but not in the correct positions "milk" for "like") were negatively related to later reading ability (Stuart and Coltheart, 1988). Byrne and Fielding-Barnsley (1995) have found that phonological awareness and letter knowledge make independent contributions to the explained variance in reading at the end of kindergarten. Letter knowledge and phonological awareness are both necessary for the beginning of self-teaching. Neither one alone is sufficient. Ehri and Wilce (1985, in Share and Stanovich, 1995) found that phonological errors became more common than visual errors only once children had gained knowledge of at least half of the alphabet, and scored well on at least two out of six tests of phonological awareness. For self-teaching to begin, rudimentary knowledge of the segmental nature of speech and some letter knowledge are essential.

2.2.2 Contextual cues, partial decoding and self-teaching

Rudimentary letter knowledge and phonological awareness allow a child to decode words partially and to create primitive orthographic representations from the outset. Research shows that partial decodings may not be sufficient to decode words fully when they are presented in isolation (e.g. "bk" for "bank"). When a partially decoded word is placed in a meaningful context, the correct pronunciation is retrieved and a new word is learned ("I saved all my money in the "bk" ... bank"). Thus the third component in the self-teaching model is added - the use of contextual information to expand the primitive orthographic representations. The self-teaching model can be summarised thus far:

A) Exposure to print + phonological awareness + letter knowledge -----> partial decoding which builds up primitive orthographic representations from the earliest stages.

B) Exposure to print + partial decoding + contextual cues -------> full decoding which expands the primitive orthographic representation of the word.

2.2.3 Irregular words and self-teaching

Teachers often point out to their students that there are many "trick words" such as "choir, laugh and yacht" that need to be memorised for life. These are the so-called irregular words where there is no regular one-to-one relationship between the phoneme and grapheme. One may ask how phonological re-coding and the self-teaching model account for learning to read these words.

Regularity appears to be on a continuum. All words, with the exception of the silent letters (e.g. write) have regular consonants. It is the vowels which are responsible for the irregularity in English orthography. Vowels appear to play a less important role in word recognition than consonants (Adams, 1990 and Share and Stanovich, 1995). With this information in mind, the self-teaching model fits well with the decoding of so-called irregular words. The consonants, being regular phonetically, create the possibility for a partial decoding. The context in which the partially decoded word finds itself then provides an opportunity to test a number of different pronunciations, until one "sounds right." Phonological re-coding or print-to-sound translation is essential not only for regular words such as "September", but also for less regular words such as "build".

2.2.4 Exposure to print and lexicalisation: becoming fully literate

The self-teaching model needs to account for how a child moves from simple one-to-one correspondences between print and sound, to becoming aware of the positional and morphological constraints of print. For example, a literate child will "know" that there are regularities which are dependent on the position that a letter holds in a word or which letter follows it. For example the soft and hard "g" and "c" and the "y" used as a vowel or consonant (cage vs bag , face vs cat , yo-yo vs cry vs jelly). Knowledge of the morphological conventions of print allow for children to read dogs as (dogz)* to write (klapt) as "clapped" and to read the morphemes "cian (magician), tion (fraction) or sion (suspension)" all as (shin). It is through exposure to print that the one-to-one correspondences between letter and sound become modified and the orthographic store of patterns is expanded. Stages A and B of the self-teaching model can now be expanded as follows:

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* The transcription conventions are based on those used by Augur and Briggs (1993). They use brackets ( ) to represent the sound that the letter makes. A key for the transcription of vowels is presented in table 9. Augur and Briggs' conventions have been used instead of the international phonetic alphabet as they are more familiar to teachers.

C) Exposure to print + full decoding + exposure to print + growing awareness of the patterns and regularities beyond the simple one-to-one correspondences (dogz) - DOGS, (fays) - FACE, (majishin) - MAGICIAN -------> Lexicalisation process (some patterns may become lexicalised at the very beginning of self-teaching).

Through letter knowledge, phonological awareness, the use of context to fully decode partially decoded words, and a great deal of experience with print, a child is able to self-teach and build a well defined orthographic store which will allow for automatic reading and spelling of words. If a child is exposed to large amounts of print, patterns such as the plural "s" may become stored even in the earliest "stages" of literacy acquisition. There are no hard and fast stages. At the very core of the self-teaching model is phonological awareness on which all other skills build. Poor phonological awareness skills as explained by the self-teaching model, result in " a causal chain of escalating negative side effects" (Stanovich, 1986, PG 364). Poor segmentation skills result in poor success with unfamiliar words. The child is slow at decoding and so is exposed to less text and reading material which is too difficult. As a result the child has fewer opportunities to practise his/ her emerging skills, and the acquisition of general and specific orthographic knowledge about words is limited. Limited success discourages more reading which in turn results in less exposure to print. Word recognition is not automatic and most of the child's energy is directed to word recognition and away from text comprehension, a frustrating and demotivating experience. The cognitive effects of a lack of automatic reading are that the child generally has poor reading comprehension, which in turn does little to increase vocabulary and syntactic knowledge.

3. The construct and developmental progression of phonological awareness

The two models of literacy acquisition discussed implicate phonological awareness and letter knowledge as crucial components. Letter knowledge is a straightforward skill. A child is taught that a particular letter has a particular sound and is written in a particular way. Phonological awareness however can be assessed and taught in many different ways.

The following are just some of the ways in which phonological awareness has been operationalised: identifying the odd word in a group of rhyming words ; detecting alliteration (Bradley, 1992) deciding whether words have the same or different initial and final sounds (Torgesen and Bryant, 1994), deleting sounds in words (Rosner, 1975), completing a word by adding the final sound (Muter, 1994) , tapping the number of syllables in a word, blending phonemes to create a word (Illinois Test of Psycholinguistic Abilities, Kirk, Mc Carthy, and Kirk, 1968) or saying each phoneme in a word (Yopp, 1995).

The use of a wide variety of tasks can make the interpretation and comparison of phonological awareness test results confusing and selecting the most effective training tasks difficult. A child may perform well on one type of phonological awareness task, but be unable to cope with another. Tasks which on the surface appear to be measuring the same construct may require different degrees of linguistic awareness or may differ in their cognitive demands. Despite a myriad different tasks, phonological awareness tasks tend to fall into one of four categories: rhyme (detection or production e.g. Bradley, 1992), segmentation (syllables or phonemes e.g., Torgesen and Bryant, 1994 ; Muter, 1994 and Yopp, 1995), blending (syllables or phonemes) and manipulation (syllables or phonemes, e.g., Rosner, 1975).

Yopp (1988), through statistical comparisons of numerous phonological awareness tasks, found that there were two factors underlying the construct of phonological awareness. Each factor was defined by the tests that had high loadings on it. Factor one was termed simple phonemic awareness. These tests require one operation and then a response. Factor two tests, termed compound phonemic awareness, require more steps to complete, and place a greater burden on memory. The respondent performs an operation (for example, isolates a given sound) and then holds the resulting sound in memory while performing yet another operation.

Yopp (1988) concluded that her study lent construct validity to the concept of phonemic awareness because the vast majority of phonological awareness tasks had loadings on either one of the two factors. The two factors appear to reflect two levels of difficulty rather than two qualitatively different kinds of skill. She suggested that when testing, it is important to include a combination of tests, one from each factor. The two tests together hold greater predictive validity for the initial steps in reading acquisition than either test alone.

Other researchers support the notion of different components of phonological awareness. Lundberg (1994) reported on a study in which over 1500 children were tested in pre-school and grade one, on rhyme recognition, syllable counting, initial -phoneme identification, phoneme deletion, phoneme synthesis and phoneme counting. Three basic factors were extracted in a principle component analysis: a phoneme, syllable and rhyme factor. All three factors were separate predictors of early word reading ability. The syllable factor was the weakest predictor. The phoneme factor was the most potent predictor of early reading acquisition (phoneme identification task). Phonological awareness is a skill which develops over time. Depending on the amount of stimulation received, children of the same age may have differing levels of skill, especially in the pre-school years (Catts, and Vartiainen, 1993). By the time a child has received some formal literacy instruction, one can predict with more accuracy the expected level of skill. By the age of about ten years, children should reach a "ceiling" on most phonological awareness tasks and at that age more complex tasks are required to determine whether there is a phonological awareness deficit (Fawcett and Nicolson, 1994). The following discussion is an attempt to place the basic phonological awareness components (rhyme, segmentation, blending and manipulation) identified in the literature, into a rough developmental progression and to determine which components are most predictive of literacy success. The hierarchy is comprised of five stages which are summarised in Table 1.

3.1 Stage 1

An awareness of supra-segmental aspects of speech, including voice quality, intonation, knowledge of rhymes and songs and spontaneous production of rhymes, comprise the first stage of phonological awareness. This develops early in the pre-school years. Adams (1990) describes this as the most "primitive level... [which involves a]...sensitivity to similarities and differences in the overall sounds of words." (PG 80). Children reflect this awareness during role play whereby they alter their pitch and intonation on specific words in sentences or engage in spontaneous rhyming games. Goswami and Bryant (1990) report that rhyming is a natural part of language development which emerges very early in some children. They quote two-and-a-half-year-old Tania who produced a rhyme based on the word "milk", to illustrate this point.

> Ilk-silk-tilk
> I eat kasha with milk.
> Ilks-silks-tilks
> I eat kashas with milks.(PG 22)

Bradley (1992) reports that pre-schoolers can produce rhyme very well, and generally they are able to produce rhyming words spontaneously before they consciously detect them (e.g. a child may spontaneously produce rhyming words as in the above example, before (s)he can say that "pan and man" are rhyming words). Muter (1994) however noted an opposite trend with rhyme detection being easier than production. This apparent contradiction may be a function of the type of tasks employed. In the present classification, rhyme production is placed before detection, as the former reflects spontaneous rhyme play, which as shown by Goswami and Bryant (1990) develops very early in some children. Early rhyming can be said to serve as a bridge to a slightly deeper level of phonological awareness.

3.2 Stage 2

At the next stage the child shows an awareness of the segmental properties of speech at the intra-syllabic level. This is reflected in an ability to perform oddity tasks which require the child to be sensitive to rhyme and alliteration (Bradley, 1992). Bradley and Bryant (1983) interpret this as an awareness of onset and rime boundaries in words (the onset being any sound before the vowel and the rime being the vowel and the rest of the word. For example, "cat" has an onset (k) and rime (at). "Bring" has an onset of (br) and rime (ing). Words which rhyme have the same rime, whilst alliterative words have the same onset. In spontaneous play this may be reflected in a child commenting that two words, "Matthew" and "Mike" are alike. This then would reflect true metalinguistic awareness. Bradley (1992) reports that rhyme detection in oddity tasks is slightly easier than detection of alliteration. He noted that children had limited success with both production and detection of alliteration until they were about 5.6 years old. A vast improvement in alliteration tasks was seen with the introduction to formal reading instruction.

3.3 Stage 3

The third stage is reflected in a child's ability to divide words into syllables and blend both syllables and phonemes. This involves an ability to recognise what phonemes sound like out of the context of a word. It implies an awareness that words are made up of small "bits" of sound, which have no meaning alone. It may be that levels two and three develop simultaneously, but for clarity, rhyming has been kept as a separate entity. It is to be expected that a child will be able to segment syllables before phonemes, because these are acoustically more salient. Each syllable is represented by a peak of energy. Phoneme-sized units on the other hand do not exist acoustically, they are merged and are identifiable acoustically only at the level of the syllable (Catts, 1991). Many pre-schoolers can cope easily with syllable segmentation and simple blending tasks.

An indication that the child is at an advanced level of this stage may be the ability to identify initial sounds in words (games such as "I spy" using letter sounds). Adams (1990) refers to this as syllable splitting.

Stuart and Coltheart (1988) report on Hooper's (1976) finding that children are sensitive to the acoustic strength of consonants. They found that this had an effect on which letter sounds children learned first. They noted a significant trend of letter sound learning with strength of consonants. Although not explicitly stated, this implies that there may be a developmental sequence in terms of which consonants are segmented first in words. Stuart and Coltheart's sequence, based on consonantal strength, from the strongest to the weakest, is as follows (PG 158):

1. Obstruents: b, c, d, f, g, h, j, k, p, s, t, v, s
2. Non-obstruents: l, m, n, r, w, y

(nasals, liquids and glides)

3. Vowels: a, e, i, o, u

Catts (1991) makes suggestions as to which phonemes should be segmented first in phonological awareness training. These are contrary to the above sequence. He suggests that one should begin with continuant sounds (fricatives and nasals e.g. (s), (f), (m) and (n) as these are longer and acoustically more salient. Non-continuant sounds such as stop consonants (p), (b), (t), (d), (k) and (g) are harder to segment and therefore should be introduced later. Catt's suggestions seem more feasible and, if a developmental sequence does exists, clinical experience indicates that continuants are easier to segment. This may be due to the fact that an acoustic length cue is more salient than acoustic strength. Visual cues may also play a part in the ease with which a sound is segmented. For example, (p) is visually more salient than (k) and therefore may be easier, initially, to segment. In addition to first and last sounds, children may be able to manipulate syllables during the last few months in kindergarten (e.g. say "cowboy", now say it again, but don't say "boy").

3.4 Stage 4

An ability to segment words into each individual sound, on demand, reflects the next level of phonological awareness. Because the phoneme is an abstract unit, exposure to a sequence of printed letters in a word helps the child to see the divisions between sounds and to segment at the phonemic level. This level of phonological awareness is thus stimulated through early instruction in literacy, in grade one. Blending skills are also likely to be extended with exposure to the printed word. The pre-schooler is unlikely to be able to segment each sound in a word. The deepest level of phonological awareness is reflected in phoneme manipulation tasks in which sounds are deleted, added or moved to create new words. Manipulation skills may have been emerging at stage three with the ability to delete a syllable from a word ("cowboy" without boy says "cow"). However, conscious manipulation of phonemes is only seen in the school age child (Rosner, 1975). The reason for this is that phoneme manipulation relies on automatic phoneme segmentation skills, developed during level four.

3.5 Stage 5

By grade two children should be able to segment, blend and manipulate sounds in simple words. They should now be able to use their automatic segmentation and blending skills to segment and manipulate phonemes in consonant clusters (e.g. say "smack", now say it again but don't say (m) -> "sack").

Table 1
Developmental stages of phonological awareness

Stage 1: (expected to appear early in the pre-school years)
a) Rhyme production as part of spontaneous linguistic development (e.g. "Silly Billy")

Stage 2: (expected to appear later in the pre-school years)
a) Sensitivity to rhyme and alliteration as reflected by comments that words sound the same. ("Mike, Matthew... they sound the same")
b) Detection of rhyme (e.g. Cat, dog , mat: which word rhymes with cat ?)
c) Rhyme production on demand (e.g. Give me a word that rhymes with "fat")

Stage 3 (expected to be stimulable in the year before school, with stages c to f acquired (with stimulation) by the second to third term in the final pre-school year)
a) Syllable segmentation (e.g. How many claps does your name have ?)
b) Blending of syllables (e.g. what word am I saying ? cu - cum - ber)
c) Segmentation of initial sounds in words (e.g. What sound does Peter starts with ?)
d) Segmentation of last sounds in words (e.g. What sound does "cat" end with ?)
e) Blending of onset and rime patterns (e.g. what word am I saying ? (Str) - (ing)
f) Syllable manipulation (Say "picnic" without (pic).... (nic))

Stage 4 : (expected after formal literacy instruction, early in grade one)
a) Blending of simple consonant-vowel-consonant (CVC) words (What word am I saying (c) - (a)- (t))?
b) Segmentation of each phoneme in CVC words (What are the sounds in "cat"?)
c) Blending of longer phoneme sequences and phoneme clusters (What word am I saying (c)-(l)-(a)-(p))?
d) Simple phoneme manipulation(cat without (c) says ... (at)).

Stage 5 (expected in grade two)
a) Manipulation of phoneme clusters (play without (p) says (lay)

4. Assessment of phonological awareness and emerging literacy for early grade one children.

The two models of literacy acquisition discussed earlier stress phonological awareness and letter knowledge as two essential elements in the development of reading and spelling. If one is to assess a child who is still in the process of literacy acquisition, all the components of the process need to be assessed. These include phonological awareness, letter knowledge, reading, spelling and the interaction between all four. When assessing phonological awareness it is useful to include both a factor one and factor two task to increase predictive strength of the tests (Yopp, 1988). Letter knowledge is generally assessed by showing children the full alphabet in random order and asking for the letter sound and name of each of the alphabet letters (Clay, 1985, Ball and Blachman, 1991 and Lundberg, 1994). Both these elements are relatively simple to operationalise for early grade one children, but how does one measure reading and spelling when a child is still in the process of acquiring these skills?

Standardised assessment of reading and spelling is useful because results can be compared with other children of the same age and to the child's general level of functioning. They are, however, generally more useful for the assessment of older children than those who are in the earliest stages of literacy acquisition. Emerging literacy skills and their relationship to phonological awareness can be examined more accurately if test items are chosen on the basis of a model of literacy acquisition. For example, within a stage model approach, test items for early grade one children (early alphabetic stage) would exclude irregular words or words containing morphemes (e.g. - "ing") as children are only expected to read these at later stages in the process of literacy acquisition.

Within a self-teaching model, a child's performance may be compared on regular, pseudowords and irregular words. In fact many researchers have noted specific effects of phonological awareness training on these various word types. (e.g. Castle et al, 1994; Byrne and Fielding-Barnsley, 1995 and Ball and Blachman, 1991).

Regular words would assess a child's ability to apply sound to print translation. If the child reads these words quickly and accurately, it can be assumed that the word has been stored as a full orthographic unit. Another way of assessing the relationship between phonological awareness and literacy skills is to use regular pseudowords. If a child can decode simple, regular pseudowords (e.g. peb) then he/she can be assumed to have the basic skills for self-teaching. Pseudowords have been found to be a pure measure of phonological re-coding and have been widely used in research with young children (Rack, Snowling and Olson, 1992 ; Clarke-Klein and Hodson, 1995 and Snowling, 1992). A specific improvement of pseudoword spelling has been shown as a result of phonological awareness training (Castle et al, 1994).

According to the self-teaching model, children with rudimentary phonological awareness and letter knowledge skills begin building partial orthographic units for any word, regular or irregular, from the very beginning of exposure to print. Irregular words have also been used widely in the literature to test the level of literacy. However effects of phonological awareness training have been less marked on irregular word reading in the early grades (Byrne and Fielding Barnsley, 1995). This may be due to the fact that grade one children have not yet had sufficient exposure to print to be able to read irregular words out of context, despite good phonological awareness and letter knowledge skills. If early literacy skills were to be assessed using irregular words, then credit should be given to irregular word reading or spelling which showed evidence of partial decoding (e.g. "sad" for "said").

Reading and spelling are distinct processes. In the early stages of literacy acquisition, it is common to find a child who can read but not spell the same word, and vice versa (Snowling, 1992). Reading and spelling should therefore be assessed separately, and different word types mentioned above used for both reading and spelling.

To be maximally effective and in keeping with a primary health care model (preventive, accessible, sustainable and affordable), phonological awareness training should be given to groups of less advantaged children, at their schools, together with teacher training. Children with the poorest phonological awareness should be chosen, as these are the ones who benefit most from intervention. Training is best carried out in conjunction with explicit letter knowledge stimulation. When choosing the training components (e.g. segmentation, blending and manipulation) consideration must be given to their developmental progression. Finally, by placing phonological awareness into the context of a model of literacy acquisition, testing procedures become more logical and meaningful (for example the use of real versus pseudowords).

In the present research a training programme was devised with the above findings in mind. Letter knowledge was explicitly taught, together with structured, graded phonological awareness activities. Less advantaged grade one children were chosen as subjects and were taught in a group of twenty. Pre- and post-treatments measures reflected a self-teaching model of literacy acquisition whereby both easier and more difficult phonological awareness tasks were included, in addition to a letter knowledge test and real and pseudoword reading and spelling tasks. The aims and methodology of the research are presented in the subsequent section.

CHAPTER TWO
METHODOLOGY

1. Aims

In this study two groups of disadvantaged first graders were trained. One group received intensive phonological awareness and letter knowledge training described in subsequent sections of the methodology, and the other group was subjected to a control procedure in which semantic rather than phonological awareness activities were administered (this design was similar to that of Byrne and Fielding-Barnsley, 1993).

The research aimed to answer the following questions:

1. To determine whether the beneficial effects of phonological awareness and letter knowledge training which have been observed in other countries, are replicable with a group of disadvantaged, South African, first graders.

2. To determine whether the training programme improves the levels of phonological awareness and letter knowledge as indicated on three post-treatment phonological awareness measures and the post-treatment letter knowledge test.

3. To determine whether successful recognition of letter sounds and phonological awareness is associated with improved literacy skills.

4. To determine whether the effects of training are evident for both reading and spelling skills.

The following secondary questions were also addressed:

5. To determine whether pseudowords are easier to read and spell than real words, following phonological awareness training.

6. To determine whether the subjects perform differently on words of different linguistic complexity.

7. To determine whether letter knowledge and phonological awareness skills are predictive of literacy performance.

8. To determine whether tests of phonological awareness correlate with each other and with literacy performance.

2. Subjects

The subjects were 40 grade one pupils, 24 females and 16 males, from two schools in Westville, Mitchell's Plain. Their ages ranged from 6.0 to 7.5 years (mean age 6.3 years). They spoke English as their main language and had normal hearing. They had no obvious signs of visual, physical, structural or emotional abnormalities. All subjects had poor phonological awareness, despite normal intelligence.

Twenty subjects each were placed in the experimental and control groups. The groups were matched for gender (each group had 12 females and 8 males), age and socio-economic status (Tables 2 and 3)

Table 2

Comparison of the ages of experimental and control groups using an ANOVA

	Experimental	Control	t value	p value
mean age	6.54	6.75	1.962	0.054
S.D.	0.38	0.26		

* $p < 0.05$

Table 3

Comparison of the experimental and control groups on parental income and education

	Income			**Education**		
	Range	Chi square	p value	Range	chi square	p value
Experimental	R0-R4000	5.42	0.367	<grade7 to 12	5.37	0.497
Control	R0-R2500			grade7 to 12		

*$p < 0.05$

3. Subject selection criteria

3.1 Questionnaire

Parents of all 107 English speaking school beginners (grade 1 children) at Westville and Weltevreden Primary schools received a questionnaire. In addition to personal, developmental and health background, the questionnaire sought information on parental income, education, and language to assist in the selection of subjects.

3.2 Phonological awareness and letter knowledge

The 107 children were all pre-tested on a shortened version of the Test of Phonological Awareness (TOPA, Torgesen and Bryant, 1994) and a test of letter knowledge (based on work by Ball and Blachman, 1991; Clay, 1985 and Lundberg, 1994). Past research indicates that phonological awareness training has a stronger effect on the spelling and reading of children with the lowest phonological awareness at the outset of the training (Torneus, 1984 and Olofsson and Lundberg, 1985). Only those children who obtained a score of five or less out of ten on the shortened TOPA test were included as subjects for the research.

3.3 Socio-economic status

Strong socio-economic status differences in phonological awareness have been demonstrated both in Australia and South Africa, indicating a need to control for this variable (Bowey, 1995; Worrall and Nadler-Nir, 1994 and Fisch, 1995). Measures of socio-economic status are generally based on parental occupation and education levels, using the Registrar-General's classification of occupations (Maclean, Bryant and Bradley, 1987 ; Bowey, 1995 and Fisch, 1995). In the present research, an interview with the school principal of Westville Primary indicated that both schools had limited financial resources. (The school budget for building and ground maintenance, all books and equipment was R32 000 for the year. In effect each child had a budget of R41,90 for the entire year (Vollenhoven, 1995)) The decision as to whether the children were from a disadvantaged background was made on the basis of the father's education and income. This information was acquired through the parent questionnaire. No parents of these children had received any tertiary education, and all earned less than R3000 per month, with the exception of one subject in the experimental group whose father earned between R3000 and R4000 per month. All subjects, except one, were judged to be from the same socio-economic group. This subject was accepted because he met the other subject selection criteria, and was needed to match the number of children in the experimental group with the control group (Appendix 1 shows figures of income and education range for each group).

3.4 Language

In the questionnaire, all subjects' parents cited English as their main language. All subjects were judged by their teachers to be fluent in English. (Afrikaans and English are the two main languages spoken in the community and there have been reports that English is viewed as the language of learning. For this reason some parents who speak Afrikaans as their first language request that their children be placed in English classes (Brooks, 1996).) Care was taken to ensure that no second language English speakers were included in either experimental or control groups.

3.5 Intelligence

None of the subjects had repeated a grade and all were judged by their teachers to be of average intelligence. The 53 children who passed all the above criteria were tested on the School Readiness Test for School Beginners (Bosch, 1990). Three children failed this test and were excluded.

3.6 Hearing

To reduce the amount of testing, the hearing of each of the children who passed all the above subject selection criteria was tested. They all passed a pure tone hearing screening test with a criterion of 20dB at the octave frequencies from 250Hz to 4000Hz (Barrett, 1978).

4. Procedure for subject selection

4.1 Questionnaire

The principals and staff of Westville and Weltevreden Primary schools were contacted and they agreed to participate in the project. Letters describing the research and questionnaires were then sent out to the parents of all the English grade one classes at both schools. In the letters, parents were asked to fill in the questionnaire, sign it and return it to the school, thus giving consent for the project. Six parents who did not return the questionnaire were contacted telephonically to obtain questionnaire details and consent.

4.2 Phonological awareness, letter knowledge and school readiness tests

After a training session, teachers administered the phonological awareness (TOPA-Kindergarten Screening Test) and letter knowledge tests to all 107 children. Sixty-four of the 107 children scored poorly on the phonological awareness test. Of these 64 children, eight did not meet the subject selection criteria as they spoke Afrikaans as their first language, or had failed a grade, or were from more advantaged families. The teachers then tested the remaining 56 children on the School Readiness Test for School Beginners (Bosch, 1990). Three children failed the test and were excluded. The hearing of the remaining 53 children was tested by the researcher and one other registered speech therapist and audiologist who had experience in hearing screening procedures. All subjects passed the hearing test.

4.3 Experimental and control groups

Of the sample of 53 children who met the subject selection criteria, the first 20 in the experimental school and the first 20 in the control school were chosen as subjects for the study. The researcher is aware that this was not a true random sampling procedure. Strict randomisation could not be adhered to, however, as children needed to be kept at their respective schools, with one school acting as the experimental group and the other as the control group. Keeping children at their respective schools allowed training to occur during school hours, with minimal disruptions to the school curriculum. The researcher is aware that this non-random allocation of subjects to each group could introduce a sampling bias (Cozby, 1981).

5. Procedure for implementing the experiment

5.1 Teacher training

To ensure that testing was carried out in a standardised manner, to maximise the transfer of phonological awareness skills and to allow for administration of classroom worksheets to the experimental group, teachers at the experimental school received training from the researcher. Three teachers from the experimental school were trained for three one-hour sessions, before the programme was implemented.

Training included some theoretical background in phonological awareness, testing procedures, oral motor classification of speech sounds, a description of the contents of the training programme and practice in administration of classroom worksheets. One grade one teacher from the experimental school did not attend the training sessions, but received the training literature from the other teachers. Teachers at the control school received one training session on testing procedures.

The 40 subjects involved in the research were drawn from the three English classes. This introduced the possibility of teacher effects (Cozby, 1981). It was not possible to control for this effect as these were the only English classes. All three teachers were however experienced. Teachers at both the schools were asked not to discuss the programme while it was running.

5.2 Pre-treatment measures

Once the experimental and control groups had been selected, both groups were tested on two pre-treatment measures, the full TOPA -Kindergarten Test (Torgesen and Bryant, 1994) and a non-standardised letter knowledge test (Ball and Blachman, 1991; Clay, 1985 and Lundberg, 1994). These tests were administered by the researcher and the registered speech therapist and audiologist who also administered the children's training programme. This testing was carried out approximately one week before programme implementation.

5.3 The experimental condition

The trainer of the multi-sensory phonological awareness and letter knowledge programme was a registered speech-language therapist and audiologist who had been working closely with the researcher for a year. The trainer had experience in treating children with phonological awareness deficits, had read research studies on phonological awareness and was involved in developing the worksheets used in the study. A remedial teacher from the experimental school and another speech-language therapist and audiologist who had been involved in developing the worksheets, alternated in assisting the trainer. The researcher observed every second training session to ensure that the programme was implemented as planned. All 20 experimental subjects were trained in a single group.

Training extended over 29 sessions, on a twice-weekly basis for 45-minute sessions (excluding school holidays), during school hours. (A literature review had indicated that the length and intensity of phonological awareness training varies from study to study. For example, Torneus (1984) trained her subjects for only eight sessions, Bradley and Bryant's (1983) subjects received intensive training over two years, whilst Lie (1991) administered training every day for 10 to 15 minutes over one semester. Castle et al (1994) trained children for 20 minutes twice a week, for a total of 6.7 hours. Most studies trained subjects in small groups of about six to eight children. The researcher had noted gains in phonological awareness within three to six months, when therapy occurs on an individual basis, once a week, for 30-to-45-minute sessions. It was decided that group training, on a twice-weekly basis, with carry-over classroom worksheets, for 29 sessions should be sufficient to observe treatment effects.) All 20 subjects were taught together in a single session as disadvantaged communities tend to have fewer teaching resources and large classes. All teachers received the same worksheets for classroom generalisation activities. Written notes were provided to help teachers administer worksheets in a standard manner.

5. 4 The control condition

There has been some controversy as to whether attention alone changes performance (Das, Mishra and Kirby, 1994). In the present study an attempt was made to control for the possibility that the attention from the speech therapist and not the type of training would result in an improvement in the post-treatment measures. The control group therefore received vocabulary stimulation exercises, a skill unrelated to phonological awareness training. The control group received the same number and length of sessions as the experimental group, from the same trainers. The vocabulary stimulation sessions followed traditional language stimulation methods (Carrow, Woolfolk and Lynch, 1984 and Crystal, 1981).

5.5 Post-treatment measures

To avoid recency effects, post-treatment measures were taken two weeks after the final training session. These included: the full TOPA-Kindergarten (Torgesen and Bryant (1994), non-standardised letter knowledge test, Test of Auditory Analysis Skills (TAAS, Rosner, 1975), The Yopp-Singer test of phoneme segmentation (Yopp, 1995) and non-standardised reading and spelling tests (Byrne and Fielding-Barnsley, 1995 ; Bruck and Treiman, 1990 ; Snowling, Gouldandris and Stackhouse, 1994 and Rack et al, 1992).

The non-standardised spelling test and the full TOPA-Kindergarten were administered in groups of five to eight children. The trainer administered the full TOPA-Kindergarten both at pre- and post-treatment, to avoid tester effects. The spelling tests were administered by the researcher. Both of these tests were administered on the same day with a break between them. To avoid possible order effects, half the subjects received the full TOPA-Kindergarten test first and the spelling tests second, whilst the other half received the tests in the opposite order.

The remaining four tests (non-standardised letter knowledge test, Test of Auditory Analysis Skills (TAAS, Rosner, 1975), The Yopp-Singer test of phoneme segmentation (Yopp, 1995) and non-standardised reading tests) were administered individually. These tests were administered by the researcher, the trainer and the speech therapist assistant mentioned previously. The four tests were administered on a separate day from the full TOPA-Kindergarten and spelling tests, to avoid fatigue. The order of the four tests was randomised. The other two speech therapists who administered the tests received a demonstration and practise session for test administration. All test instructions were written down and read to the subjects verbatim. Tests are reported in detail in the section seven of the methodology. All tests were administered with only the child and tester in a classroom which was stripped of alphabet freezes.

5.6 Feedback on effectiveness of the programme

Three weeks after the final testing, a meeting was held with the staff who had been involved in the training programme. At this time the teachers discussed the merits and pitfalls of the programme and the researcher reported on the results of the programme. Future applications of the programme were then discussed.

6. Possible uncontrolled variables

6.1 Pre-school experience

Most pre-schools include songs, rhymes and rhythm games in their daily activities. Rhyme has been shown to be one of the earliest developing phonological awareness skills and is highly predictive of achievement in literacy (Bradley and Bryant, 1983). It was thus considered to be extremely important to control for pre-school experience as this experience in the control group could have placed them at an advantage, thus reducing the effects of training. However the experimental and control groups could not be matched for pre-school experience. Only the control school had a pre-school class attached to the premises. This acted as a "feeder school" to the control school grade one classes. The experimental school had no pre-school class and drew pupils mostly from day care centres in the area. The proportion of children who had attended a pre-school was 94.2% for the control group and 47.4 % for the experimental group. As can be seen in Table 4, the difference in pre-school experience was statistically significant and was therefore controlled by statistical means (see section 9 for details).

Table 4

Comparison of the experimental and control groups on pre-school experience using the Mantel-Haenszel test

	chi square	p value
pre-school experience	8.98	0.0027 *

* $p < 0.05$

6.2 Intensity of training

Although the trainer presented the same number of sessions to the experimental and control groups, attendance records for each child indicated that the control group subjects received on average significantly more sessions than the experimental group (Table 5). The intensity of training was therefore also controlled by statistical means.

6.3 Pre-treatment letter knowledge scores

As can be seen from Table 5, the experimental and control groups differed significantly in their letter knowledge at pre-treatment, with the experimental group having a higher letter knowledge score than the control group. Due to a limited subject pool and stringent subject selection criteria, it was not possible to match the two groups on both letter knowledge and phonological awareness at the outset of the treatment. It was therefore decided to match the groups on phonological awareness as this was the major emphasis of the training programme. The difference in letter knowledge at pre-treatment was controlled for by statistical methods.

Table 5

The intensity of training and the mean letter knowledge scores obtained by the experimental and control groups (Mann-Whitney two- sample test)

	Intensity of training			**Letter knowledge**		
	Mean	S.D.	p value	Mean	S.D.	p value
Experimental	25.65	2.28	0.04*	5.2	2.215	0.009*
Control	23.15	5.2		3.5	2.29	

* $p < 0.05$

7. Data Collection

7.1 Pre-selection measures

7.1.1 Questionnaire

A questionnaire and letter describing the study were sent out to all parents of English grade one pupils at both schools (see Appendix 2 for the full questionnaire). Parents obtained the correspondence in both English and Afrikaans as the subjects are part of a highly bilingual community, with some first language Afrikaans children attending the English medium classes (Brooks, 1996). Questions pertaining to the child's medical history, home language, pre-literacy stimulation and parental socio-economic status were included.

7.1.2 School readiness test (School readiness test for school beginners, Department of Education and Culture, Bosch, 1990).

The School Readiness Test for School Beginners was administered from the middle to the end of the first school term, by the class teachers, to groups of five to eight children. The teachers had extensive experience in administration of the test as it had been used by the school in previous years. This test comprised two sections. The first was a group test whereby each child was required to draw a picture of a person and then to copy a picture of a house. Both drawings were scored out of a total of ten points. The Draw-a-Person section of this test was similar to the Goodenough-Harris Drawing Test (Harris, 1963) which has been found to correlate significantly with the intelligence for children between the ages of 5 to 10 years. The second section was an individual test which assessed verbal, mathematical and non-verbal skills. The subtests included: conversation, counting, sharing and addition. The final individual test involved building a wall out of blocks, which the examiner first demonstrated. The normative information indicated that pupils obtaining a score of < 22 out of a total of 44 were not school ready. The test was compiled by Dr Bosch (psychologist) who was the head of the subject advisors for the kindergarten section from the House of Representatives. It was widely used by teachers and psychologists in the Mitchell's Plain area.

According to psychologists the test correlated well with the Aptitude Test for School Beginners (Swart, 1974) a published school readiness test. Although no reliability data are available on the school readiness test for school beginners, it was chosen for convenience. It was familiar to the teachers and required no additional training.

The two groups had similar school readiness scores (Table 6). The experimental group had a mean score of 32.15 out of a total of 44 points and the control group mean was 30.75. The two groups had similar standard deviations and the difference in mean scores was statistically non-significant ($p = 0.259$). This indicates that the groups were matched, at the outset of the programme, for school readiness.

7.1.3 Phonological awareness test (TOPA-Kindergarten screening test)

The TOPA (Test of Phonological Awareness) was administered from the middle to the end of the first school term, in groups of five to eight children , by teachers who were trained to administer the test. Two versions of the TOPA exist, the full TOPA-Kindergarten test which is designed for use with kindergarten children, and the full TOPA-Early Elementary test, for use with first and second graders. Following a pilot study (Nadler-Nir, 1995(b)), it was found that the full TOPA-Early Elementary version was too difficult for grade one children from this community. As a result, a shortened version of the full TOPA-Kindergarten test (Torgesen and Bryant, 1994) was used.

The test was shortened by the researcher from 20 to 10 items so that it could be used as a fast screening instrument for all the English speaking grade one pupils ($n = 107$). The researcher is aware that by reducing the number of test items, the reliability of the test may be affected. It is however common practice for screening instruments to have fewer items than the original test. Individual test items in the full TOPA-Kindergarten yielded a coefficient alpha of 91 (Torgesen and Bryant, 1994). This indicates that the 20 individual test items in the full TOPA-Kindergarten test have a high degree of interrelation and measure the same construct.

Reducing the number of test items in a test which has high internal consistency is less of a threat to the reliability of a test than to one in which there is a low internal consistency. Some items were changed in the TOPA-Different section of the full TOPA-Kindergarten test in an attempt to include words representing as many different places and manner of articulation as possible. The researcher is aware that this may have affected the reliability of this section of the test (see Appendix 3).

The modified TOPA-Kindergarten comprised two sub-tests. The initial sound-same subtest (TOPA-Same) required the child to mark which of three words began with the same sound as a stimulus word. (e.g. Stimulus word : FIRE : HAT STAR FOOT). The initial sound-different subtest (TOPA-Different) required the child to mark which word in a group of four words began with a different first sound from the other three (e.g. FORK, FAN, FOOT, SHIRT). Each child obtained a booklet with pictures of the words to avoid loading short term auditory memory. Three training items were administered before testing began.

The groups were matched on the TOPA-Kindergarten screening test (Table 6). The experimental and control group means were 2.1 (out of a total of 10 points) and 2.85, respectively. This difference was non-significant ($p = 0.072$).

Table 6

Comparison of the groups on the pre-selection measures (The school readiness test for school beginners and the TOPA-screening test) using an ANOVA (Mann-Whitney Two-Sample test)

Measure	**Experimental**		**Control**			**p-values**	
	M	S.D.	Max	M	S.D.	df	
School readiness test	32.15	4.87	44	30.75	3.754	1	0.259
TOPA Screening	2.1	1.334	10	2.85	1.31	1	0.072

$p < 0.05$

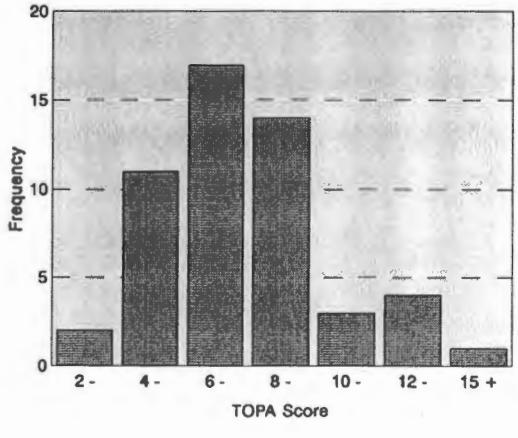
7.2 Pre-treatment measures

7.2.1 TOPA-Kindergarten (Torgesen and Bryant, 1994)

The full TOPA-Kindergarten test was administered only to children participating in the study. The trainer tested the participants in groups of five to eight, one week before the training was implemented. Testing took place at the beginning of the second school term, over a period of one week. The test was administered according to instructions in the examiner's manual. Permission was given by the first author of the test to change test items where culture bias was present and as recommended by the author, the distracter items were chosen so that they had as much overall phonemic similarity as possible. (See Appendix 3 for the full test). The test was made up of two sections, namely, the TOPA-Same (10 items) and TOPA-Different (10 items). A full TOPA-Kindergarten score was obtained by adding together the scores from the two sections (20 items). In the Initial Sound-Same section the word "pail" was changed to "nail" and in the Initial Sound-Different section, "horn" was changed to "hand" and "jack" to "jacket." The TOPA-Kindergarten has been shown to have a good test-re-test reliability (r = .94, Torgesen and Bryant, 1994, PG 20). In a pilot study the full TOPA-Kindergarten was tested on the 1995 grade one class from Westville Primary School and was found to be normally distributed, although slightly negatively skewed (Fig 1).

Fig. 1

Frequency Distribution of the Full TOPA-Kindergarten Test for the 1995 grade one Westville Primary Class



7.2.2 Test of letter knowledge

The letter knowledge test was administered individually, by a registered speech therapist, in a quiet room free of alphabet freezes, one week before the training programme was implemented. Although non-standardised, the letter knowledge test used in the present study was similar to ones used by Ball and Blachman (1991), Clay (1985) and Lundberg (1994) in that credit is given for either letter sound or letter name and the letters are displayed in random order. Muter (1994) has reported on research indicating that after phonological awareness, letter knowledge is the second strongest predictor of early literacy skills. Both letter name and letter sound knowledge have proved to be powerfully predictive of early reading and spelling development (Clay, 1985 ; Adams, 1990 and Lundberg, 1994). In the present study letter knowledge was found to correlate with all tests of phonological awareness and literacy. Based on the above findings, the letter knowledge test used in the present study is considered to have criterion related validity. Ball and Blachman (1991) found inter-rater reliability on the same letter knowledge test, for 20 subjects, to be .997. A reliability measure was conducted on the post-treatment letter knowledge results, using the results of the error variance (Ve/Vt). This indicated that the test had moderately good reliability ($r = 0.68$).

In the present study, the full alphabet was displayed in front of the child, in random order. The letters were presented in rows of five, in lower case. All children received the letters in the same order. The examiner asked the following two unscored questions: 1) "Do you know what you call these ?" and 2)" Can you find the one your name starts with ?" The scored section of the test consisted of the following: Pointing to each letter in turn the examiner asked, "Do you know what sound it makes ?" If the child gave the incorrect sound or did not answer, the examiner then asked, " Do you know its name?" The child received a score of one, regardless of whether (s)he gave the letter sound or name. All twenty-six letters of the alphabet were tested, thus the maximum number of points was 26.

7.3 Post-treatment measures

7.3.1 TOPA- Kindergarten (Torgesen and Bryant, 1994)

This test was identical to the pretest TOPA-Kindergarten.

7.3.2 Test of letter knowledge

This test was identical to the letter knowledge test administered at pre-test, with the exception that three new letter digraphs were added, namely, "th", "sh" and "ch". These are digraphs which are only taught later in grade one. The total number of test items was 29.

7.3.3 Test of auditory analysis skills (TAAS, Rosner, 1975)

The TAAS was chosen to assess whether the phonological awareness training had generalised to a different type of phonological awareness task from the TOPA. Yopp, (1988) through statistical comparisons of numerous phonological awareness tasks, found that there were two factors underlying the construct of phonological awareness. Each factor was defined by the tests that had high loadings on it. Factor 1 was termed simple phonemic awareness. These tests require one operation and then a response. Factor 2 tests, termed compound phonemic awareness, require more steps to completion and place a greater burden on memory. The respondent performs an operation (for example, isolates a given sound) and then holds the resulting sound in memory while performing yet another operation. Yopp (1988) found that the vast majority of phonological awareness tasks had loadings on either one of the two factors. The two factors appear to reflect two levels of difficulty rather than two qualitatively different kinds of skill. She suggested that, when testing, it is important to include a combination of tests, one for each factor. The two tests together hold greater predictive validity for the initial steps in reading acquisition than either test alone.

Both the TOPA-Kindergarten and TAAS would be considered factor 2 tasks. Yopp (1988) found that of all the phonological awareness tests she analysed, the TAAS had the highest loading on factor 2 (the loading on factor 2 after oblique rotation was .94) and had a moderate to high reliability (cronbach's alpha = .78).

The TAAS assesses the ability to delete a syllable or sound from a word, e.g. Say "sunshine"; now say it again but don't say "shine" -> "sun." ; say "meat"; now say it again, but don't say (m) -> "eat." There are two training items and 13 test items. The full test is presented in Appendix 4.

7.3.4 Yopp-Singer test of phoneme segmentation (Yopp, 1995)

The Yopp-Singer test was used to determine whether the phonological awareness training effects had generalised to factor 1 phonological awareness tasks (simple phonemic awareness). These tasks require one step to their completion. Yopp (1988) found that the Yopp-Singer test of phoneme segmentation had the highest loading on the simple phonemic awareness factor (the loading on factor 1 after oblique rotation was .88). She found the test to have a reliability score (cronbach's alpha) of .95, indicating that it is a highly reliable measure. She concluded that it was the best test of simple phonemic awareness.

The Yopp-Singer test assesses the ability to separately articulate the sounds of a spoken word in order (e.g. given the orally presented word "sat", the child should respond with three separate sounds: (s)-(a)-(t), Yopp, 1995, PG 21). The test consists of three training items, followed by 22 test items. A child is credited with one point only if (s)he supplies all of the phonemes in the target word. The items range in length from two to three phonemes and only two items contain consonant clusters (e.g. grew: (g)-(r)-(oo)). The test is displayed in Appendix 5.

7.3.5 Non-standardised reading tests

A trend in the literature is to test and compare three word types for spelling and reading; real regular words ; irregular words (matched for frequency with the regular words) and regular pseudowords (Byrne and Fielding-Barnsley, 1995 ; Bruck and Treiman, 1990 and Snowling et al , 1994). Results from an unpublished pilot study (Nadler-Nir, 1996) showed that irregular words were too difficult for the grade one children from Westville Primary school to read. These words do not have a one-to-one correspondence between the phoneme and grapheme e.g. "laugh." As a result, only real regular and regular pseudowords were included for the assessment of reading in the present study.

Regular words are ones where each letter in the word represents its most common sound. There are no silent letters and there are no digraphs representing single phonemes (e.g. "ch", "ou", Byrne and Fielding-Barnsley, 1995, PG 445). Pseudowords are formed by changing one or two letters in regular real words (e.g. "mat" --> "mot").

By choosing to use real regular and pseudowords as test items rather than a standardised measure, the researcher made an attempt to create a test which follows a self-teaching model of literacy acquisition (Jorm and Share, 1983 in Share and Stanovich, 1995). This model maintains that the only viable way to acquire a well defined orthographic lexicon, which will lead to automatic reading and spelling, is through phonological re-coding (print to sound translation). Pseudowords are the purest measure of phonological re-coding (Rack et al, 1992). They have also been found to be predictive of literacy development in later school years (Freebody and Byrne, 1988). Other reasons for including regular pseudowords is that they have been widely used in research with young children (Rack et al, 1992 ; Clarke-Klein and Hodson, 1995 and Snowling, 1992) and have been shown to correlate with real regular word reading, tests of phonological awareness and letter knowledge. There was a strong correlation between the reading and spelling tests used in the present study ($r = 0.86$). These findings lend concurrent validity (Wallace, 1992 in Torgesen and Bryant, 1994), and predictive validity to pseudoword reading tests. A limitation of using a non-standardised test is that no normative data is available.

Sixteen real regular words and sixteen regular pseudowords were included in the reading test. Rack et al (1992) suggest that pseudoword tests which have varying levels of linguistic complexity avoid ceiling effects and are more sensitive in determining a phonologically based reading difficulty. An attempt to vary the linguistic complexity of words was made by choosing the following word types both for real and pseudowords: four VC (vowel consonant, e.g. it, im); five CVC (consonant, vowel, consonant, e.g. sun, sen); five CVCC or CCVC (best, flag, besk, plag) and two two-syllable words (topic, ipdoc). The complete test is presented in Appendix 6. The real and pseudowords were presented as separate tests. The VC, CVC , CCVC and two syllable words were presented in a random order. All words were printed in lower case letters of approximately 5mm in height.

Words containing consonant clusters such as "clap" have been found to be more difficult for young pupils to read and spell than words like "cap" which do not contain a cluster (Bruck and Treiman, 1990). These authors also found that the ability to represent consonant clusters in spelling tests is strongly related to phonological awareness skills. It was considered reasonable to predict that two syllable words would be the most difficult to read. The different word types were used to create a graded reading test which would be sensitive to minor variations in phonological awareness skills.

Pointing to the first word the examiner said, "Now I want you to read some words for me." After the child read a word, regardless of whether it was correct, the examiner prompted with the phrase, "good try." The child was allowed to try for as long as (s)he wished and the best attempt was scored. Responses were scored either right or wrong, with a credit of 1 given for correct responses and 0 for incorrect responses. Reading pseudowords is unnatural for young children and may cause misunderstanding (Rack et al, 1992). The examiner attempted to overcome this by introducing the test items as follows: "Now I want you to read some silly words for me. They are so silly that you have never seen them before." The acceptable prompts and scoring procedure were exactly the same as for the real word reading task.

7.3.6 Non-standardised spelling tests

Reading and spelling are distinct processes and in the early stages, it is common to find a child who can read but not spell the same word, and vice versa (Snowling, 1992). Reading and spelling were therefore assessed separately. Results of the pilot testing (Nadler-Nir, 1996) indicated that irregular and two-syllable words were too difficult for the grade one children from Westville Primary to spell. These types of words were therefore not included in the non-standardised spelling test. Only one-syllable real regular and regular pseudowords were included.

Two scores were calculated from the spelling test. The number of words spelt correctly was the first, termed the simple raw score. The second was a developmental measure based on the work of Byrne and Fielding-Barnsley (1991, 1993 and 1995) and Ball and Blachman (1991). They used a developmental scoring measure to determine to what extent a misspelled word captured the phonetic structure of the target word.

The more phonemes a child attempted to represent, the higher the developmental score. The developmental scoring procedure used in the present study is compatible with the self-teaching model of spelling acquisition. Even if a child misspells a word, (e.g. "hit" -> "ht) the developmental scoring procedure credits the child for showing indications that she is building up partial orthographic representations of a word, which through exposure to print will be fully expanded. The developmental scoring procedure, with examples is presented in Appendix 7. In both scoring procedures letter reversals were ignored as these are a typical features of grade one spellings (Liberman, Shankweiler, Orlando, Harris and Berti, 1971, in Byrne and Fielding-Barnsley, 1993). The following reversals were ignored:(b-d, p-  , g-  , f-  j-  a- ). In the present study a strong correlation was found between the two scoring methods (r = .89) which validates the developmental scoring procedure.

The spelling test was considered to have concurrent validity as it correlated with all measures of phonological awareness and letter knowledge used in the present study (Cozby ,1981). Inter-judge and test re-test reliability measures were calculated for the non-standardised spelling test, using Spearman's correlation. An experienced speech therapist was asked to re-score 11 randomly selected spelling tests, as a measure of inter-judge reliability. Results indicated that the non-standardised spelling test was a reliable measure (scorer reliability r = .99). The data for the test re-test reliability measure was obtained from five randomly selected children who re-did the spelling test a few days after it was first administered. The test re-test reliability was also high (r = .896).

The spelling test consisted of 15 real regular words and 15 pseudowords. Five of each of the following word types were represented for both real and pseudowords: VC (e.g. am, ap); CVC (dog, zog); and CVCC or CCVC (hand, step, sten, zind). The word types were presented in a random order. The examiner presented the real word spelling test as follows: "Now I want you to write these words. Let's try this one for practice. CAT. My cat is furry. CAT." Each word was said once, repeated in a sentence, and spoken a third time. The full test is presented in Appendix 7.

To avoid any confusion about the pseudoword spelling task, the examiner presented it as follows: " Now I want you to write some silly words. They are so silly that you have never heard them before. Try to write them just like they sound. I will say the word three times, then you say it after me." The examiner ensured that all the children had repeated the word correctly before they attempted to write it. One practice word was given, together with the written answer.

8. The training programme

8.1 Basic principles and criteria of the programme

In devising the programme, ideas were borrowed from the "Sounds Abound" (Catts and Vartiainen, 1994), Rosner (1975), and Auditory Discrimination in Depth (Lindamood and Lindamood, 1969) programmes. The basic principles and activities were not new, but the order in which the phonological awareness components and letters were introduced was unique. The application of such a programme to disadvantaged South African children was new.

The design of the programme was based on the following principles:

8.1.1 Games worksheets and stories

Each session was pre-planned and consisted of group games, worksheets, stories and carry over worksheets for the classroom. Each child had a booklet containing his/her worksheets. Training programmes which include games, worksheets and stories have been shown to have beneficial effects on literacy (Byrne and Fielding-Barnsley, 1995 and Lie, 1991).

8.1.2 A multi-sensory teaching style

A multi-sensory approach, with a focus on the auditory, oral- motor kinaesthetic, visual and tactile senses was used. A large emphasis was placed on the oral-motor kinaesthetic sense. The subjects were shown how each speech sound was made so that place, manner and voicing features were highlighted.

Research has shown that young children use articulatory cues when attempting to segment words (Lie, 1991). It follows that the best way to teach a child how to segment words is to teach him/her to pay attention to his/her own articulation of the phonemes. Studies which have looked at phoneme confusions indicate that the most commonly confused features are those of place and then manner (Lie, 1991).

8.1.3 Structured order for the introduction of phonemes and their corresponding graphemes

Phonemes, paired with their corresponding grapheme, were introduced in a particular order. The more acoustically and visually salient phonemes were introduced earlier in the programme. For example the labiodental fricative (f) was introduced before the velar stop (k) Catts, (1991). Explicit letter knowledge training was carried out because the effects of phonological awareness training on reading and spelling have been found to be greater in those programmes which explicitly trained the children to discover the link between the letter and its sound (Ball and Blachman, 1991).

8.1.4 The order of introduction of phonological awareness components followed a developmental sequence

The order of introduction of phonological awareness components was carefully structured. Literature suggests that rhyming is the earliest developing phonological awareness component followed in order of difficulty by syllabification, segmentation/blending of single sounds, segmentation/blending of two and three phonemes and finally, deletion of phonemes (Rosner, 1976 ; Perfetti Beck, Bell and Hughes, 1987 and Fisch, 1995). Rhyming was excluded from this programme because late kindergarten children often approach ceiling on rhyming tests (Yopp, 1988 ; Lundberg et al 1988; Worrall and Nadler-Nir, 1994 and Mutter, 1994). The rhyming activities omitted from the programme should not be confused with segmentation and blending of onset and rime patterns, which have been included as they correlate significantly with literacy (Goswami and Bryant, 1990 and Maclean, Bradley and Bryant, 1987). Thus the following sequence of phonological awareness skills which was discussed earlier was introduced. See Table 9 for transcription details.

A) Segmentation, blending and manipulation of syllables (e.g. clap and say each part of this word "Cucumber"; what word am I saying ? (te)-(lu)-(foan) -> telephone ; Say "cowboy", and take away "cow" -> "boy").

B) Segmentation of word initial phonemes (what sound does "fan" start with ->(f))

C) Segmentation of word final phonemes (what sound does fan end with -> (n))

D) Segmentation and blending of onset and rime patterns (cat can be broken into (c) and (at); (h) - (at) says hat).

E) Introduction of vowels, segmentation of word initial vowels (what is the first sound in ice? -> (ie).

F) Segmentation and blending of CV words (what are the two sounds in me -> (m) - (ee) ; what word am I saying ? (g) - (oa) -> go).

G) Segmentation and blending of CVC words (what are the sounds in loud -> (l) - (ou) - (d); what word am I saying ? (m) - (ou) - (s) -> mouse).

H) Manipulation (deletion) of word initial phonemes in CVC words (say cat without (c) - > (at)).

I) Manipulation (deletion) of word final phonemes in CVC words (say pain without (n) -> (pay)).

8.2 Components of the training programme

8.2.1. Syllabification

The programme began with two sessions focusing on syllabification. Although most grade one pupils find syllable segmentation activities very easy (Worrall and Nadler-Nir, 1994) it was included to provide the children with a sense of competence. Syllable work also acted as a bridge to the more difficult phoneme segmentation, blending and manipulation activities. The following syllabification activities were graded according to Catts and Vartiainen's "Sounds Abound" programme (1994), with the addition of syllable completion activities:

1. Segmentation of compound words (cowboy can be broken into "cow" and "boy").
2. Segmentation of multisyllabic two- three- and four-syllable words (clap and say each part of September -> (sep) - (tem) - (bu).

A short story loaded with a specific target phoneme was read for one to two of the four phonemes. The stories for the other phonemes were read in class by the teachers. *The Letterland ABC* book (Carlisle and Wendon, 1988) was used for this purpose. It contains a short story about each alphabet sound and each grapheme is illustrated with a character. Each story is loaded with words that contain a specific target phoneme. For example, Sammy Snake... "likes sunning himself by the surf and sitting on sandcastles" (Carlisle and Wendon, 1988, PG 44). The letter, the letter character from the story and a mouth form picture were pasted up in the classroom (see Appendix 8). The mouth form pictures and labels were adapted from The Auditory Discrimination in Depth programme (Lindamood and Lindamood, 1969). Teachers introduced the remaining letter stories during regular classroom instruction.

The phonemes which were not grouped into voiced/voiceless "twin" pairs, were termed "brother sounds", because they did not look exactly the same but had the same manner of articulation. The liquid phonemes were grouped together and termed lifters; nasals were labelled as "the nosy sounds," glides were placed together and labelled as "windy sounds" (Lindamood and Lindamood, 1969). The (y) sound as is "yo-yo" was introduced only through the *Letterland ABC* story (Carlisle and Wendon, 1988). Lindamood and Lindamood's (1969) classification of it as an alternative way of writing the vowel sound (ee), was felt to be unfamiliar to the way in which this consonant is taught by the teachers. The letters "x" and "q" were also introduced by the teachers through the Letterland stories, and not targeted directly in the phonological awareness and letter knowledge programme.

Although consonant digraphs: (th), (ch) and (sh) are introduced only later in grade one, they were introduced early in the phonological awareness programme as they were felt to be acoustically and visually salient phonemes and were therefore easy to segment. Back stops such as (k) and (g) were introduced later as these are short in duration and not visually salient (Catts. 1991). Although nasals are acoustically salient, they were introduced later because they were grouped with sounds that do not consist of voiced/ voiceless pairs. More time was allocated to the identification of the first few phoneme pairs and less to later pairs, as generalisation was expected. The phoneme groups and their order of introduction was as follows:

3. Syllable completion (Finish off my word. strawbe -> (ree) "strawberry").
4. Syllable blending (what word am I saying (die) - (nu) - (sau) -> "dinosaur").
5. Syllable deletion. (Say Table without (tay) -> (bil)).

8.2.2 Word initial segmentation of consonants

Twelve sessions were dedicated to the identification of first sounds in words. A large portion of the programme was dedicated to this activity for the following two reasons. Firstly because each phoneme was paired with its corresponding grapheme, time was required to discuss the articulatory cues for each sound, play games identifying it in the word initial position and read a story highlighting each sound. Secondly, it was assumed that if word initial phoneme identification was well consolidated, less time would be required to identify word final phonemes, as generalisation would be expected.

Children were taught to explore a voiceless phoneme in isolation, before placing it in the context of a word. They were led to discover the place and manner features of the phoneme. They then gave the phoneme a label which highlighted the features (e.g. (f) was termed a lip biter because one needs to gently bite the lip and blow air out). A mouth form picture of the phoneme was then presented. The voiced phoneme, in the voiceless/ voiced phoneme pair, was then introduced (in the (f) (v) phoneme pair, (v) would then be introduced). Voiced / voiceless phoneme pairs were introduced as "twin sounds" because they looked the same (same place and manner features), but had different characters, one was noisy and the other was quiet (e.g. (f) was the quiet lip biter and (v) was the noisy lip biter). Two pairs of visually distinct phonemes were introduced in one lesson (e.g. (s, z) and (f, v) would be introduced in one lesson).

To contrast and compare phoneme features, sequences of phonemes were articulated and then represented with coloured bean bags, e.g. (s) (z) (s). These were represented with a red, a blue, and a red bean bag. The children identified that the first phoneme was a quiet snaky sound, the next was a noisy snaky, and the last was another quiet snaky sound (Lindamood and Lindamood, 1969).

The identical twin sounds:

1. (s), (z) (snaky sounds) and (f), (v) (lip biter sounds)
2. (th), (th) (tongue out sounds) and (sh), (zh), as in treasure. (SH baby ! sounds)
3. (ch), (j) (choo-choo sounds) and (p), (b) (pop sounds)
4. (t), (d) (tap sounds) and (k), (g) (back sounds)

The brother sounds

5. (l), (r) (lifter sounds)
6. (m), (n), (ng) (nosy sounds) (ng was introduced, but not practised at this stage as it does not occur in word initial position)
7. (w), (h) (windy sounds).

After sequencing phonemes in isolation, games were introduced to identify word initial phonemes in single words. An iteration procedure was used together with the articulatory cues and grapheme, to highlight the word initial phoneme. A set of picture-based worksheets was then introduced contrasting each set of phonemes. All worksheets involved identification of word initial phonemes, the use of articulatory cues and explicit letter knowledge. Easy worksheets were introduced to begin with, whereby the child had to identify if two words began with the same phoneme. An attempt was made to use visually distinct phonemes for this purpose (e.g. sun, feather). Later more difficult worksheets were introduced whereby three pictures were used and the child was asked to find the picture that began with the same sound as the first picture (vegetable: van , zoo). The most difficult worksheets required the children to look at three pictures and decide which picture began with a different phoneme from the other two (sing, fire, sit). The grading of worksheet from same-different judgements, to matching first sounds and finally to finding the "odd one out", was based on the work of Catts and Vartiainen (1993). Phonemes with voiced voiceless contrasts were used to increase the level of difficulty (e.g. sun, zoo, zero). An example of each type of worksheet is presented in Appendix 9.

8.2.3 Word final segmentation

Three sessions were dedicated to word final phoneme segmentation. Having introduced the word initial phonemes in a highly structured way, generalisation was expected for word final phoneme identification. Word final phonemes were chosen at random. The only exception to this was the phoneme (ng) which received specific practice as it exists only in word medial and final positions. Oral motor-kinaesthetic labels, and graphemes were reinforced during word final phoneme identification.

8.2.4 Identifying and classifying vowels

Four sessions were dedicated to identifying and classifying vowels. Vowels are amongst the most difficult phonemes to represent with graphemes. Up until the reading age of about 9 years it is still common to find normally developing children who misrepresent vowels (Snowling, 1992). This is because vowels are largely responsible for the irregularity of English spelling patterns (Share and Stanovich, 1995). For example the (ay) sound may be represented in the following ways: ay "day", a-e "cake", a "apron", ai "rain" and eigh "eight". The ability to segment vowels is an essential first step in spelling words containing vowel digraphs.

The Auditory Discrimination in Depth Programme (Lindamood and Lindamood, 1969) is one of the few programmes which teaches vowels in a systematic way. It uses a modified linguistic vowel circle to introduce vowel sounds and their articulatory cues. Vowels are laid out in a half circle and each vowel in the circle represents changes in tongue placement for different vowel sounds. The vowels are then labelled according to groups ("smile", "open", "round" and "sliders"). These labels focus attention on the way the lips appear when the sounds are formed. The present programme adapted the linguistic circle into a "vowel house" as this was found to be more sensible to young children.

The vowel house was comprised of six front smiley steps (See Table 9 for transcription details). Each step represented a vowel sound and the children were shown how the tongue "walks down these six steps." (ee), (i), (e), (ay), (a), (u). The general mouth shape for this group was a smile and the group was thus labelled "the Smiley vowels." (o) was placed on its own at the bottom of the steps (the tongue was now at the bottom of the mouth) and was labelled an "open vowel sound." (au), (o͝o) and (o͞o) were placed up the back stairs and labelled the "round sounds". A large slide was drawn in the garden and on it were placed the slider sounds or diphthongs (ou), (oi), (oa), (ie), (ue). They were labelled sliders as the mouth moves or slides when they are produced. The researcher changed the position of two vowels from Lindamood and Lindamood's (1969) original linguistic circle. The vowel (au) was changed from open to round and (oa) was changed from round to a slider as it was considered to be more like the other diphthongs. Coloured steps represented each vowel sound. A poster sized vowel house was used when teaching the vowel house concept. Appendix 10 shows the vowel house that each child had in his/her book and the trainer's copy.

After the vowel house concept was introduced the five vowels which are taught in grade one, (a), (e), (i), (o) and (u), were written on the correct step of each child's vowel house. The Letterland story (Carlisle and Wendon, 1988) for each vowel sound was then introduced. Activities focusing on vowels were graded as follows:

1) Gross discrimination of vowel sounds using oral motor kinaesthetic cues. E.g. The trainer articulated a vowel sound and the children were required to say where "it lived" in the vowel house e.g. / ou / slider.

2) Same/different judgement of isolated vowel sounds using oral motor kinaesthetic cues.

3) Worksheets targeting word initial vowel identification (Appendix 11) .

Table 7
Key to transcription of vowels

SMILE:	OPEN:	SLIDER:
(ee) as in tree, eat	(o) as in orange	(ou) as in out, owl
(i) as in ink	ROUND:	(oi) as in oil, boy
(e) as in egg	(au) as in Paul, paw	(oa) as in boat, bow, rope
(ay) as in day, rain, cake	(o͝o) as in book, put	(ie) pie, my, right
(a) as in apple	(o͞o) as in moon	(ue) cute, few
(u) as in umbrella		

8.2.5 Segmentation, blending and manipulation of phonemes in CV and CVC words

Ten sessions were dedicated to segmentation, blending and manipulation of CV and CVC words. Most training studies have found that literacy skills improved as a result of training these skills (Torneus, 1984 ; Ball and Blachman, 1991 ; Lie, 1991 ; Castle, et al 1994, and Lundberg, 1994). The following hierarchy was used:

1) Segmentation of phonemes in CV words: Children were encouraged to used their oral-motor kinaesthetic labels to identify the first and second sounds. E.g. "tea" has two sounds, (t) which is a tap sound and (ee), a smiley (see Appendix 12 for the demonstration worksheet).
2) Blending onset and rime patterns
3) Segmentation of phonemes in CVC words
4) Blending CVC words
5) Manipulation of phonemes. Word initial and, later, word final phonemes were deleted from CVC words, e.g. What sound in "mice" is missing from "ice" ? Picture based minimal pairs were used to teach this skill (Appendix 13).

9. Data analysis

A number of test reliabilities were calculated on the non-standardised spelling and letter knowledge tests. Pearson's correlation was used to calculate inter-judge, test-re-test and a test of reliability using the variances of the test scores (the error variance divided by the total variance, Ve/Vt).

There were two groups involved in the research: one experimental group and one control group. Using the group means, Two-Sample independent t-tests were carried out on the pre-treatment data. The significance level chosen for all calculations was $p= 0.05$. The groups were compared on eight variables (gender, age, SES, pre-school experience, school readiness, the intensity of training and the pre-treatment measures (phonological awareness and letter knowledge). It was found that the groups were matched on all but the following three variables: letter knowledge, pre-school experience and intensity of training.

At the end of the programme the groups were tested again to determine the effect of the phonological awareness and letter knowledge training. Having tested for significant differences between the groups, it was noted that their variances were not homogeneous. It was therefore necessary to transform the scores into logarithmic scales. These were termed the transformed scores. The three possibly uncontrolled variables (pre-school experience, letter knowledge and intensity of training) which had been noted at the outset of the programme were controlled for in the following way: Each of the post-treatment measures (the TOPA, Letter Knowledge test, TAAS and Literacy tests) was correlated with each of the three possible confounding variables. If the test scores correlated significantly with any of the variables, this variable was corrected for by statistical means. For example, the post-treatment letter knowledge scores correlated significantly with both pre-school experience and the pre-treatment letter knowledge scores, but not with the intensity of training. The post-treatment letter knowledge scores were thus corrected for pre-school experience and the pre-treatment letter knowledge scores, but not for intensity of training. The statistical correction yielded adjusted scores. Two types of results are reported. The first are the results before they were transformed into a logarithmic scale and adjusted for the possible confounding variables. These are termed the non-transformed scores and are reported and displayed graphically as they tend to be more easily interpreted than logarithmic scores. The second type of score is the adjusted transformed score. Because these are presented in a logarithmic scale, the numbers are smaller. They also do not lend themselves easily to graphical display and are reported in Table form only.

A paired t-test was also calculated on the letter knowledge and TOPA tests to determine how much each individual subject improved, from the pre to the post-treatment condition. For each subject, the pre-treatment measure was subtracted from the post-treatment measure. The mean difference from pre-to post treatment was then calculated. Statistical corrections were not undertaken for these measures.

Lastly, correlations between the tests used and multiple and step-wise regression analyses were calculated to determine which tests best predicted the literacy scores.

CHAPTER THREE
RESULTS

In the following section results of the various tests will be reported to determine what effect the training had on phonological awareness, letter knowledge and literacy skills. The TOPA-Kindergarten and Letter Knowledge tests, administered at both pre- and post-treatment, will be reported first. Statistical corrections were made to control for the uncontrolled variables discussed in the methodology. These adjusted, transformed scores are then reported. Within subject changes conclude this section. The tests which were administered only at post-treatment are reported next. These include the two tests of phonological awareness (Yopp-Singer test of phoneme segmentation and the Test of Auditory Analysis Skills) and the literacy tests. The non-transformed and the adjusted, transformed scores will be reported to determine if the uncontrolled variables had any effects on the scores. Results of the literacy tests are first reported as total measures. The results of reading and spelling tests are then reported separately. These include brief results of the different types of words used (pseudo vs real words) and the various levels of linguistic complexity of the test items (VC, CVC, CCVC). The results section concludes with a report of the relationship of phonological awareness and letter knowledge tests to each other and to literacy performance. This shows which of the tests were most predictive of literacy scores.

1. TOPA-Kindergarten test

1.1 Pre-treatment TOPA-Kindergarten test

At pre-treatment, both the experimental and control groups performed in a similar manner on the full TOPA-Kindergarten test, although the control group's mean (7.45/20) was slightly higher than the experimental group's mean (6.15/20). As seen in Table 8 and Fig 2, this difference was statistically insignificant ($p>0.05$).

The group means were also compared for the two sections of the full TOPA-Kindergarten test (TOPA-Same and TOPA-Different, 10 test items each). As seen in Table 8, the same pattern, of the control group scoring higher, was evident in both sections. The experimental and control group means for the TOPA-Same section were 3.5 and 4.45 out of 10, respectively, a non-significant difference ($p > 0.05$). The TOPA-Different mean scores for the two groups approached significance ($p = 0.056$), with the experimental and control mean scores being 2.7 and 3.05 respectively. The two groups had similar standard deviations for both sections.

Table 8

TOPA-Kindergarten subgroup means, standard deviations and p-values at pre and post-treatment (Mann-Whitney Two-Sample test), adjusted transformed post-treatment scores and the mean difference between pre and post treatment measures (paired t-test)

Measures	**Experimental**			**Control**		**p-values**
MEAN PRE-TREATMENT	M	S.D.	MAX	M	S.D.	
full TOPA	6.15	2.7	20	7.45	2.3	0.1060
TOPA-Same	3.5	1.9	10	4.45	1.8	0.091
TOPA-Different	2.7	1.45	10	3.05	1.31	0.056
MEAN POST-TREATMENT						
full TOPA	12.4	3.619	20	9.5	4.161	0.0216*
TOPA-Same	7.55	1.93	10	5.95	2.3	0.027*
TOPA-Different	4.85	2.519	10	3.55	2.5	0.11
full TOPA adjusted, transformed	2.41	0.495		2.22	0.495	0.059
full TOPA-Same, adjusted, transformed	2.09	4.3		1.89	4.55	0.072
full TOPA-Different, adjusted, transformed	1.608	0.822		1.5	0.885	0.58
MEAN DIFFERENCE						
Full TOPA	6.25	4.2		2.05	4.08	0.003*
TOPA-Same	4.1	2.38		1.5	2.01	0.0009*
TOPA-Different	1.15	2.83		0.5	2.26	0.06

* $p < 0.05$

1.2 Post -treatment TOPA-Kindergarten test

There was a significant difference between the groups on the full TOPA-Kindergarten test, in favour of the experimental group ($p = 0.0216$). Inspection of the results in Table 8 and Fig. 2 show that the experimental group mean was 12.4 out of a total of 20 points and the control group mean was only 9.5. There was also a significant difference between the groups for the TOPA-Same section, in favour of the experimental group ($p < 0.05$). The experimental group mean was 7.55 and the control group mean was 5.95. The difference between the two groups for the TOPA-Different section was not significant ($p > 0.5$), although the experimental group's mean score was slightly higher. The experimental group mean was 4.85 and the control group mean was 3.55.

1.3 Adjusted, transformed post-treatment TOPA-Kindergarten scores

During calculation of the above TOPA results, it was found that the variances of the groups were not homogeneous. It was therefore necessary to transform the scores into logarithmic scales. These are termed the transformed scores The three possible confounding variables (pre-school experience, letter knowledge and intensity of training) which had been noted at the outset of the programme were then controlled for in the following way: the TOPA-kindergarten test was correlated with each of the three possible confounding variables. If the test correlated significantly with any of the variables, then this variable was corrected for by statistical means. These corrections yielded the adjusted, transformed scores which are summarised in Table 8.

The full-TOPA scores were found to correlate only with the pre-treatment letter knowledge scores and were corrected for this variable. The TOPA-Same and TOPA-Different scores were corrected for intensity of training, pre-school experience and letter knowledge as they correlated with all three variables.

Following the above statistical corrections, there were no significant differences between the two groups on all three TOPA-Kindergarten sections. However, even with the statistical corrections, the experimental group showed consistently higher values on the full TOPA, TOPA-Same and TOPA-Different sections. The logarithmic and p values are displayed in Table 8.

Fig. 2

Mean full TOPA-Kindergarten scores for both groups at pre- and post-treatment

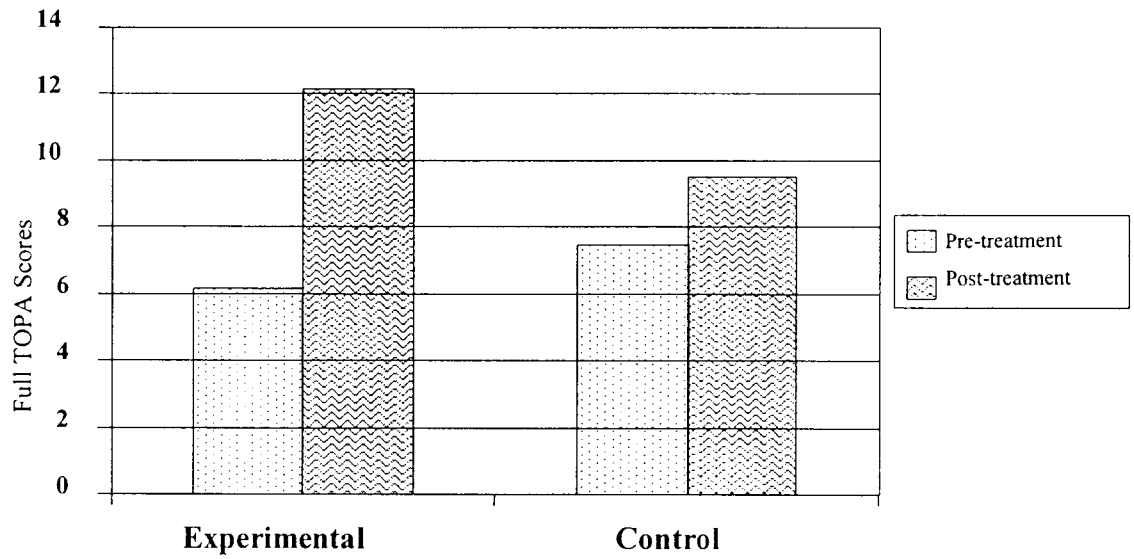


Fig. 3

Pre- and post-treatment full TOPA-Kindergarten scores, for each control subject (n=20)

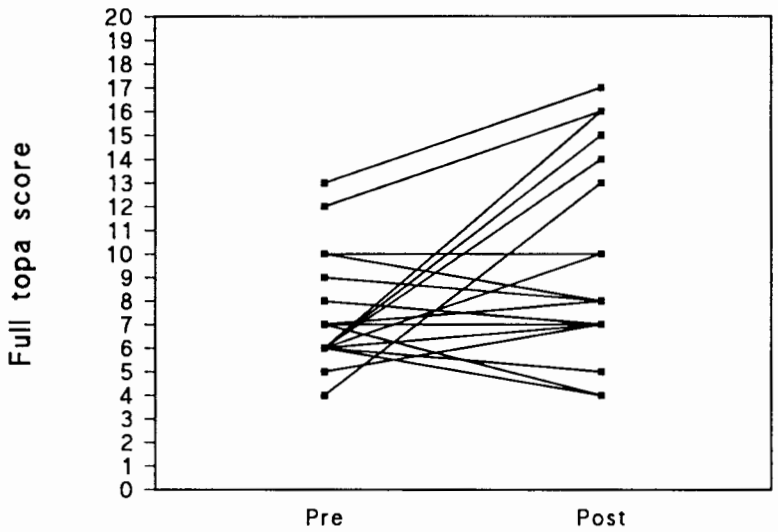
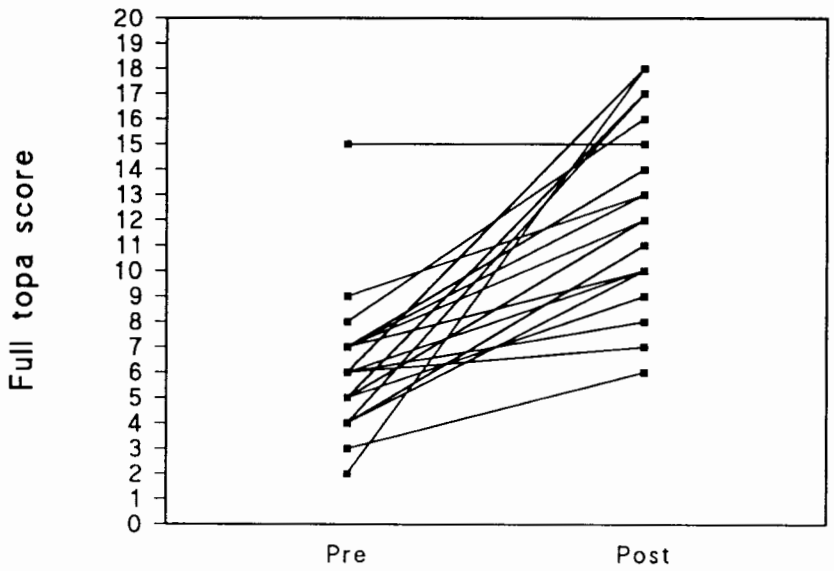


Fig. 4

Pre- and post-treatment full TOPA-kindergarten scores, for each experimental subject (n=20)



1.4 Within subject changes on the full TOPA-Kindergarten test

Literacy and phonological awareness have been found to show a relationship of reciprocal causation where normal classroom literacy instruction has positive effects on phonological awareness development and phonological awareness stimulation improves literacy performance (Lundberg et al, 1988). Figures 3 and 4 show the pre- and post-treatment full TOPA-Kindergarten scores for each subject in the control and experimental groups, respectively. The general trend in both groups was an increase in score from pre to post-treatment. In the control group, 11 of the 20 subjects improved their scores from pre to post-treatment, six subjects showed a one to two point decrease in the TOPA score at post-treatment and three showed the same pre- and post-treatment scores. In the experimental group, 19 of the 20 subjects showed an increased score and only one subject showed no change from pre to post-treatment (individual subject data is presented in Appendix 14).

As can be seen in Table 8, on the full TOPA-Kindergarten test, the experimental group improved on average 6.25 points, from pre to post-treatment, whilst the control group improved by only 2.05 points. The experimental group's improvement was significantly higher than the control group's ($p < 0.05$). The mean improvement on the TOPA-Same section was also significantly higher in the experimental group. The experimental group improved on average 4,1 points, and the control group improved by only 1.5 points ($p < 0.05$). Both groups showed minimal improvement on the TOPA-Different section, with the experimental and control groups improving on average, 1.15 and 0.5 points respectively ($p > 0.05$).

Table 8 displays the group means at pre and post-treatment as well as the average number of points by which each subject improved (mean difference). The mean improvement scores yielded slightly higher significance levels than the group means, although both calculations indicated that the training had very little effect in improving the TOPA-Different scores.

2. Letter knowledge test

2.1 Pre-treatment letter knowledge test

At pre-treatment, both groups performed poorly on the letter knowledge test. Out of the total of 26 points possible, the experimental group did slightly better, scoring 5.2 on average against the control group's mean of 3.5. This difference was statistically significant, in favour of the experimental group ($p = < 0.05$). Both groups had similar standard deviations (Table 9).

2.2 Post-treatment letter knowledge test

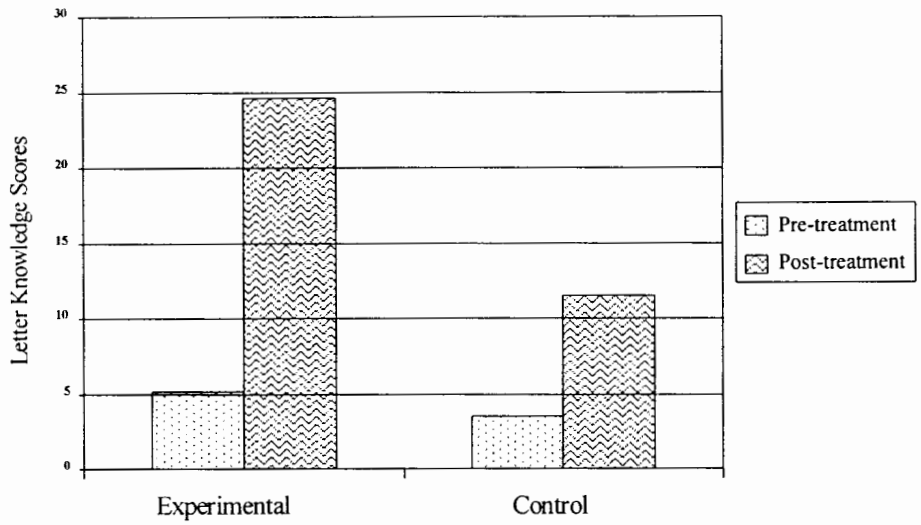
As seen in Table 9, there was a significant difference between the groups on the letter knowledge test, in favour of the experimental group ($p = < 0.001$). The experimental group mean was 24.65 out of a total of 29 points and the control group mean was 11.55.

Table 9
Letter knowledge subgroup means, standard deviations and p-values for pre- and post-treatment scores (Mann-Whitney Two-Sample test), adjusted transformed post-treatment scores and the mean difference between pre and post treatment measures (paired t-test)

LETTER KNOWLEDGE	**Experimental**		**Control**			
	M	S.D.	MAX	M	S.D.	p values
Mean Pre-treatment	5.2	2.215	26	3.5	2.929	0.043*
Mean Post-treatment	24.65	3.376	29	11.55	8.256	0.000008*
Post, adjusted transformed	3.11	0.810		2.34	0.860	0.0001*
Mean Difference	19.35	3.01		8.05	2.26	0.000001*

* $p< 0.05$

Fig. 5
Mean letter knowledge scores for both groups at pre- and post-treatment



2.3 Adjusted, transformed letter knowledge scores

The post-treatment letter knowledge scores correlated significantly with pre-school experience and pre-treatment letter knowledge scores, and were corrected for these. Despite statistical corrections, the difference between the groups remained significant in favour of the experimental group, ($p < 0.001$). The experimental group mean was 3.11 and the control group mean was 2.34 (Table 9).

2.4 Within subject changes on the letter knowledge test

Figures 6 and 7 show the pre- and post-treatment letter knowledge scores for each subject in the control and experimental groups. In both groups there was an increase in the number of letters correctly identified, at post-treatment. The experimental group had learned on average 19.35 new letters at post-treatment, whilst the control group had learned only 8.05 new letters (Table 9).

This difference was highly significant (P<0.05). In the control group, only one of the twenty subjects showed a one point decrease in letter knowledge at post-treatment. Two showed the same pre- and post-treatment scores. In the experimental group, all twenty subjects showed an increased letter knowledge score at post-treatment (see Appendix 14 for raw data).

3. The Test of Auditory Analysis Skills (TAAS)

Inspection of Table 10 and Fig. 8 reveals that, at post-treatment, the experimental group scored slightly higher than the control group (3.4 vs 2.36) but this difference was not statistically significant (p > 0.05). The distribution of scores was, however, very different for the groups, with the control group's distribution being more skewed to the left than the experimental group's (figs 9 and 10). When calculating the control group's mean TAAS scores, data from only 19 subjects were used as one subject was absent when the post-treatment measures were taken. As can be seen in Appendix 14, eight of the experimental subjects obtained a score of 4 or more out of 13. Only one control subject obtained more than 4 out of 13. The maximum score in the control group was 9, and in the experimental group, 8.

Fig. 6
Pre- and post-treatment letter knowledge scores, for each control subject (n=20)

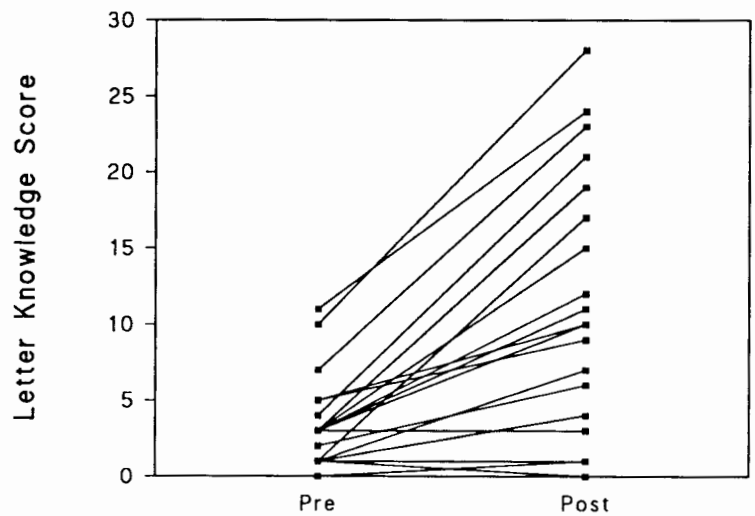


Fig. 7
Pre- and post-treatment letter knowledge scores, for each experimental subject (n=20)

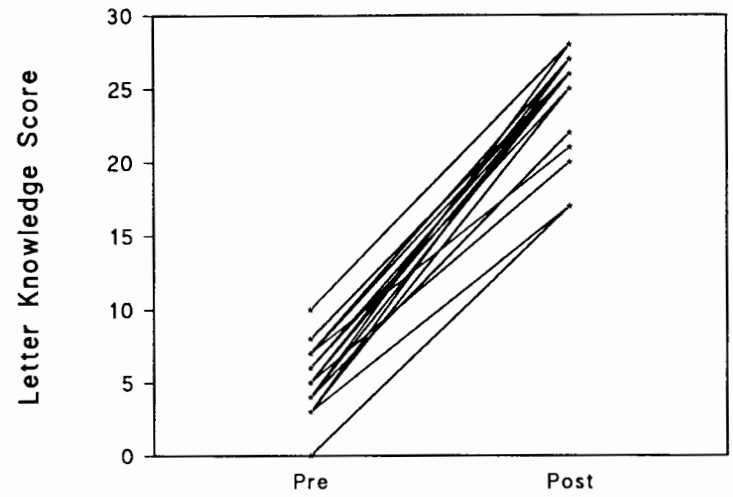


Fig. 8
Mean TAAS scores for the experimental and control groups

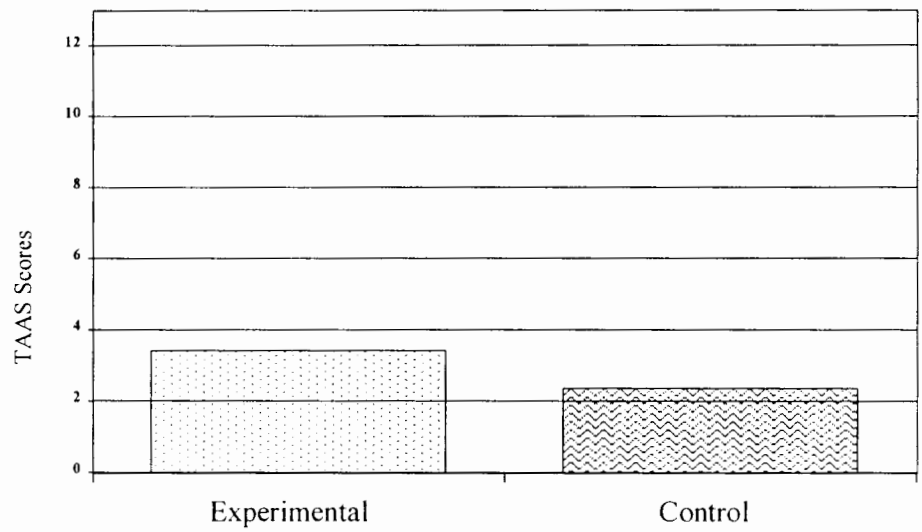


Fig. 9
Frequency distribution of TAAS scores for experimental subjects (n=20)

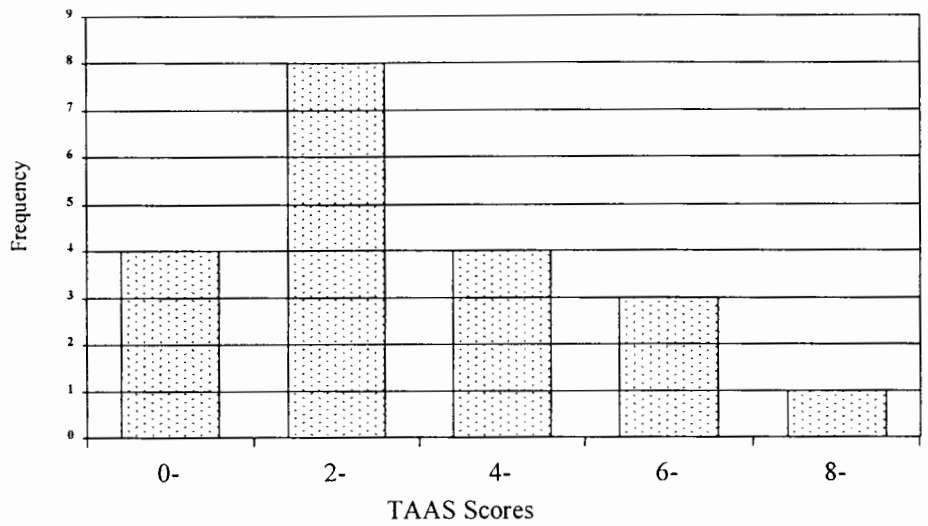
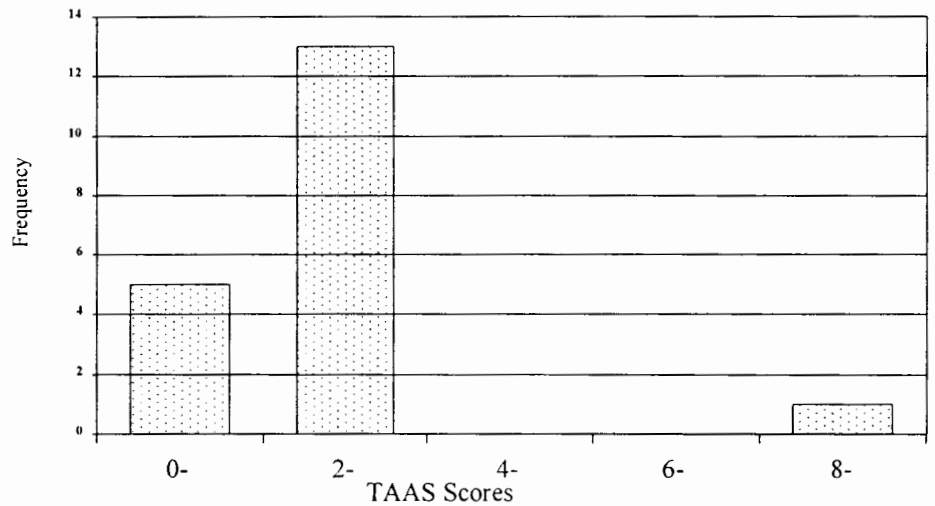


Fig. 10
Frequency distribution of TAAS scores for control subjects (n=19)



3.1 Adjusted, transformed TAAS Scores

The TAAS scores were corrected for the pre-treatment letter knowledge scores. As can be seen in Table 10, with the statistical correction, there was still no significant difference between the groups (p = 0.42). The experimental and control group means were 1.23 and 1.07 respectively. With the correction, the trend continued to be in favour of the experimental group.

Table 10

TAAS and Yopp-Singer subgroup means, standard deviations, and p-values (Mann-Whitney Two-Sample test) and adjusted transformed post-treatment scores

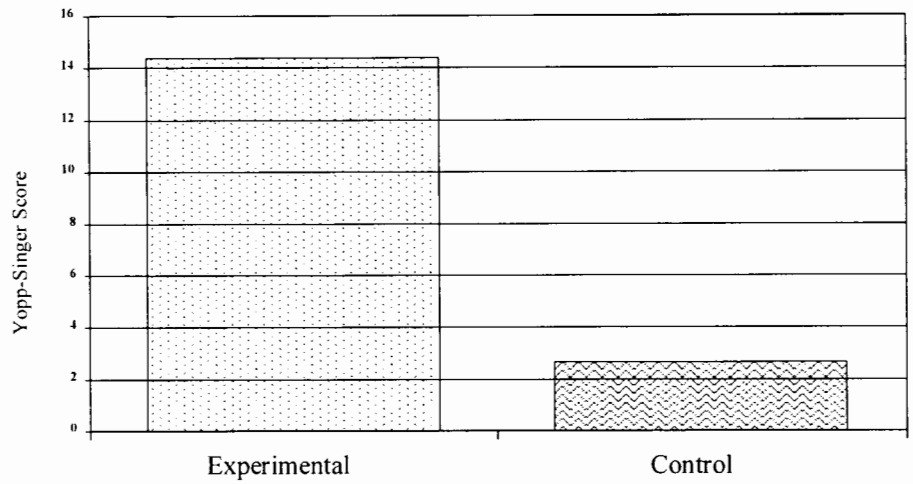
Measure	**Experimental**			**Control**		
TAAS	M	S.D.	MAX	M	S.D.	p-value
Post-treatment	3.4	2.280	13	2.368	2.060	0.119
adjusted, transformed	1.23	0.866		1.07	0.866	0.42
YOPP-SINGER						
Post-treatment	14.4	6.193	22	2.386	5.733	0.000005*
adjusted, transformed	2.45	0.993		0.80	0.993	0.00001*

* $p < 0.001$

4. Yopp-Singer test of phoneme segmentation

At post-treatment, the experimental group scored significantly ($p < .001$) higher than the control group (14.4 vs 2.65). The differences are displayed in Table 10 and Figure 11. In the experimental group, thirteen subjects obtained a score of 15 or more out of 22. Eight subjects obtained scores as high as 19 or 20. Seven subjects scored 13 or less out of 22. Only one subject obtained the minimum score of 2. In the control group two subjects obtained relatively high scores (more than 15 out of 22). The remaining eighteen subjects scored below 7 out of 22 and twelve subjects obtained the minimum score of 0 (see Appendix 14).

Fig. 11
Mean Yopp-Singer scores for the experimental and control groups



4.1 Adjusted, transformed Yopp-Singer Scores

The post-treatment Yopp-Singer scores were corrected for intensity of training and the pre-treatment letter knowledge scores as they had significant correlations with both of these uncontrolled variables. As can be seen in Table 10, the experimental group's logarithmic scores were still higher (2.24) than the control group's (1.07). This difference was statistically significant ($p < 0.001$).

5. Literacy measures

5.1 Total literacy scores

The total literacy score was derived in two different ways. Firstly, the total reading score (out of a total of 32 points) and total raw spelling scores (out of a total of 30 points) were added. Out of the total number of words tested, the experimental group could spell significantly more words (24.05) than the control group (5.05). This difference was statistically significant at the 0.001 level of confidence. Although both groups had experienced only six months of formal literacy instruction, the higher scores achieved by the experimental group indicate that they were further ahead in the process of literacy acquisition than the control group. The results are summarised in Table 11.

The groups were then compared by adding the total reading (out of a total of 32 points) and the developmental spelling scores (out of a total of 150 points) to derive the total literacy scores. The developmental score valued segmentation skills. It is possible that a child could spell only one word perfectly, and yet be displaying good emergent segmentation skills, by representing word initial and final consonants correctly (e.g. "sp" for "sip"). The experimental group scores remained significantly higher than the control group's when the developmental scoring method was used ($p < 0.001$). The experimental and control group means were 112.25 and 44.85 respectively out of a total of 182 points. As indicated by the fairly large standard deviations for the raw and developmental scoring procedures, the subjects' performance varied a great deal in both groups (Table 11).

5.2 Adjusted, transformed total literacy scores

The total literacy score was corrected for pre-school experience and the pre-treatment letter knowledge scores. As seen in Table 11, the difference between the groups was still significant, in favour of the experimental group ($p < 0.001$). The experimental and control group means were 4.54 and 3.54 respectively.

5.3 Total reading scores

As can be seen in Table 11, the experimental group scored significantly higher ($p < 0.001$) than the control group for reading. The experimental and control group means were 14.45 and 3.2 (see Figure 12). The experimental group could read on average 11.25 more words than the control subjects, indicating that they were further along in the process of reading acquisition. Both groups had a high standard deviation, indicating that there was a great deal of variability in the subjects' reading performance (Table 11). In the control group, twelve subjects obtained a score of 0 or 1, yet one subject (subject 33) achieved a score of 26. In the experimental group, the scores ranged from 4 to 29 (see Appendix 14).

5.4 Adjusted, transformed total reading scores

A statistically significant difference remained after the total reading scores were corrected for pre-school experience and the pre-treatment letter knowledge scores ($p < 0.001$). As can be seen from Table 11, the experimental group's scores were still much higher.

Table 11

Total literacy, total reading and total spelling measures: means, standard deviations and p-values for non-transformed and adjusted, transformed scores

Measure	**Experimental**			**Control**		
LITERACY(read+spell)	M	S.D	MAX	M	S.D.	p-value
read+raw spelling scores	24.05	15.21	62	5.05	10.81	0.0001*
read+dev. Spelling scores	112.25	35.467	182	44.85	34.838	0.000022*
adjusted, transformed	4.54	1.069		3.54	1.138	0.0005*
READING						
total reading	14.45	8.912	32	3.2	5.979	0.000007*
adjusted, transformed	2.24	0.904		1.07	0.968	0.00001*
SPELLING						
total spell (raw)	9.6	7.0	30	1.85	5.0	0.000074*
total spell (developmental)	97.8	28.35	150	41.65	29.64	0.00001*
adjusted transformed	4.38	0.727		3.58	0.727	0.001*

* $p < 0.05$

5.5 Total Spelling Scores

Table 11 shows that when the simple raw score measure was used to calculate the total spelling score, a significant difference between the groups was noted in favour of the experimental group ($p < 0.001$). Thus both reading and spelling scores contributed to the experimental group's better performance on the total literacy score. The experimental group mean was 9.6 (out of a total of 30 points) and the control was 1.85 (Fig. 13). The control group found this test particularly difficult and scored on average 7.75 points below the experimental subjects. There was a great deal of variability in the way individual subjects performed which was reflected by the large standard deviations (Table 11). Thirteen of the control subjects obtained scores of 0, whilst one subject (again subject 33) obtained the highest score of 22. In the experimental group, only two subjects achieved the minimum score of 0 and one obtained the score of 21. Most experimental subjects' scores ranged between 6 and 19.

The developmental scoring procedure was also used to calculate the total spelling score. By using the developmental scoring procedure, an attempt was made to determine whether the experimental group was making better use of segmentation skills than the control group. Results are presented in Table 11. It can be seen that the mean developmental scores for the experimental group and control groups were 97.8 and 41.65 respectively out of a total of 182 points. The difference in scores was significant at the 0.001 level of confidence, indicating that the experimental group was making better use of segmentation skills than the control group.

There was a strong correlation between the raw and the developmental scoring procedures for both experimental and control groups (experimental group $r = 0.85$ and control group $r = 0.76$, the p value for both groups was < 0.001).

Fig. 12

Mean reading scores for the experimental and control groups

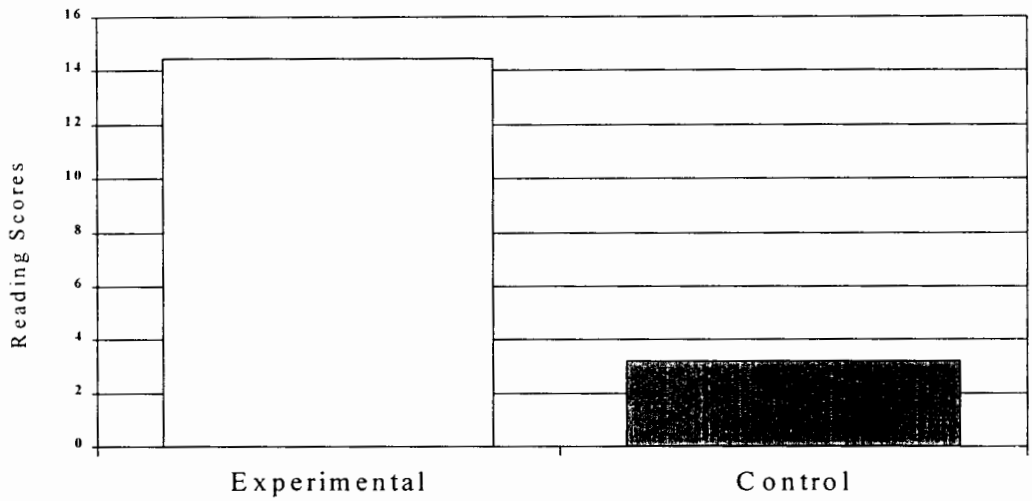
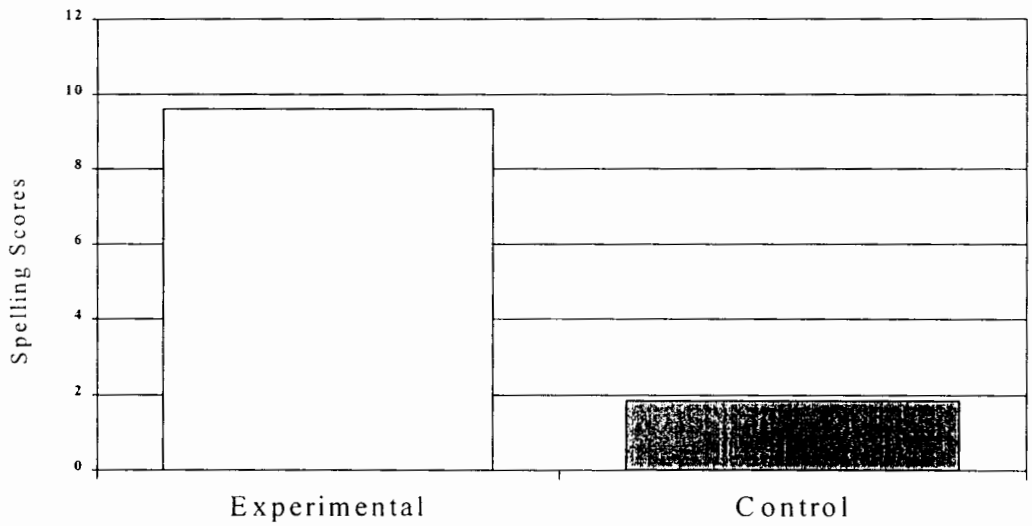


Fig. 13

Mean raw spelling scores for the experimental and control groups



5.6 Adjusted, transformed total spelling scores

Inspection of Table 11 indicates that even after correcting the total developmental spelling scores for the pre-treatment letter knowledge scores, the difference between the groups remained statistically significant ($p = 0.001$). The experimental group mean was 4.38 and the control group mean was 3.58.

5.7 Real vs pseudoword reading and spelling

Using Pearson's correlation, a strong relationship was found between real and pseudoword reading for both control and experimental groups, respectively (control group: $r = 0.96$ and experimental group: $r = 0.93$). This indicates that the performance of both groups on the pseudoword reading and spelling tasks was no better or worse than on real word tasks. As a result, real and pseudoword reading scores were combined.

5.8 VC, CVC and CCVC word reading and spelling

Reading

Table 12 shows the means and standard deviations of both groups combined, for reading each word type. Both real and pseudoword scores were combined to give total VC, CVC and CCVC scores. There was no significant difference between VC and CVC word reading for the whole group ($F = 0.813$, $p > 0.05$). On average subjects found CCVC words significantly more difficult to read than VC and CVC words ($F = 5.17$, $p = 0.02$). The subjects performed with a great deal of variability for all word types, as reflected in the standard deviations.

Spelling

Means and standard deviations of both groups combined, for spelling each word type are presented in Table 12. The scores from both real and pseudowords were combined to give total VC, CVC and CCVC scores. The developmental scores were used in the calculations. None of the three word types were significantly more difficult to spell than the others. ($F = 0.813$, $p > 0.05$). There was a similar amount of variability in performance for all three word types.

Table 12

Means and standard deviations of both groups combined, for reading and spelling each word type

Word Type	MAX	M	S.D.
READING			
VC	8	3.55	2.917
CVC	10	3.375	3.571
CCVC	10	1.850	3.505
SPELL. (developmental score)			
VC	50	24.775	15.32
CVC	50	23.95	15.386
CCVC	50	21.00	10.483

6. Relationships of phonological awareness and letter knowledge tests to each other and to literacy performance

Table 13 shows the correlations between each of the phonological awareness and letter knowledge tests. All the tests correlated significantly with each other ($p < 0.05$). The two tests that correlated highest were the test of letter knowledge and the Yopp-Singer test of phoneme segmentation ($r = .768$).

A multiple regression analysis was conducted with the total literacy score as the dependent variable, and three phonological awareness tests (full-TOPA-Kindergarten, Yopp-Singer and TAAS) as predictors. 76.4 % of the variance in the total literacy score could be explained by the three phonological awareness tests. When the letter knowledge test was added as the fourth predictor, all four tests accounted for 85.22% of the variance in the total literacy score.

When each test was entered into the regression analysis alone, it was found that the Yopp-Singer explained 75% of the variance, in the total literacy score, followed by the TOPA (43 %) and the TAAS. (42.9%). This suggests that the Yopp-Singer test of phoneme segmentation added most to the variance in the total literacy score whereas the TAAS and TOPA-Kindergarten added very little to the total variance in the total literacy score.

The Yopp-Singer and letter knowledge tests were then entered as predictors and the total literacy score remained as the dependent variable. The Yopp-Singer and letter knowledge tests contributed 84.8 % of the variance in the total literacy score. A further analysis indicated that letter knowledge alone predicted 74.85 % of the variance in the total literacy score. The Yopp-Singer test alone predicted 75.71 % of the variance. Thus the Yopp-Singer and letter knowledge tests appear to be strongly related to each other and highly predictive of literacy performance. The tests, in order of predictive strength for literacy performance are: Yopp-Singer test of phoneme segmentation, letter knowledge, TOPA-Kindergarten and finally the TAAS.

Table 13

Correlations between the phonological awareness and letter knowledge tests

	TAAS	TOPA	YOPP	LETTER
TAAS	1.000	0.5889	.6433	.5436
sample size	(39)	(39)	(39)	(39)
significance level	.000	.0001	0.0000	.0003
TOPA	.5889	1.000	.6451	.4841
sample size	(39)	(39)	(39)	(39)
significance level	.0001	.000	.0018	.0407
YOPP	.6433	.6451	1.000	.7683
sample size	(39)	(39)	(39)	(39)
significance level	.0000	.0000	.0000	.0000
LETTER	.5436	.4841	.7683	1.000
sample size	(39)	(39)	(39)	(39)
significance level	.0003	.0018	.0000	.0000

Results of the TOPA-Kindergarten indicated that the full TOPA and the TOPA-Same sections were significantly higher at post-treatment for the experimental group than the control group. The experimental group did not score significantly better on the TOPA-Different section or on the TAAS. The training appeared to be most effective in raising levels of phoneme segmentation (Yopp-Singer test), letter knowledge and literacy. The statistical corrections for the uncontrolled variables eliminated the significant differences on all sections of the TOPA-Kindergarten test, but had little effect on the phoneme segmentation, letter knowledge and literacy results, which remained strongly in favour of the experimental group.

CHAPTER FOUR
DISCUSSION

Results suggest that the programme is highly effective in improving phonological awareness, letter knowledge, reading and spelling skills. The experimental group scored significantly higher than the control group on simple phonological awareness tasks, such as segmenting the sounds in a word and matching words with the same first sounds. The difference between the groups was minimal for more complex phonological awareness tasks, such as deleting a sound from a word and for tasks with higher linguistic demands, such as finding the word that began with a different sound from the others. After training, the experimental group's letter knowledge and their ability to read and spell real and pseudowords was significantly better than that of the control group.

In the following discussion, an attempt will be made to explain the different effects that the training had on the children's ability to perform the three tests of phonological awareness (Yopp-Singer test of phoneme segmentation, the TOPA-Kindergarten and the TAAS). It is claimed that the superior letter knowledge and phonological awareness skills of the experimental group over the control group is directly responsible for the experimental group's more advanced reading and spelling skills. The relationship of phonological awareness and letter knowledge skills to each other and to literacy skills will be used to give support to the self-teaching model of literacy acquisition (Jorm and Share, in Share and Stanovich, 1995) which implicates phonological awareness and letter knowledge as basic building blocks for literacy development. Limitations and implications of the present research are discussed as they pertain to future phonological awareness training studies.

1. Phonological Awareness Tests

1.1 The Yopp-Singer test of phoneme segmentation

The experimental group performed significantly better than the control on the Yopp-Singer test of phoneme segmentation, even after statistical corrections. As the bulk of the phonological awareness training was aimed at helping children to develop this skill, the programme appears highly effective in stimulating segmentation skills which are crucial in the early stages of reading and spelling development.

To spell a word, a child needs to first segment the spoken word into each of its component sounds and then retrieve a letter corresponding to each sound. To read a word, letter sounds need to be retrieved and blended to form the word. Despite receiving more than six months of normal classroom instruction, children in the control group had extreme difficulty with the Yopp-Singer test of phoneme segmentation task, achieving an average of 2.6 points. This was in contrast to the experimental group's score of 14.4 out of a total of 22 points. Clinical experience suggests that grade one children with automatic segmentation skills generally miss no more than one to three items on the segmentation test. The experimental children missed, on average, eight items. This indicates that, despite improved segmentation skills, many of the children in the experimental group had not achieved automaticity in this skill. This lack of automaticity may have contributed to less than optimal skills on more complex phonological awareness tasks such as the TAAS and TOPA-Kindergarten.

1.2 The TOPA-Kindergarten test

The experimental group improved significantly more than the control on the TOPA-Kindergarten test. The largest difference was seen in the TOPA-Same results while both groups performed similarly on the TOPA-Different section. The reason for this may be twofold.

Firstly, it is quite possible that the test instructions influenced the results. The TOPA-Kindergarten test instructions have high linguistic demands. The first section involves comparing words with the same first sounds. In the second section, children are required to make a linguistic shift from "same" to "different", where they compare the first sounds of four words, to find the different one. The TOPA-Same section was easier for both groups, as was reflected by their higher scores (7.5 and 5.9 out of 10, respectively). In spite of training, however, the concept of "different" appeared more difficult for both groups to understand. This was reflected in the TOPA-Different section where the experimental and control groups achieved similarly low scores (4.85 and 3.33 out 10, respectively).

A second reason for the lack of a significant difference between the groups on the TOPA-Different section may be the test type. Yopp (1988) reports on two types of tests reflecting two different levels of difficulty. Factor one tests are easier and require one step to their completion. Tests such as the segmenting all sounds in a word (Yopp-Singer test of phoneme segmentation) or finding the first sound in a word would be considered factor one tasks. Factor two tasks are more difficult because they require a greater number of cognitive operations. They generally rely on well developed and automatic factor one skills. The TOPA-Different test could be considered as a factor two task with high linguistic demands. In order to cope with it, children need automatic access to first sounds, a factor one skill, and then need to have access to factor two skills so as to manage the complex auditory comparison task.

It is possible that the phonological awareness training was effective in improving the earlier developing, factor one phonological awareness skills, but that these skills were not sufficiently automatic to allow for complete success on factor two tasks. The average score of 14/22 achieved by the experimental group on the Yopp-Singer test of phoneme segmentation is high but may not reflect a sufficiently automatic skill which is necessary to cope with more complex factor two tasks such as the TOPA-Different test.

1.3 The test of auditory analysis skills (TAAS)

The TAAS is another factor two task. It requires automatic segmentation of three sounds in a word, followed by deletion, and then blending together the remaining sounds (e.g. Say meat, now say it again but don't say (m)). Children who have automatic segmentation and blending skills hardly notice each step in the process and answer automatically. Both experimental and control groups achieved similarly low scores on this test.

Highly automatic segmentation skills may be necessary before children can cope with complex factor two tests such as the TAAS. Neither the poor segmentation skills achieved by the control group (2/22), nor the relatively good segmentation skills achieved by the experimental group (14/22) were sufficiently automatic to achieve high scores on the TAAS.

A few individual cases can be used to demonstrate the need for automaticity of segmentation skills, before manipulation skills are possible. All four subjects in the experimental group who obtained the highest manipulation (TAAS) scores (6 or more out of 13), also obtained high Yopp-Singer segmentation scores (19 or more out of 22). The one subject in the control group who obtained a high manipulation score (subject 33), also obtained a high segmentation score (21/22). Conversely, the two subjects in the experimental group who obtained zero manipulation scores, also obtained low segmentation scores (6 or less out of 22). All five subjects in the control group who obtained poor manipulation scores (0/13), obtained 1 or 0/22 on the segmentation test. (See Appendix 14 for data on individual subjects)

Although the experimental group did not score significantly higher than the control group on the TOPA-Different and the TAAS tests, trends on both tests indicated that more experimental than control children had emerging factor two skills. At pre-treatment, a slightly higher number of control than experimental subjects could identify words starting with a different sound. After the training programme, the result was reversed, with slightly more of the experimental than control children being able to identify the word with a different first sound. Similarly, on the TAAS, more of the experimental than control children were able to delete a sound from a word.

Studies by Castle et al (1994) and Lie (1991) were similar to the present research in that they also trained first graders in phonological awareness skills and noted the effect that this had on phonological awareness and literacy skills. Both studies found that experimental groups receiving training in phonological awareness improved significantly more than control groups on this skill. Castle et al measured phonological awareness using Roper's (1984) test (reported briefly in the Castle et al study) which consists of 42 items, divided into six sub-tests. The subtests focused on segmentation, blending, deletion of initial phoneme, deletion of final phoneme, substitution of initial phoneme and substitution of final phoneme. As in the present study, the tests used by Castle et al reflected both factor one and factor phonological awareness skills. Unlike the present study, however, results of the sub-tests were not reported individually. It is therefore not possible to determine whether the simple phonological awareness measures such as the segmentation and blending tests, or the complex tasks such as the deletion and substitution tasks, contributed the most to the improved phonological awareness scores.

Lie (1991) measured phonological awareness using Skjelfjord's (1987) tests. The tests are not reported in detail in their study and therefore it is not possible to determine whether they are representative of factor one or factor two skills. The tests included initial phoneme analysis, sequential analysis and synthesis of phonemes. Their results indicated that the experimental groups outperformed the control on both analysis and synthesis tasks. Despite the difference in tests used and the way in which the phonological awareness results are reported, results of the present study are consistent with both the above studies and with the expanding body of phonological awareness training studies. (Ball and Blachman, 1991 ; Byrne and Fielding-Barnsley, 1991, 1993 & 1995 ; Lundberg, 1994 ; Wise, Olson and Ring, 1997 ; Lundberg, Frost and Peterson, 1988 and Torneus, 1984).

1.4 The reciprocal causation hypothesis

Phonological awareness and literacy skills have been found to share a relationship of reciprocal causation (Lundberg et al 1988). Instruction in reading and spelling improves scores in phonological awareness tasks and, conversely, phonological awareness training improves reading and spelling skills. The former relationship is supported by the fact that 57 % of the control children showed improved TOPA-Kindergarten scores from pre- to post-treatment, despite no direct training of these skills. These children received only grade one literacy instruction and vocabulary stimulation.

Without training , one control child (subject 33) achieved high scores on all three phonological awareness tests as well as extremely high scores on the reading and spelling measures. This result suggests that, for some children, normal literacy instruction is sufficient to boost phonological awareness skills. Given time, some children catch up, without intervention. In the Lundberg et al study (1988) the group differences on spelling skills diminished over three years, indicating that the control group eventually "caught up." One interpretation for this is that no explicit letter knowledge training was included in the training programme and that more robust effects on spelling might have been observed had it been included. Another explanation could be that those children who caught up were the ones who had fairly strong phonological awareness skills to begin with and that these children reduced the group differences.

In the present study, subjects were pre-selected based on a Screening TOPA-Test. Only those with the weakest skills were included. After a few weeks the experimental and control subjects were tested on the pre-treatment measures just prior to programme implementation. Most subjects' scores did not change significantly from pre-selection to pre-treatment. However, the control subject discussed earlier was amongst three subjects who showed a rapid improvement in phonological awareness skills over this period. The other two children who improved were from the experimental group.

The fact that they improved so rapidly suggests that training may not have been necessary for these children. Given that there are limited resources for disadvantaged children, therapists would want to avoid unnecessarily including the "quick learners" in a phonological awareness group. It may be that many children from disadvantaged communities do not achieve good scores on tests because they have had insufficient stimulation or are unfamiliar with a formal test situation, not because they lack the skill. After some teaching, they may progress very rapidly.

One way to overcome the problem of including children unnecessarily for training, would be to assess them in a dynamic rather than static way. In a dynamic assessment, children's learning potential, rather than their performance at any one point in time, is assessed (Olswang and Bain, 1991). If a child is unable to perform the task, a short period of training is implemented to determine their learning potential. This training period could be more cost effective than unnecessarily placing a child in a remediation programme.

The rapid improvement in literacy and phonological awareness skills seen in the one control subject was the exception rather than the rule. About 90% of the control subjects achieved very low scores on the Yopp-Singer test of phoneme segmentation and about 47% showed no improvement on the TOPA test, from pre- to post-treatment (see Appendix 14). The part of the reciprocal causation hypothesis which states that literacy instruction improves phonological awareness skills did not apply to many children in the present research, at least not in the first six months of formal schooling. The positive effects of training on the literacy scores of the experimental subjects strongly support the second part of the reciprocal causation hypothesis, which states that phonological awareness training improves reading and spelling skills.

1.5 Adjusted, transformed phonological awareness scores

Due to inadequately matched groups, statistical corrections were required which resulted in eliminating the significant difference between the groups on the TOPA-Same test. Despite the corrections, the experimental group's average score was still slightly higher than that of the control group. The statistical corrections made little difference to the robust results of the Yopp-Singer Test of phoneme segmentation, which remained in favour of the experimental group. The correction of scores for the uncontrolled variables did not alter the interpretation that the training was more effective in improving factor one than factor two phonological awareness skills.

2. Letter knowledge test

Even after statistical corrections, the experimental subjects' post-treatment letter knowledge scores were significantly higher than those of the control subjects. A possible interpretation could be that the teachers at the experimental school had taught more letters than the teacher at the control school. This was not the case, however, as teachers at both schools had taught all the letter sounds by the time of post-treatment. The significantly better scores of the experimental group are attributed to the fact that the majority of phonological awareness tasks were reinforced with explicit letter knowledge training. This is consistent with the literature (Ball and Blachman, 1991). The low pre-treatment letter knowledge scores in the experimental group were not predictive of low post-treatment letter knowledge scores. Five subjects, who had amongst the lowest pre-treatment letter knowledge scores, obtained the highest letter knowledge scores at post-treatment. In the control group it was those children who had obtained high pre-treatment scores who also obtained high post-treatment scores. The phonological awareness and letter knowledge programme was felt to be highly effective in stimulating both of these skills

3. Literacy measures

Phonological awareness and letter knowledge are considered to be the two crucial building blocks in the self-teaching model of reading and spelling acquisition (Jorm and Share, 1983 in Share and Stanovich, 1995). Ball and Blachman (1991) confirmed this when they found that improvement in letter knowledge and phonological awareness are both necessary in order to develop literacy skills, especially spelling. In the present study, the experimental group's far superior reading and spelling skills are felt to be directly related to their improved phonological awareness and letter knowledge. The higher literacy scores of the experimental group compared with the control group provide support for the self-teaching model of literacy acquisition, as well as the reciprocal causation hypothesis, which states that phonological awareness training results in improved reading and spelling skills.

Before drawing conclusions about the effectiveness of phonological awareness programme on literacy skills, however, one should ask whether the significant effects on reading and spelling could have been attributed to any factor other than the training. The use of non-standardised tests needs to be closely scrutinised as they could bring the validity of results into question. Non-standardised tests were chosen over standardised measures because research in the area of phonological awareness often uses similar non-standardised measures (Ball and Blachman, 1991 and Byrne and Fielding- Barnsley, 1995) and normative information on standardised tests for most communities in South Africa is inappropriate. Also, items in standardised tests seldom follow a theoretical model of normal literacy acquisition. For example, the Peabody Individual Achievement (PIAT) Reading Recognition sub-test (Frederick and Markwardt, 1989) first assesses both phonological awareness and letter knowledge together (e.g. by showing four letters and a picture, children are asked which letter the picture starts with). The next fourteen items are the real words: "you", "and", "can't", "play", "one", "runs", "said", "went", "outside", "fishing", "town", "smile", "wagon", "houses", "meaning". Little can be said of a grade one child's reading skills if she or he obtains a score of zero when reading these words.

A stage model of literacy acquisition would avoid irregular words or words containing suffixes such as -ing or -s when testing mid grade one (early alphabetic stage) children (Snowling, 1992). Only two of the first fourteen items in the PIAT reading recognition sub-test would be "fair" to an early alphabetic reader (ie: "went" & "and" because they are regular, allowing for a one-to-one translation from print to sound). A self-teaching model would, at very least, credit attempts which showed evidence of partial decoding (e.g. "sad" for "said"). Thus standardised measures were avoided because they were felt to be too difficult, have inappropriate normative data and because they did not suit the theoretical models of literacy acquisition discussed in the present research. Results of reliability measures indicated that the non-standardised measures were reliable measures of reading and spelling.

Improvements in literacy skills following phonological awareness training have been found by many other researchers (Lie, 1995 ; Hatcher et al, 1994 ; Torneus, 1984 ; Byrne and Fielding Barnsley, 1995 ; Bradley and Bryant, 1983 ; Ball and Blachman, 1991 and Lundberg et al, 1988), although not all studies have found equally strong effects on reading and spelling skills. Byrne and Fielding-Barnsley (1995) trained children's phonological awareness skills and then tested their ability to read and spell regular, irregular and pseudowords. They found that the children who underwent training fared significantly better than the control children on pseudoword reading, they performed slightly better than the control children on real word reading but were no better on irregular word reading or any of the spelling measures in grade one. In the present study, the children who underwent the phonological awareness and letter knowledge programme were able to read and spell words, regardless of whether they were real or pseudowords, far better than the control children.

A lack of significant results for irregular word reading in Byrne and Fielding-Barnsley's study can be explained when placed in context of either the stage model (Snowling, 1992) or the self- teaching model (Jorm and Share, 1983 in Share and Stanovich, 1995) of literacy acquisition. Children in grade one have had insufficient exposure to print to be able to cope with many irregular words.

When grade one children are asked to read isolated irregular words, they may use the following strategies: they may instantly recognise a few of the more high frequency irregular words. These would be the words which have been stored through repeated exposure, as logographic units or fully expanded orthographic units, in the orthographic lexicon. If the child had well developed phonological awareness and letter knowledge skills, an opportunity for partial decoding would arise for the remaining irregular words. Given that irregular words are regular consonantally, a child may decode the irregular word "said" as "sid" or "sad." A single word reading test provides no context in which to make a "reasonable guess," and so fully expand the partially decoded word. Grade one children, by virtue of their developmental stage in the process of reading acquisition are unlikely to cope well with irregular words, even after training in letter knowledge and phonological awareness. Irregular words are more appropriately used as tests items in grade two. By this stage, children have experienced more exposure to print. This will have allowed them to expand those partial orthographic representations which were developed through strong phonological awareness and letter knowledge skills.

A stronger training effect on pseudoword over regular word reading was found by both Byrne and Fielding-Barnsley (1995) and Castle et al (1994). This would be consistent with the self-teaching model of literacy acquisition. If children undergo phonological awareness training, they are likely to be very familiar with the idea of segmenting words into sounds whether they be real or pseudowords. Children who are less phonologically aware may need to rely more on a logographic style of reading whereby they instantly recognise the word as one which they have seen before or one they "know." Pseudowords are not familiar and therefore will not be recognised.

The marginal difference on real word reading for the groups in Byrne and Fielding - Barnsley's (1995) study may indicate that the control children were receiving thorough teaching in word recognition. They had therefore developed a large store of "sight words" despite being less phonologically aware than the experimental children. The fact that they could not decode pseudowords as efficiently as the experimental group indicates that they were less equipped to deal with novel words. This has implications for self-teaching.

Children who have strategies to decode novel words are likely to experience more success with literacy, become independent readers sooner, become freed from the mechanics of decoding sooner and so concentrate more on text comprehension.

In the present research, the idea that phonologically aware children are better equipped for self-teaching, was borne out by the way in which subjects approached the task of pseudoword reading and spelling. Most of the experimental children immediately sounded out each letter of a pseudoword, and then attempted to blend it to determine the pronunciation. Most control subjects substituted the pseudoword for a real word which they had learned as a "sight word" in class. For example, when asked to read the pseudoword "mog" a child in the control group produced the word "the" which had been recently taught in class. Another common strategy amongst the control group children was to produce a familiar word starting with the same sound as the pseudoword. For example when asked to read the pseudoword "besk" a child read "bow" and for "sen" he produced the real word "say." Some children simply insisted that they had not yet learned the word in class and made no attempt to read the pseudoword. None of these were effective self-teaching strategies.

The way in which many of the control group children approached the pseudoword spelling task also reflected their poor self-teaching skills. Although the children correctly repeated the pseudoword which they were required to spell, many failed to segment it into each individual phoneme and write the corresponding letters. They either wrote their name or another familiar word in response to every pseudoword. A few children in the control group were able to segment the pseudowords and managed to represent some of the sounds in the words with the appropriate alphabet letters (e.g."faf" for "praf"). In contrast, most of the experimental children actively sounded out the words while they attempted to write them. They had to be constantly reminded to talk quietly to themselves so as not to disrupt other children.

The apparent effectiveness of the phonological awareness and letter knowledge training in improving both real and pseudoword reading and spelling measures could be attributed to a number of factors. Firstly, it may be related to the choice of phonological awareness skills taught.

Ninety-five percent of the programme was aimed at getting children to a point where they could segment and blend three sounds in words. Most of the experimental children coped moderately well with this skill by the end of the programme. Out of all the phonological awareness skills assessed, segmentation of three sounds was most predictive of literacy performance. Secondly, the positive results may have been related to the fact that segmentation skills were taught using both a positional and sequential approach. (i.e. first sound identification, last sound identification, segmentation of two sounds in order and finally segmentation of all three sounds in order). Lie (1991) found that phonological awareness training which focused on sequential identification of phonemes was slightly more effective in the initial stages of literacy acquisition, than training which focused on identifying first, then last and then middle sounds in the words (positional training).

Thirdly, the fact that the experimental group outperformed the control group on spelling, is felt to be related to the explicit letter knowledge training included in the programme. Researchers have found that letter knowledge is highly predictive of literacy performance (Adams, 1990 and Lundberg, 1994). This was confirmed in the present study by the finding that letter knowledge was the next strongest predictor of literacy performance, after phoneme segmentation. The programme recognised the importance of letter knowledge by teaching the children both how to recognise and write letters through a multi-sensory approach. Children were taught how the sound was made in the mouth, which has been found to be helpful for children with weak phonological awareness skills (Lindamood, Bell and Lindamood, 1996). They were then taught how to write the letter sounds using large arm movements, and novel tasks such as writing the letter in icing sugar, and each letter was associated with a story. Multi-sensory teaching has been found to be more effective for children who struggle with literacy (Lindamood and Lindamood, 1969 and Augur and Briggs 1993).

Neither the experimental nor the control group found it more difficult to read and spell pseudowords than real words. This is not consistent with the findings of Rack et al (1992), that pseudowords are generally more difficult than real words. Rack and his colleagues found that the difference in performance on real and pseudowords is reduced if the pseudowords are visually similar to real words.

The visually similar pseudowords can be read by analogy to real words, thus reducing the demands on phonological processing. The pseudowords in the present study were created by changing one or two letters in real words (e.g. sit -sut, flop - frop, it - et), and were therefore visually similar to real words. It is unlikely, however, that the children in the present study had received sufficient exposure to print to systematically read pseudowords by analogy to real words. In order to read words using this strategy a child must have a large orthographic lexicon of words against which to compare the pseudowords (Snowling, 1992). This develops later in the process of literacy acquisition. A more likely explanation is that the children had not yet developed large and expanded orthographic lexicons. Most real and pseudowords were therefore treated as novel words thus reducing the difference between real and pseudoword scores. In order to effectively decode novel words, phonological processing is required. The experimental children had more advanced phonological awareness skills than the control children and were therefore better at decoding the novel words.

4. Relationship of phonological awareness and letter knowledge results to each other and to literacy performance

Although the training programme was found to be effective in improving most phonological awareness skills, not all phonological awareness skills improved significantly. Despite a lack of improvement on the TAAS and TOPA-Different tests (factor two tasks), the experimental group still achieved better literacy scores than the control group. How useful then are factor two tasks in predicting literacy skills, and is it essential to train these more complex tasks in a phonological awareness programme? The first question was partially answered by results of the multiple regression analysis. The TAAS and TOPA tests explained 42% and 43%, respectively, of the variance in the total literacy score. Their predictive strength was far less than the Yopp-Singer test of phoneme segmentation and letter knowledge tests which explained 75.7 % and 74.8 % of the variance in the total literacy score. Letter knowledge and a simple segmentation task such as the Yopp-Singer test appear to be quite adequate in predicting literacy skills, within the first six months of grade one. This relationship may not hold, however, when children are further along in the process of literacy acquisition.

Fawcett and Nicolson (1994) have shown that as children get older, phonological awareness tasks need to become more complex in order to detect phonological processing difficulties which contribute to poor literacy skills. If training programmes are to have long term beneficial effects on literacy skills, they need to devote more time to factor two tasks such as manipulating phonemes in words. As success on factor two tasks depends on automatic factor one skills, such as segmenting sounds in words, trainers must ensure that simple phonological awareness becomes automatic, before devoting time to more complex tasks.

Results of the present study are felt to validate phonological awareness as a useful construct because all three phonological awareness tests correlated with each other and with the literacy scores (Yopp, 1988). Results also support the self-teaching model of literacy acquisition as a useful model. The model states that phonological awareness and letter knowledge are the two crucial building blocks for literacy acquisition and self-teaching is not possible without both of these skills. The three control children who received relatively good scores (a raw score of 9 or more out of 62 items) on the spelling and reading tests combined, all showed average to good scores on at least one of the phonological awareness tests and good letter knowledge skills. The same pattern was present in the experimental children. Those who scored well on literacy tasks, scored well on at least one of the phonological awareness tests and on the letter knowledge test.

Although the phonological awareness and letter knowledge training was effective in improving most of the experimental children's reading and spelling skills, three of the twenty experimental children continued to show extremely weak literacy skills, despite training. Two of these children showed some improvement but continued to have below average phonological awareness and letter knowledge skills. Both of these children had extremely poor concentration skills and individual training might have been more beneficial for them. The third child had weak literacy skills, but adequate phonological awareness skills. This suggests that although phonological awareness skills are essential for the development of literacy skills, other skills are also necessary. The child may have had poor visual perceptual skills which were affecting his reading and spelling. All three of these children were felt to require in-depth assessment and further individual management.

A summary of the effectiveness of the programme indicates that the experimental group scored significantly better than the control group on the Yopp-Singer test of phoneme segmentation, a simple factor one task. They also performed better than the control group on the TOPA-Same test, a more complex factor two task. Although not statistically significant, slightly more experimental than control subjects achieved higher scores on the TOPA-Different and TAAS tests, both more complex factor two tasks. These results indicate that the training was highly effective in improving factor one skills, which was the focus of the bulk of the training programme. Only a few sessions were devoted to factor two tasks such as deleting a sound from a word. To observe significant training effects on factor two tasks, it may be necessary to spend more time on increasing the automaticity of simple tasks such as segmenting the sounds in words before training factor two tasks such as deleting a sound from a word. The overall improvement in phonological awareness, especially in factor one skills and letter knowledge skills was felt to be responsible for the significantly stronger literacy skills in the experimental than the control group.

5. Limitations of the present research

In field research such as this, many practical issues set limits to the control of the study. Ideally, subjects with poor phonological awareness should be randomly assigned either to the experimental group or control group. Groups could have been matched more closely on variables which had the potential to influence the results. These included letter knowledge, pre-school experience and intensity of training. Because of the limited subject numbers, it was not possible to match the groups on all these variables. By obtaining a larger sample, the groups could have been matched more closely.

When undertaking research within a community that is not one's own, a relationship based on trust needs to be established first. Compton and Ashwin (1992) indicate acceptance, reliability and boundary keeping to be crucial elements in developing trust. There should be a match between the needs of the community and the researcher's own agenda. Schools may be resistant to research, because it is seen as having no value or relevance to them. Developing this trusting relationship between the schools involved in the project and the researcher took a long time to be established. Teachers needed to be convinced of the usefulness of the study for all children, not only the ones chosen to participate in the project. This was done through training. Unfortunately the scope of the study and the resources available allowed the sample to be drawn from only two schools. Due to these difficulties an attempt was made to control some of these variables through statistical means.

Past research has used school readiness as a means to match groups on intellectual ability (Fisch, 1995). It is best to use standardised school readiness tests with normative data relevant for the community which they serve. In the present research, however, a non-standardised school readiness test was used for practical purposes. It had been widely used by the teachers and school psychologists because of its ease of administration and high correlations with a more lengthy published test. The use of such a test may have led to poorly matched groups in the present study. Future research should control for this variable more carefully. There is great need for locally developed standardised tests in South Africa for both clinical and research purposes. The use of the non-standardised literacy tests is another limitation to the study.

6. Implications of the present research and future research

Lundberg (1994) and Bradley and Bryant (1983) found that literacy difficulties can be predicted and prevented through phonological awareness assessment and training. An attempt was made in the present research to detect those children who were "at risk" for developing literacy difficulties, before they had begun to experience failure in this area.

This was done by selecting those children who had weak phonological awareness skills and then training these skills. The training did improve both phonological awareness and literacy skills in almost all of the children. Only through long term follow-up, can we draw conclusions about the percentage of children who have been "rescued" from literacy failure. Castle et al (1994) presented informal data which indicated that following training , twenty-three percent of their experimental children required reading recovery classes, whereas forty-three percent needed it in the control group.

Grade one children from disadvantaged communities have been found to have weaker phonological awareness skills than children from more advantaged communities (Bowey, 1995 and Worrall and Nadler-Nir, 1994). Through teacher training programmes, especially at the pre-school level, teachers could equip their students better for the demands of formal literacy instruction. Results of the present research have many implications for teacher training, both at the pre-school and grade one levels and training of remedial teachers.

In order to validate the present research further, it should be replicated, perhaps by a remedial teacher within the same community. The children who were involved should be followed up for as long as possible to determine the long-term effects of the training. To make training more efficient and effective, research into the length, intensity and timing of phonological awareness training is needed to establish the optimal balance between these three factors. Research into which of the phonological awareness components are most effective in improving literacy skills is needed. Clinical experience suggests that certain children have specific blending difficulties, despite intact segmentation skills. Research into whether there are subgroups of children with different phonological awareness difficulties may be useful so as to devise effective training programmes.

Phonological awareness is not the only skill which correlates positively with achievement in literacy. Other measures of phonological processing such as rapid naming, repetition of real and non-words and short term auditory sequential memory tasks have also been found to correlate highly with difficulties in breaking the code to literacy (Bowers and Swanson, 1991 ; Fawcett and Nicolson, 1994 ; Gathercole, 1995, Griffiths, 1991 and Hulme and Roodenrys, 1994). Visual perceptual skills, attention and sequential processing are other skills that are necessary for the process of literacy acquisition (Das, Mishra and Kirby, 1994). Future research is necessary to determine whether training in any of these other skills is as effective as phonological awareness and letter knowledge training, in improving literacy skills.

The present study has shown that phonological awareness and letter knowledge training can help disadvantaged children to develop better self-teaching skills for the development of reading and spelling. It would also be useful to determine whether the programme is as effective with other populations such as the hearing impaired, severely dyslexic or mentally handicapped children.

7. Conclusions

Following an identified need for a phonological awareness training programme within a disadvantaged community, a 29-session programme was implemented. It included both phonological awareness and explicit letter knowledge training which was carried out in a group of 20 children, by a trainer and an assistant. The programme was highly effective in improving the simpler phonological awareness skills such as segmenting three phonemes in a word and letter knowledge. The children who received the training also achieved significantly higher reading and spelling scores than the control children. These findings confirm that phonological awareness is a real, trainable construct which is intimately linked to the process of becoming literate. Training is best carried out in conjunction with explicit letter knowledge stimulation because the two make independent contributions to emerging literacy skills (Byrne and Fielding-Barnsley, 1995).

The self-teaching model of literacy acquisition (Jorm and Share, 1983, in Share Stanovich, 1995) was used in an attempt to demonstrate the links between phonological awareness and literacy acquisition. Results of the present study validate it as a useful model.

The long-term benefits of phonological awareness and letter knowledge training have been described as an escalating chain of events that are all linked to phonological awareness skills. The first link in the chain is a child who is phonologically aware. This awareness of phonemes in spoken words facilitates the development of letter-sound correspondences, which in turn allows a child to decode novel words. This stimulates general and specific orthographic knowledge of words, making them easier and quicker to read. Increased success in reading words encourages a child to read more. More reading implies greater exposure to print, improved vocabulary and syntactic knowledge. (Byrne and Fielding-Barnsley, 1995). Conversely, the self- teaching model can be used to describe a "causal chain of escalating negative side effects" which result from poorly developed phonological awareness skills (Ball and Blachman, 1991).

Children who arrive in grade one with poorly developed phonological awareness skills and who do not receive training are more likely to need some type of remedial intervention later on (Castle et al, 1994). Unfortunately resources at less advantaged schools are limited. This implies that not all children who need intervention will receive it. Cost-effective, group phonological awareness training has potential for saving the country and education system time and money. By providing children with phonological awareness training within the first six months of grade one, we are saving many children from exposure to failure and are offering them a better prognosis for developing independent literacy skills.

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Appendix 1

Fig. 14

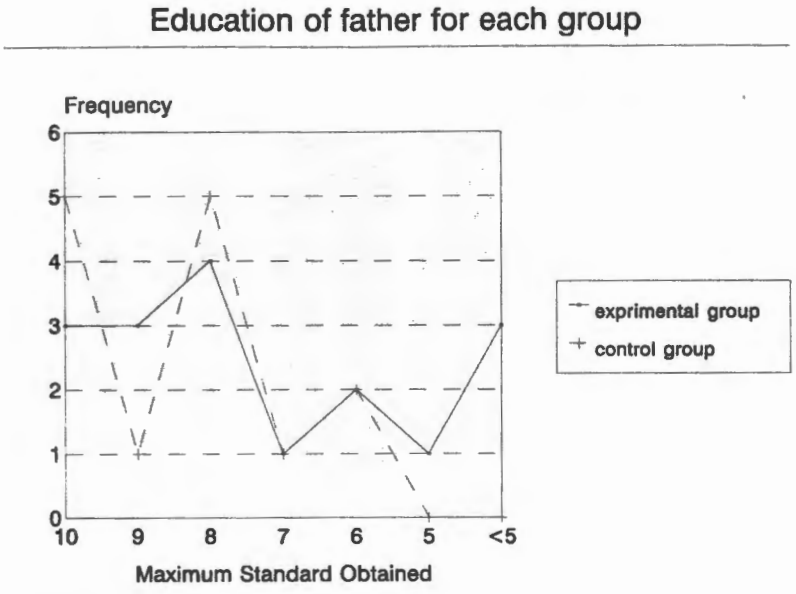
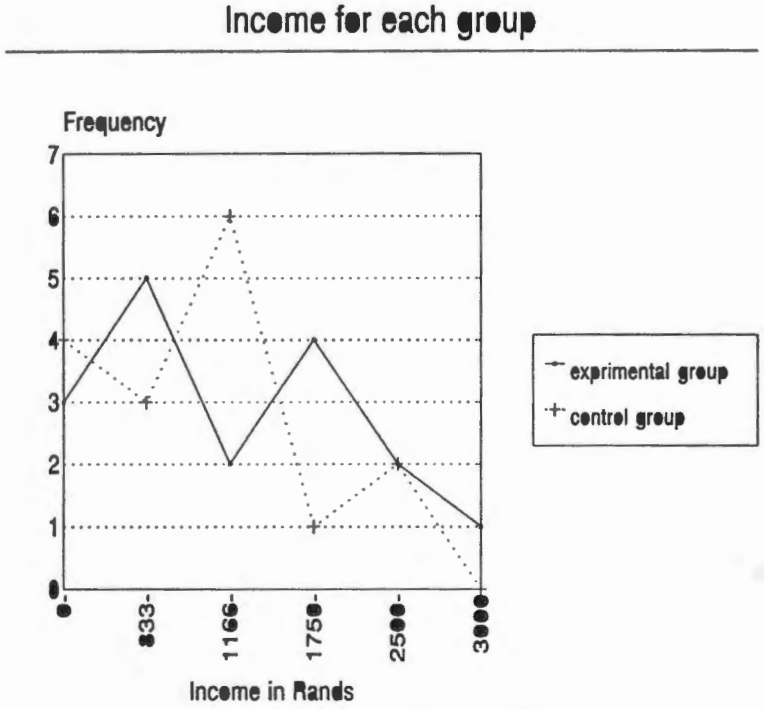


Fig. 15



Appendix 2

Parent Questionnaire

English Questionnaire (turn over for the Afrikaans version): Please fill in immediately and replace in your child's homework book. Thank you for your co-operation.

Child's name:_____
Child's date of birth: _____
Child's age: _____
Child's gender (male or female):_____
Medical History: Please indicate if any:
*** Complications during pregnancy or birth**

_____
*** Physical abnormalities:**

_____
*** Hearing problems :**

_____
Schooling History:
Did your child attend any pre-school or crèche ?(if yes, please indicate which one)

_____
General child information:
Home language: _____
Language used in class at school: _____
Is your child bilingual ?_____
If yes, what language does your child prefer using/ use more often ? _____
Do you read to your child? _____
Do you borrow children's books from the library ?_____
Do you tell stories to your child _____
Does your child colour in at home ?_____
Does your child have knowledge of sound games (I spy with my little eye something beginning with)._____.
Does your child have knowledge of nursery rhymes (e.g. Humpty Dumpty, Jack and Jill etc)_____
Can your child write his / her own name ? _____
Parent Information:
Father's occupation: _____
Father's level of education obtained: (e.g. Standard 6, Matric, College, University)_____
Mother's occupation _____
Mother's level of education obtained: (e.g. Standard 6, Matric, College, University)
Does anyone in your family have learning or reading difficulties (if yes, please specify)

_____
Who takes care of your sub A child while you work ? (e.g. grandmother, day care)

_____
Please circle father's monthly income bracket: (if you are a single mother or guardian please circle your monthly income bracket)
a: R0 - R833 b: R833.34 - R1166.67 c: R1166,68 - R1750.00
d: R1750.01 - R2500.00 e: R2500.01 - R3000.00 f: R3000.01 - R4000.00
g: R4000.01 +

Appendix 3

TOPA-Kindergarten screening test record form, TOPA-Kindergarten record form and test booklet

TOPA-Kindergarten Screening Test record form

Initial Sound-Same

Score	Stimulus	Response choices		
____ 1.	leg	lamp	hand	fish
____ 2.	fire	hat	star	foot
____ 3.	cake	key	doll	bell
____ 4.	girl	bird	goat	cat
____ 5.	duck	arm	dog	tire

Initial Sound-Different

Score	Stimulus words			
____ 1.	fork	fan	foot	shirt
_____2.	pan	toe	pig	pin
_____3.	mud	mouth	moon	nose
_____4.	carrot	chair	car	cake
_____5.	book	dress	dog	duck

_____ Total Raw Score

Full TOPA-Kindergarten record form

Initial Sound-Same

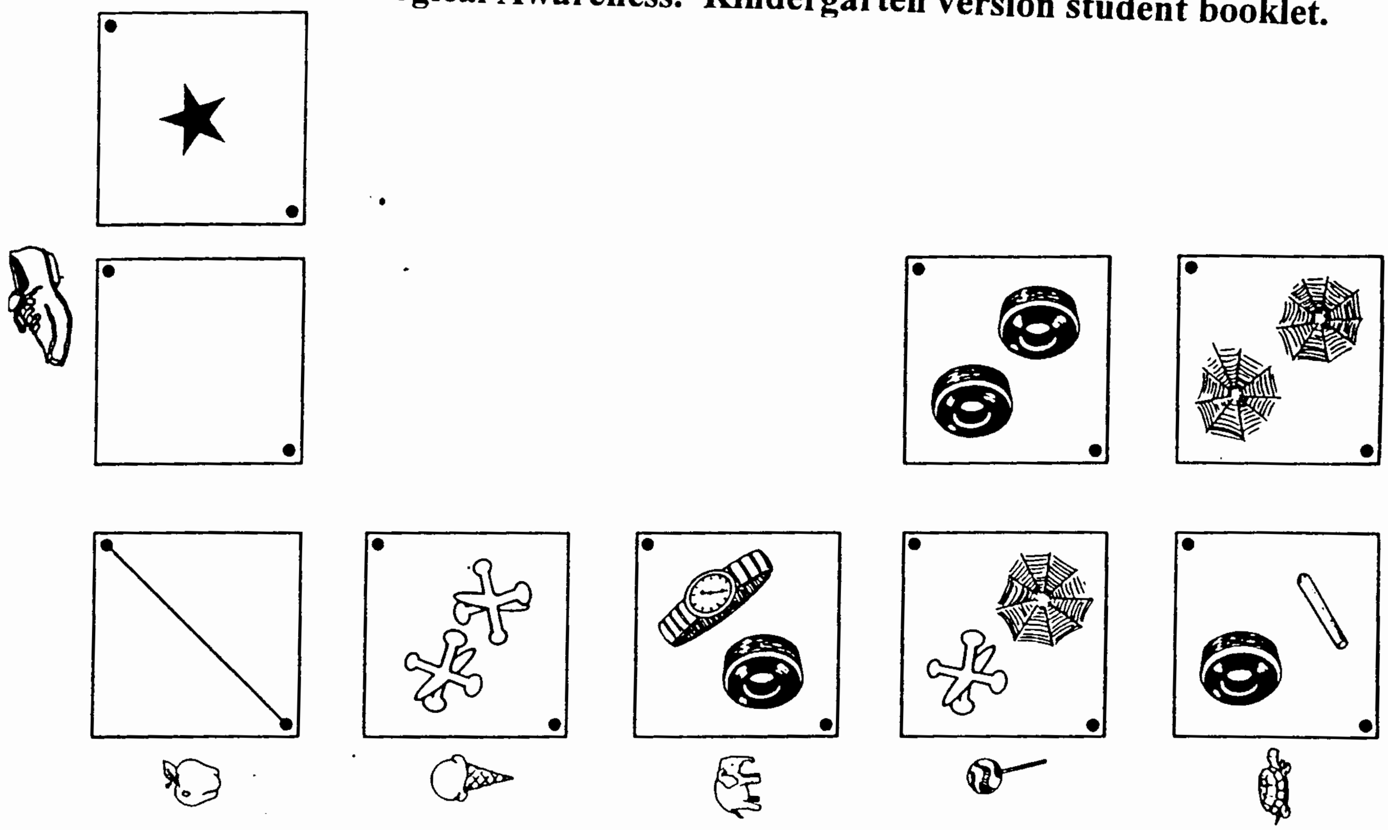
Score	Stimulus	Response choices		
____ 1.	leg	lamp	hand	fish
____ 2.	fire	hat	star	foot
____ 3.	tool	drum	tie	cup
____ 4.	sick	nail	two	sew
____ 5.	cake	key	doll	bell
____ 6.	girl	bird	goat	cat
____ 7.	mouth	cup	bed	mud
____ 8.	duck	arm	dog	tire
____ 9.	nest	leaf	nine	mouse
____ 10.	shell	shine	hut	face

Initial Sound-Different

Score	Stimulus words			
____ 1.	fork	fan	foot	shirt
____ 2.	heart	hand	jail	house
____ 3.	dog	deer	desk	bat
____ 4.	moon	nose	nest	nail
____ 5.	peek	take	pan	pet
____ 6.	sock	jacket	jail	jar
____ 7.	fly	goat	frog	four
____ 8.	mud	mouth	moon	nose
____ 9.	hook	peek	hut	house
____ 10.	tie	top	hook	shoe

_____ Total Raw Score

Test of Phonological Awareness. Kindergarten version student booklet.



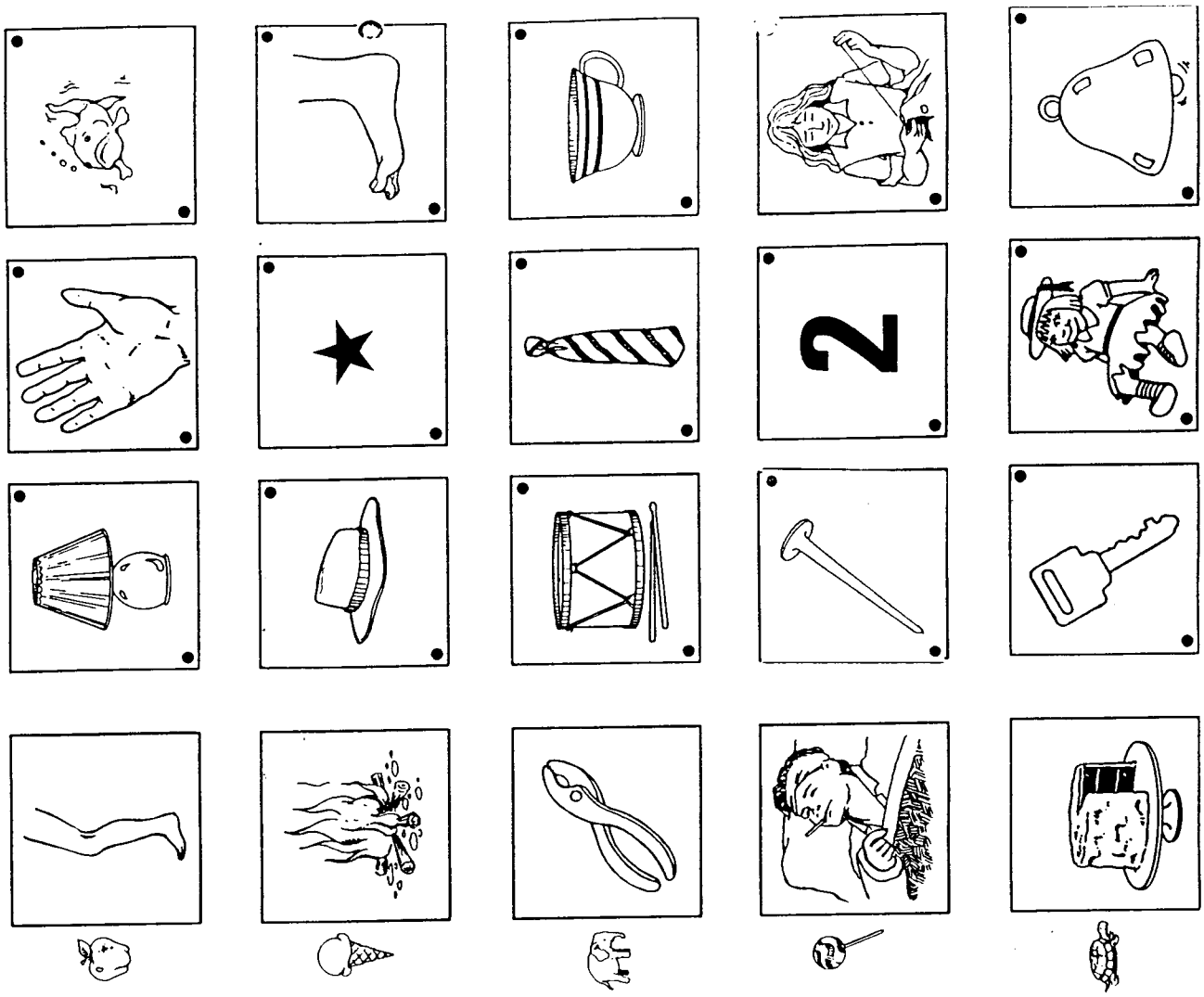
TOPA

Test of Phonological Awareness

Kindergarten Version

STUDENT BOOKLET

8700 Shoal Creek Boulevard
Austin, TX 78757
512/451-3246
Order Number 6762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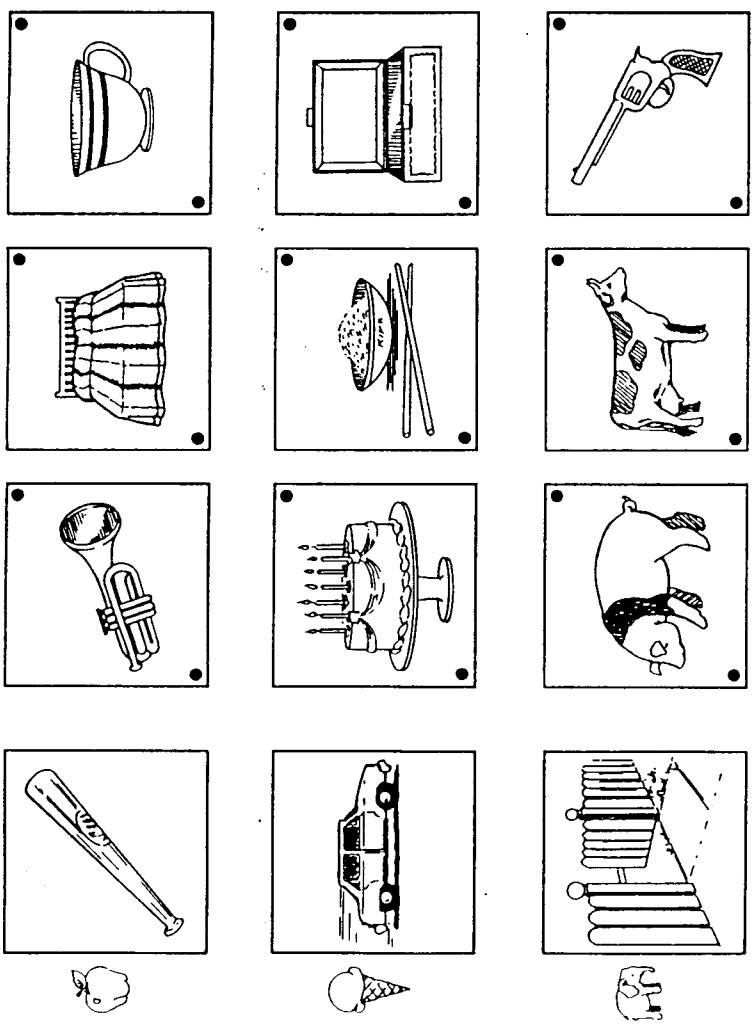

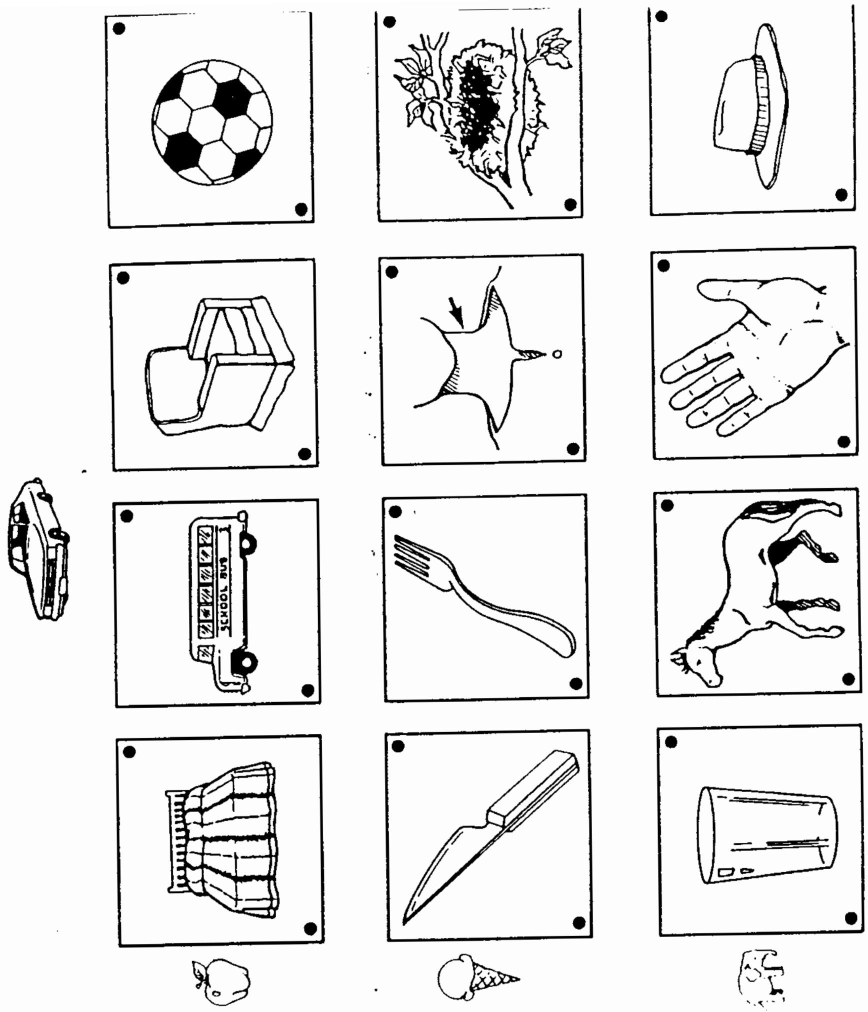

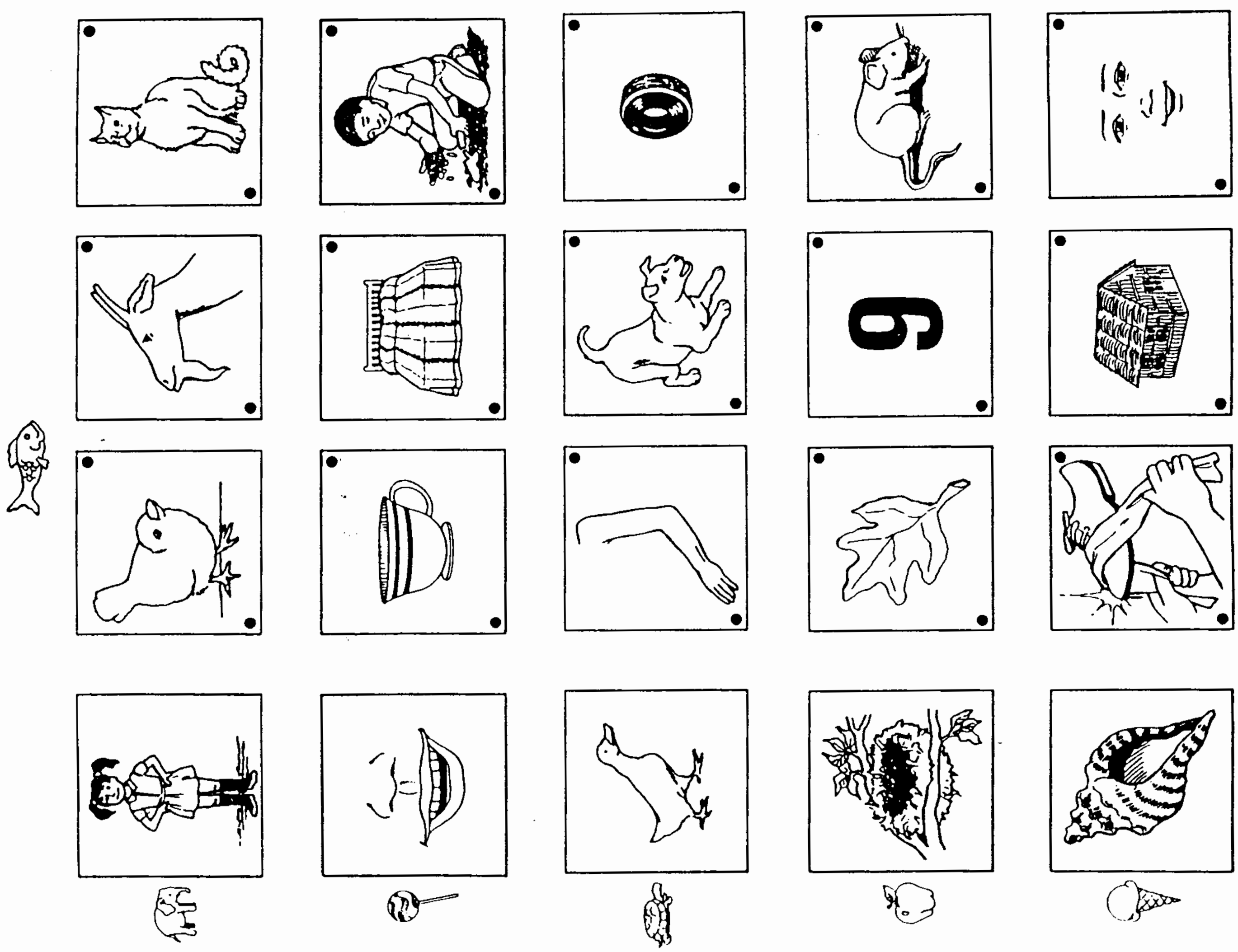

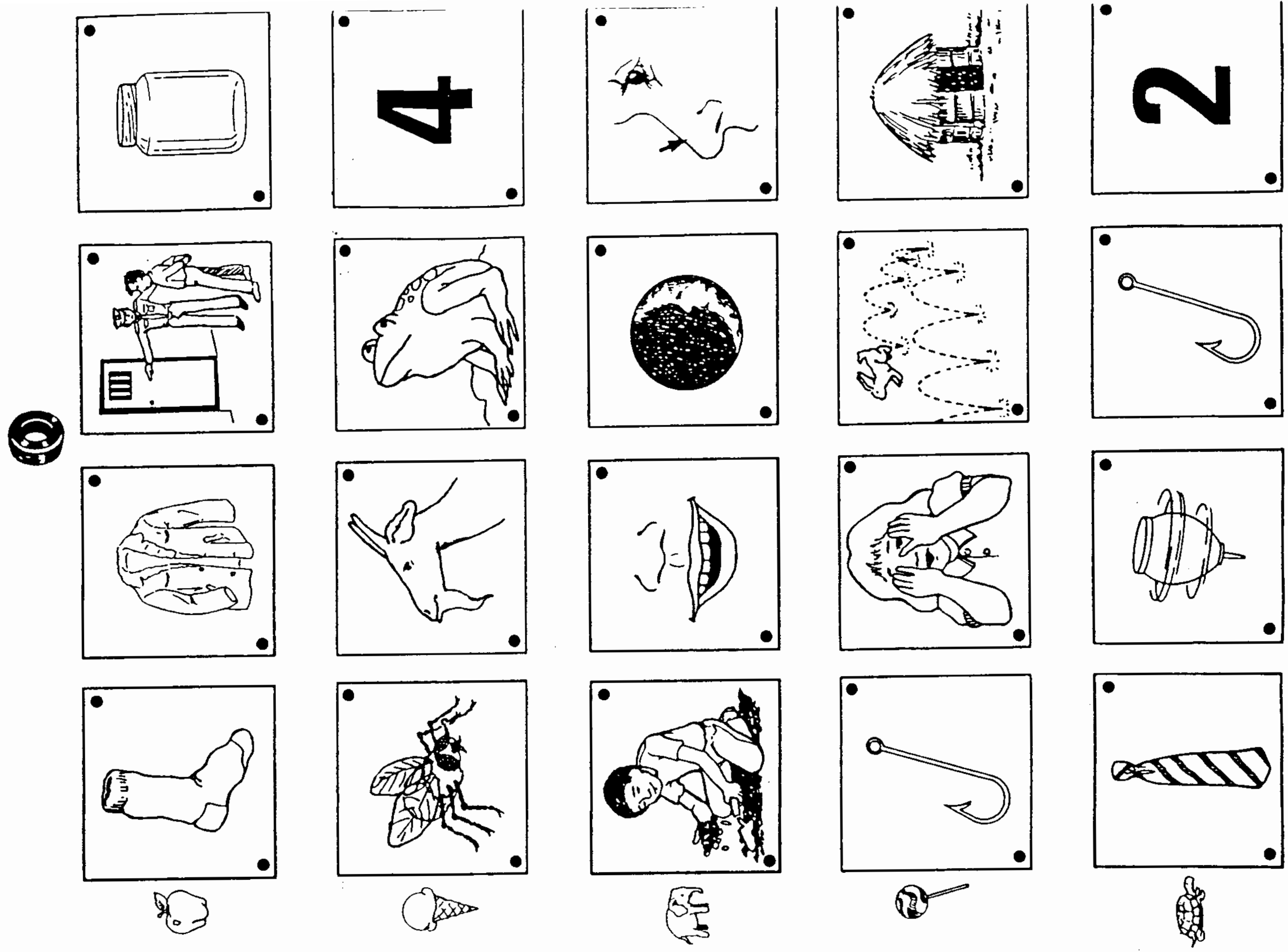
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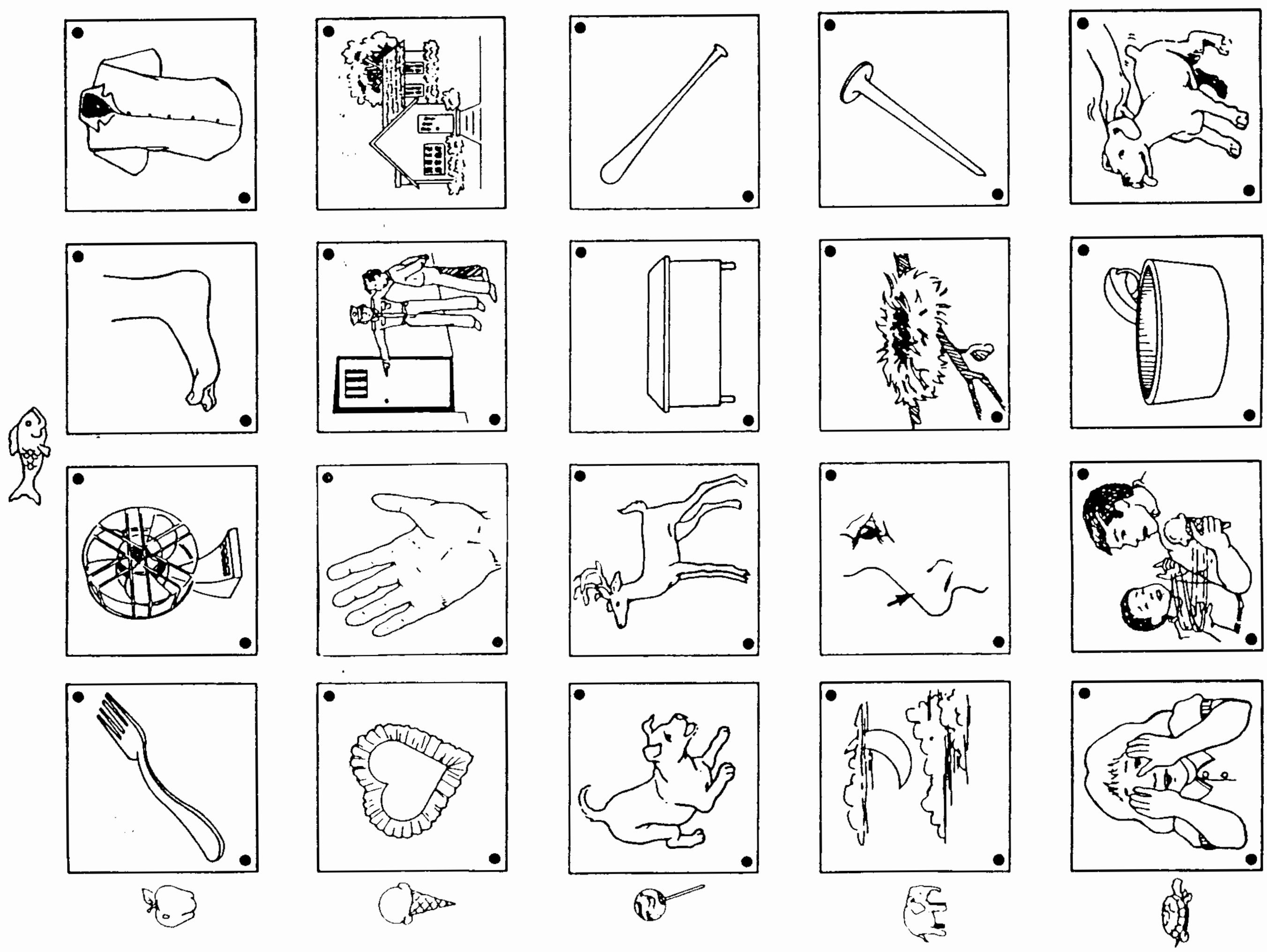


Appendix 4

TAAS

Test of Auditory Analysis Skills (Jerome Rosner, 1975)

Score 1 for each correct response. Record all responses. ceiling: 3 successive errors

	A&B	demo items		
A.	Say	COWBOY	Now say it again, but don't say BOY	
B.	Say	STEAMBOAT	Now say it again, but don't say STEAM	
1.	Say	SUNSHINE	Now say it again, but don't say SHINE	
2.	Say	PICNIC	Now say it again, but don't say PIC	
3.	Say	CUCUMBER	Now say it again, but don't say CU (q)	
4.	Say	COAT	Now say it again, but don't say /k/	
5.	Say	MEAT	Now say it again, but don't say /m/	
6.	Say	TAKE	Now say it again, but don't say /t/	
7.	Say	GAME	Now say it again, but don't say /m/	
8.	Say	WROTE	Now say it again, but don't say /t/	
9.	Say	PLEASE	Now say it again, but don't say /z/	
10.	Say	CLAP	Now say it again, but don't say /k/	
11.	Say	PLAY	Now say it again, but don't say /p/	
12.	Say	STALE	Now say it again, but don't say /t/	
13.	Say	SMACK	Now say it again, but don't say /m/	

SCORE /13

TAAS SCORES: grade levels (circle placement)

1 - k	4 - 1 (sub A)	10 - 2 (sub B)	12 - 3 (Std 1)
2 - k	5 - 1	11 - 2	13 - 3
3 - k	6 - 1		
	7 - 1		
	8 - 1		
	9 - 1		

Appendix 5

Yopp-Singer test of phoneme segmentation

DEMONSTRATION ITEMS: We-re going to play a word game.
I'm going to say a word and I want you to break the word apart.
You are going to tell me each sound in the word, in order.
For example if I say MAN, you should say /m/- /a/- /n/.
(Administrator be sure to say the sounds, not the letters in the word).

TEST ITEMS:
Lets try a few together (assist the child in segmenting their items if necessary).
Record child's attempt, even if incorrect.
(There are no pictures for this test)

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

SCORE
/22

Appendix 6

The non-standardised reading tests

REAL WORD READING TEST. NAME: _____

Raw Score: /16

WORD	RESPONSE (transcribe child's response in full)	Word Type	Raw Score	Raw subtot.
1. it		it		**VC**
2. man		at		**/4**
3. at		up		
4. camel		on		
5. on		man		**CVC**
6. best		zip		**/5**
7. wind		log		
8. up		sun		
9. topic		cut		
10. stop		pram		**CCVC**
11. log		stop		**/5**
12. sun		wind		
13. cut		best		
14. lamp		lamp		
15. pram		camel		**2 syll**
16. zip		topic		**/2**

PSEUDOWORD READING TEST

NAME:_____

WORD	RESPONSE	Word Type	Raw Score	Raw subtot.
1. im		im		**VC**
2. jit		ot		**/4**
3. plag		ag		
4. ipdoc		ep		
5. ot		jit		**CVC**
6. ret		ret		**/5**
7. besk		fup		
8. mog		sen		
9. ep		mog		
10. fup		plag		**CCVC**
11. gind		besk		**/5**
12. sifton		gind		
13. sen		vump		
14. vump		crot		
15. ag		ipdoc		**2 syll**
16. crot		sifton		**/2**

Appendix 7
The non-standardised spelling tests and the developmental scoring procedure

Sentences for the real word spelling test:

1. IF. IF am good I will get a sweet. IF.
2. HIT. Don't hit the boy. HIT.
3. STEP. Don't trip over the step. STEP.
4. AN. Mum gave me an orange to eat. AN.
5. HAND. Hold my hand. HAND.
6. LET. Let me play. LET.
7. FLAG. I can draw the South African flag. FLAG.
8. US. Watch us jump. US
9. TIN. Buy a tin of beans. TIN.
10. TEST. I must try hard in this test. TEST.
11. DOG. My dog barks. DOG.
12. LUMP. I have a lump on my head. LUMP.
13. JAM. I eat bread and jam. JAM.
14. IN. Come in. IN.
15. AM. I am happy. AM.

REAL WORD SPELLING TEST. NAME:_____
Raw Score /16 Developmental Score: /80

WORD	RESPONSE	Word Type	Raw score	Dev Score	Raw subtot	Dev subtot
1. if		am			**VC**	**VC**
2. hit		if			**/5**	**/25**
3. step		an				
4. an		us				
5. hand		in				
6. let		hit			**CVC**	**CVC**
7. flag		let			**/5**	**/5**
8. us		tin				
9. tin		dog				
10. test		jam				
11. dog		step			**CCVC**	**CCVC**
12. lump		flag			**/5**	**/25**
13. jam		test				
14. in		lump				
15. am		hand				

Pseudoword SPELLING Test: Teacher Instructions:

TRAINING:

*** Now I want you to write some "silly words." They are so silly than you have never heard them before.**

*** Try to write them just like they sound.**

*** I will say the word 3 times, then you say it after me.**

*** Lets try this one for practise: OP, OP, OP.**

*** Now you say it, "OP" (children must repeat the word BEFORE they begin writing).**

*** Say it again: "OP".**

*** Now write it.**

If a child mispronounces the word, go to that child and say it one more time and get the child to copy it. Even if the child says it incorrectly, do not repeat it a fifth time.

Present each word as follows:

*** Listen to the next silly word: ____ _____ ____ (3 presentations).**
*** Now you say it, "___."**
*** Say it again:. "____."**
*** Now write it.**

PSEUDOWORD SPELLING TEST. NAME:_____

Raw Score /16 Developmental Score: /80

WORD	RESPONSE	Word Type	Raw Score	Dev Score	Raw subtot	Dev subtot
1. ap		ap			VC	VC
2. sut		ib			/5	/25
3. praf		et				
4. zind		og				
5. ib		ut				
6. frop		sut			CVC	CVC
7. og		zog			/5	/25
8. sten		maf				
9. maf		leb				
10. zog		cun				
11. et		praf			CCVC	CCVC
12. leb		zind			/5	/25
13. tump		sten				
14. cun		frop				
15. ut		tump				

The developmental scoring procedure, with examples:

5 points : Correct word spelling

all phonemes are represented correctly

4 points : All phonemes are represented correctly

Acceptable errors:

sequencing from right to left (us -> "su")

3 points : Represents 2 or more phonemes correctly

Acceptable errors:

- correct phonemes may be sequenced from right to left (mot -> "om")
- remaining phonemes are omitted (sut > "st")
- remaining phonemes are *related or unrelated to the targets (sten -> "san")
- other phonemes are added in addition to the 2 or more correct phonemes (ut ->"uat")
- all phonemes are represented but order is muddled (hit ->"hti")

2 points : Represents one phoneme correctly

Acceptable errors:

- remaining phonemes are deleted (tump -> "t" , zind ->"vn")
- remaining phonemes may be related or unrelated (zog -> "sok" , zog -> "vot")

1 point : No phonemes are correct

Acceptable errors:

represents 1 or more phonemes with a *related phoneme (ib -> "eak")

0 points : Random string of unrelated letters or no attempt.

* An error was considered closely related if:

1) it was an error of voicing e.g. (s-z) or (p-b) or

2) the vowel was substituted with one from the same group. E.g. hit -> "het." The groups were: Smiley vowels: (i,e,a,u) and open vowel: (o). Substitution of /o/ with any of the smiley vowels: (i,e,a,u) was an unrelated substitution. E.g. zog -> "zig." See section 8.2.4 and table 9 of the methodology for an explanation of the groupings and for a key to the transcription of the vowels.

Appendix 8
Sample Letterland ABC story and picture with mouth form

Sample Letterland ABC story

Now meet Sammy Snake. He always has a friendly smile on his face. Even when he hisses, no-one is scared of him.

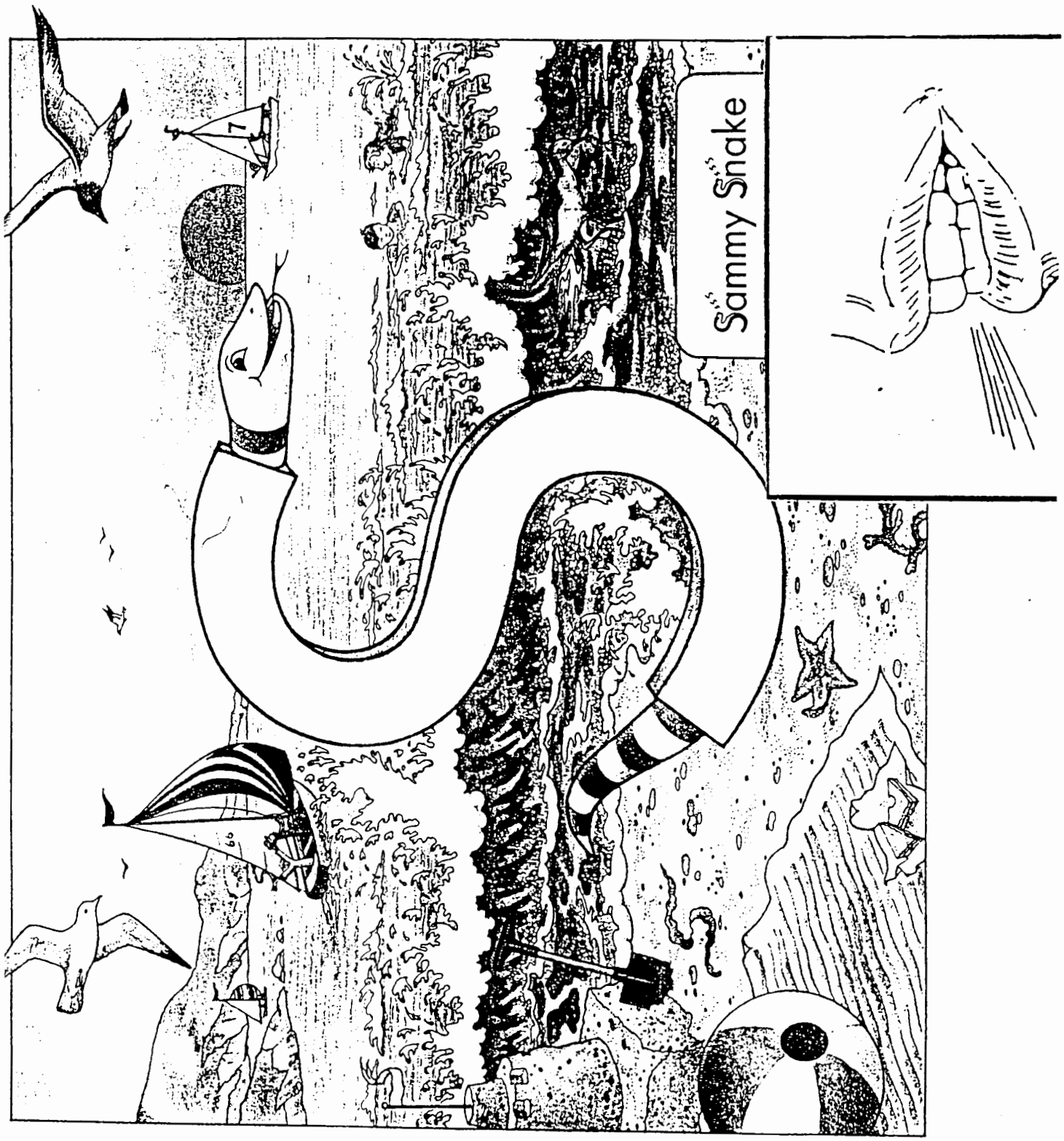
Not all snakes love the seaside, but Sammy Snake does. He loves sunning himself by the surf and sitting on sandcastles.

Sometimes he even goes in swimming, or sailing with his friends.

Best of all, Sammy Snake likes to slither and slide about in the sand—until he gets sleepy, that is. Then he has a little snooze.

Do you think he snores when he's asleep?

Sample Letterland ABC picture with mouth form



Appendix 9

Sample teacher instructions, answer keys and worksheets

Worksheet 1 a to 1 d. Same / different judgement of first sounds. / s, z, f, v/.

Teacher Instructions:

A) Listen as your teacher names the two pictures in each row. If the words begin with the same sound, put a cross on them.

B) If the child has difficulty use the following teaching steps: These teaching steps refer to worksheets 1 a to 1 d.

Answer Key:

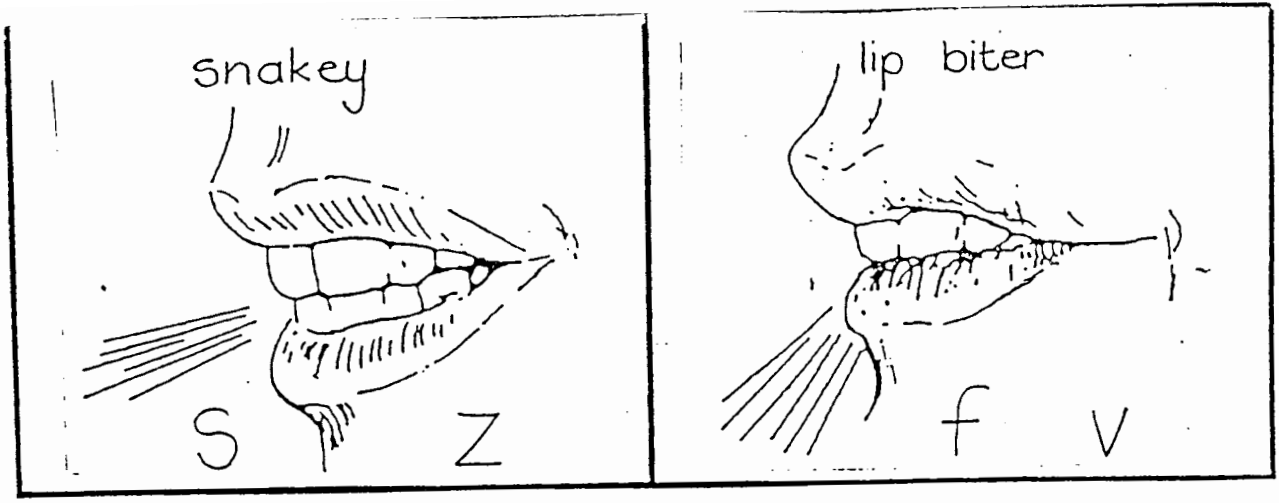
1 a)		1 b)		1 c)		1 d)	
sun	feather	zip	vegetable	sun	feather	vest	finger
soap	**sock**	**zoo**	**zebra**	**fall**	**four**	**sing**	**sock**
fish	**fat**	zero	vest	**feet**	**fan**	six	zip
sit	**sing**	**van**	**vacuum**	**zip**	**zoo**	five	van
finger	six	vegetables	zebra	**seven**	**six**	sun	zebra

Teaching Steps 1 a to 1 d.

Item : SUN, FEATHER

SUN. What kind of sound does your mouth make at the beginning of the word **SUN** ?
Repeat the first sound for the child. /s/, s, s/ ...**SUN.** (A snaky sound).
Look at the 2 mouths at the top of your page. Which mouth makes /s/ for **SUN**?
Does /s/ feel like the quiet or noisy snaky sound ? Use the "voice box and sea shell" tests (the quiet snaky sound).
FEATHER. What does your mouth do at the beginning of **FEATHER**?
Repeat the first sound for the child. /f/, /f/, /f/ ...**FEATHER.** (It bites on your lip).
Look at the 2 mouths at the top of your page. Which mouth makes /f/ for **FEATHER**?
Does /f/ feel like the quiet or noisy lip biter ? Use the "voice box and sea shell" tests (the quiet lip biter).
Do **SUN** and **FEATHER** begin with the same sound ? If they do, draw a circle around each picture. (If the child still has difficulty say: SUN begins with /s/, a snaky sound. FEATHER begins with /f/, a lip biter)

Find the letter /s/ and copy it into the block next to **SUN.** That letter says "s" for **SUN.**
Find the letter /f/ and copy it into the block next to **TEETH.** That letter says /t/ for **TEETH.**



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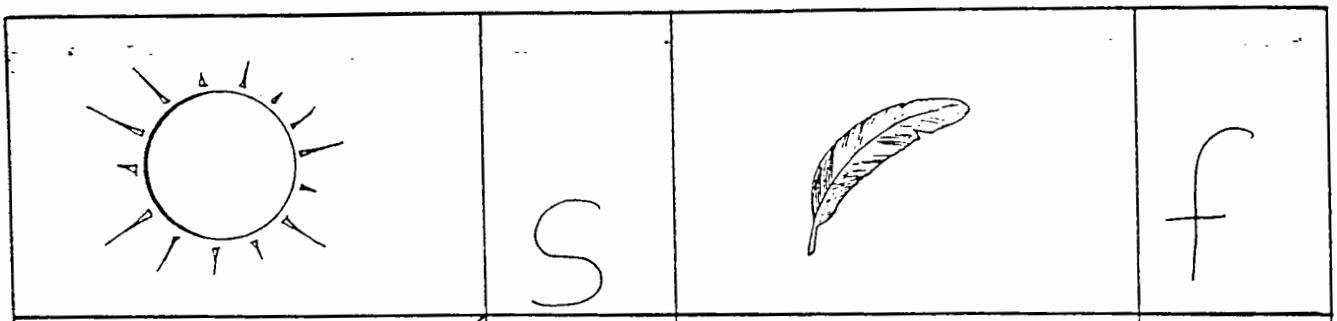

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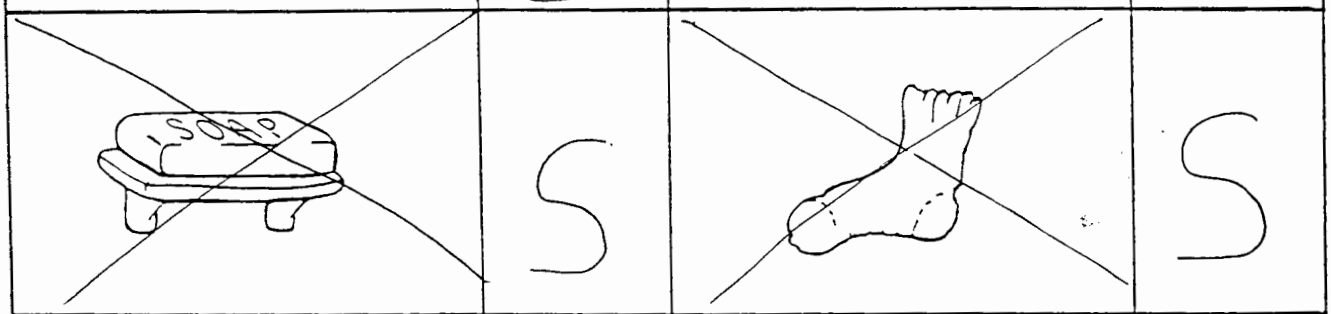

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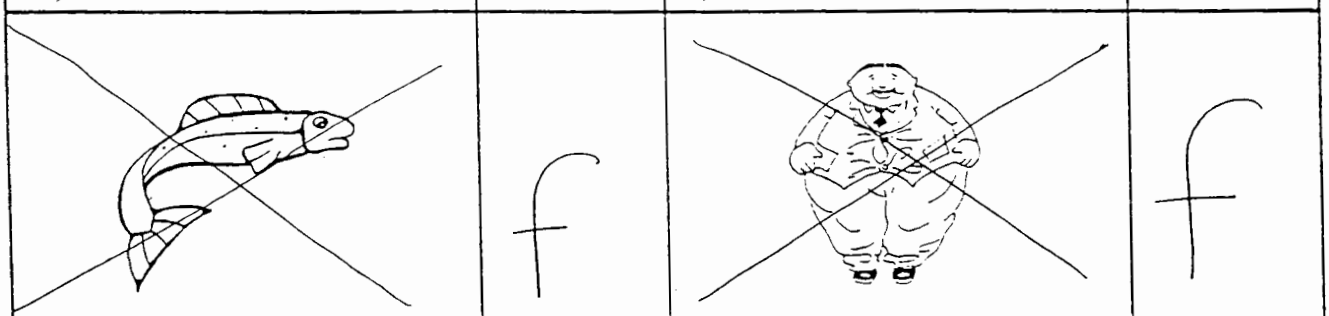

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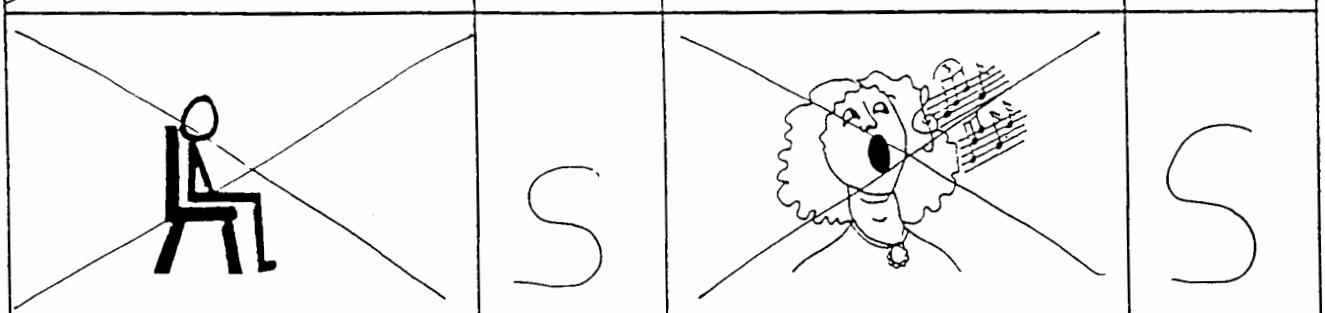

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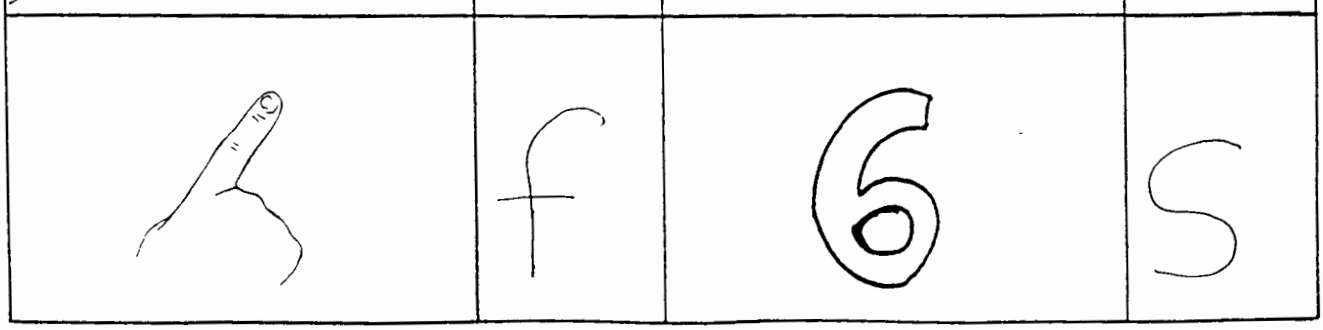


Worksheet 1 e and 1 f. Matching first sounds. /s, z, f , v/

Teacher Instructions:

A) Listen as your teacher names the pictures in each row. Then, put a cross on the picture that starts with the same sound as the first word.

B) If the child has difficulty use the following teaching steps: These teaching steps refer to worksheets 1 e and 1 f.

Answer Key:

1 e)	**vegetable**	**van**	zoo	1 f)	**sun**	fall	**sing**
	soap	fat	**sit**		**face**	**fire**	**vegetable**
	seven	**sand**	fan		**zip**	seven	**zoo**
	zebra	face	**zero**		**fan**	**fork**	van
	sand	**sing**	fork		**six**	**sock**	feather

Teaching Steps 1 e and 1 f.

Item 1: VEGETABLE, VAN, ZOO

VEGETABLE. What does your mouth do at the beginning of the word **VEGETABLE?**
Repeat the first sound for the child. **/v, v, v/...VEGETABLE**. (bites my lip).
Look at the 2 mouths at the top of your page. Which mouth makes **/v/** for **VEGETABLE ?**
Does **/v/** feel like the quiet or noisy lip biter ? Use the "voice box and sea shell" tests. (the noisy lip biter).

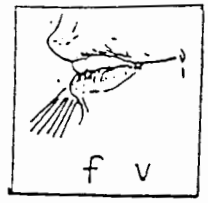
We are looking for another word that also starts with the noisy lip biter **/v/.**

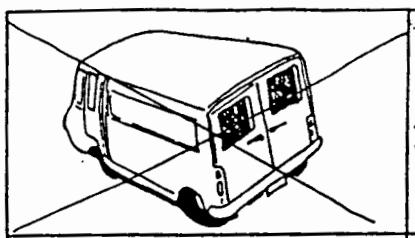
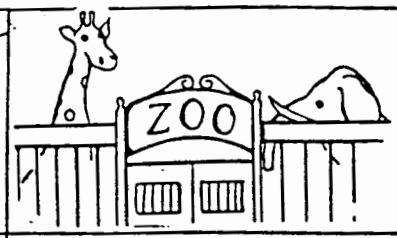
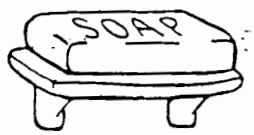
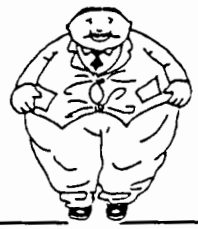
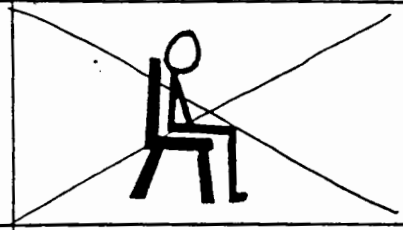
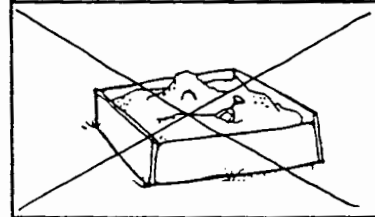
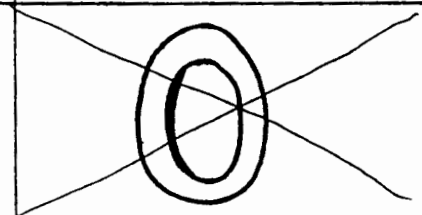
VAN: What does your mouth do at the beginning of the word **VAN?**
/v, v, v, / ...VAN (bites my lip). Which mouth makes **/v/** for **VAN?**
Does **/v/** feel like the quiet or noisy lip biter ? (the quiet lip biter).

Do /v/ and /v/ feel the same ? (yes).

VEGETABLE begins with the noisy lip biter /v/ and. VAN begins with the noisy lip biter /v/.
So draw a cross on Vegetable and VAN because they both begin with /v/.

Find the letter **/v/** and copy it into the block under **VAN** and **VEGETABLE.**
That letter says **/v/** for **VAN** and **/v/** for **VEGETABLE.**



1.			
	V	V	Z
2.			
	S	f	S
3.	7		
	S	S	f
4.			
	Z	f	Z
5.			
	S	S	f

Worksheet 1 g and 1 h. Finding different first sounds /s, z, f, v/.

Teacher Instructions:

A) Listen as your teacher names the pictures in each row. Then, circle the picture that doesn't begin with the same sound as the others.

B) If the child has difficulty use the following teaching steps: These teaching steps refer to worksheets 1 g and 1 h .

Answer Key:

1 g)	sing	**fire**	sit	1 h)	**sun**	zoo	zero
	van	vest	**soap**		six	sand	**zip**
	sock	**face**	seven		vest	vacuum	**feet**
	fork	feather	**sun**		sit	**zebra**	sock
	vegetable	zip	zebra		**van**	fat	fire

Item 1: SING, FIRE, SIT

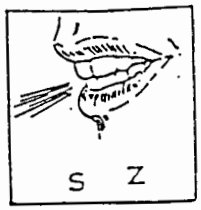
SING. What sound does your mouth make at the beginning of the word SING ?
Repeat the first sound for the child. **/s, s, s/...SING.**. (a snaky sound).
Look at the 2 mouths at the top of your page. Which mouth makes /s/ for SING ?
Does /s/ feel like the quiet or noisy snaky sound ? Use the "voice box and sea shell" tests. (the quiet snaky sound).

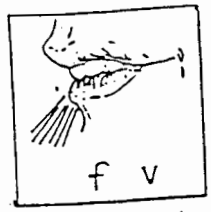
FIRE: What does your mouth do at the beginning of the word FIRE ?
/f, f, f/ ...FIRE (It bites my lip). Which mouth makes /f/ for FIRE ?
Does /f/ feel like the quiet or noisy lip biter ? (the quiet lip biter).

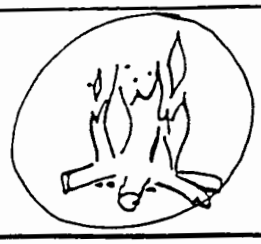
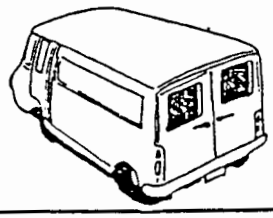
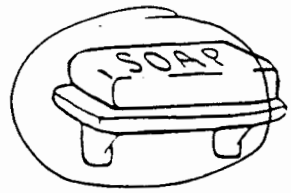
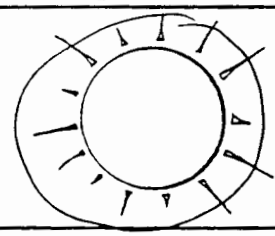
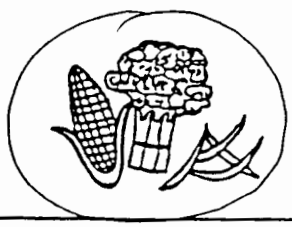
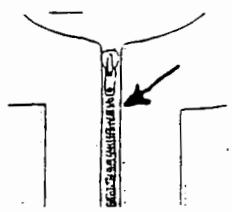
SIT: What sound does your mouth make at the beginning of the word SIT ?
Repeat the first sound for the child. **/s, s, s/...SIT**. (It taps up).
Which mouth makes /s/ for SIT ?
Does /s/ feel like the quiet or noisy snaky sound ? Use the "voice box and sea shell" tests. (the quiet snaky sound).

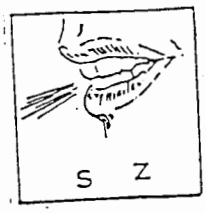
SING, FIRE, SIT: So which word begins with a different first sound ?
SING begins with a quiet snaky sound /s/. FIRE begins with the quiet lip biter /f/. SIT begins with a quiet snaky sound /s/ So circle FIRE because it begins with a different sound.

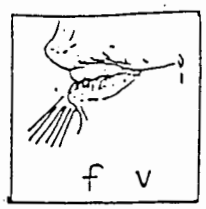
Find the letter /f/ and copy it into the block under FIRE
Find the letter /s/ and copy it into the blocks under SING and SIT

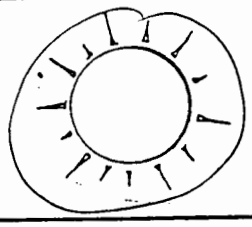
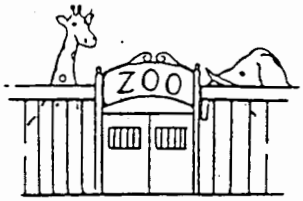
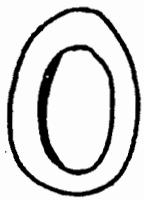




1.			
	S	f	S
2.			
	V	V	S
3.			
	S	f	S
4.			
	f	f	S
5.			
	V	Z	Z





1.			
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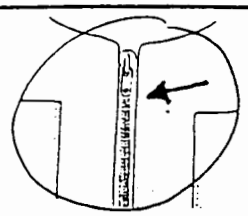
2.			
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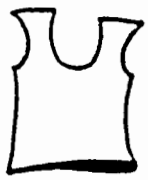
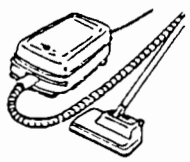
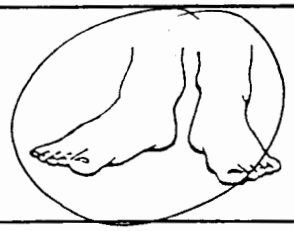
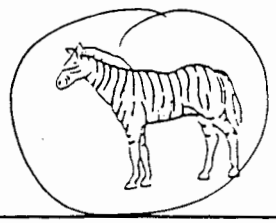
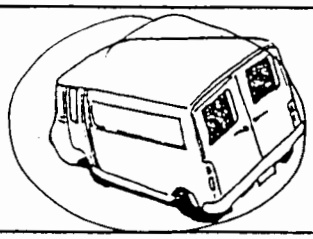
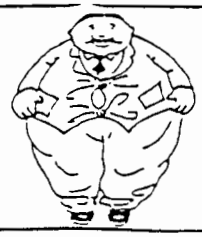
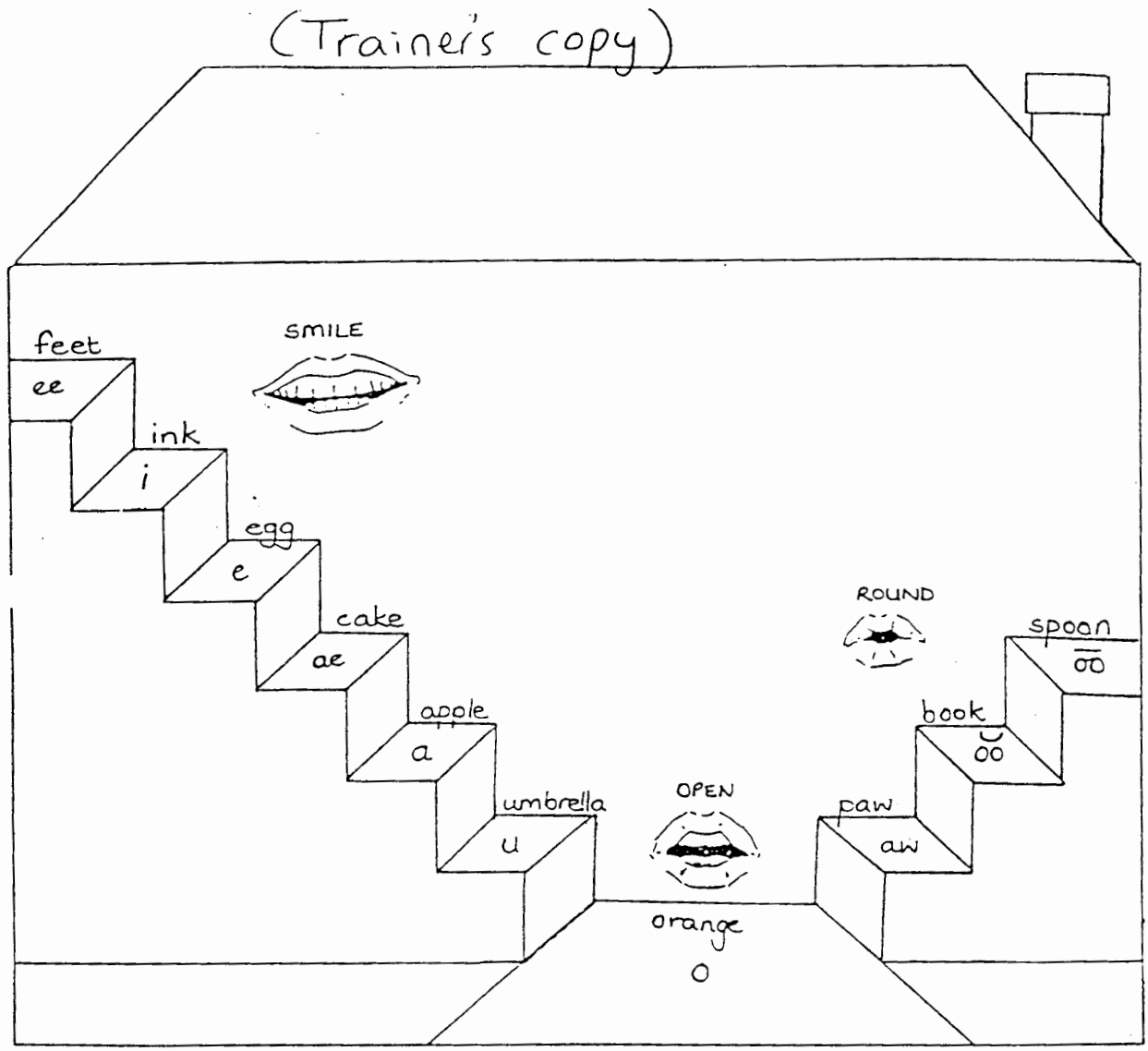
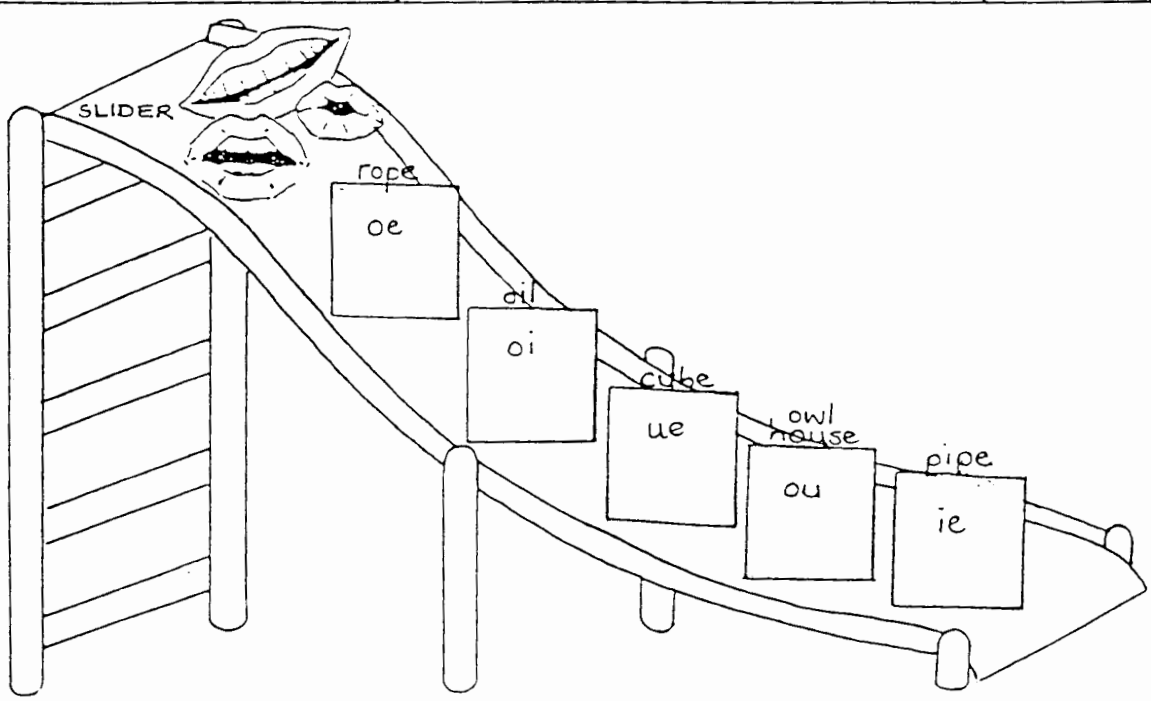
3.			
	V	V	f
4.			
	S	Z	S
5.			
	V	f	f

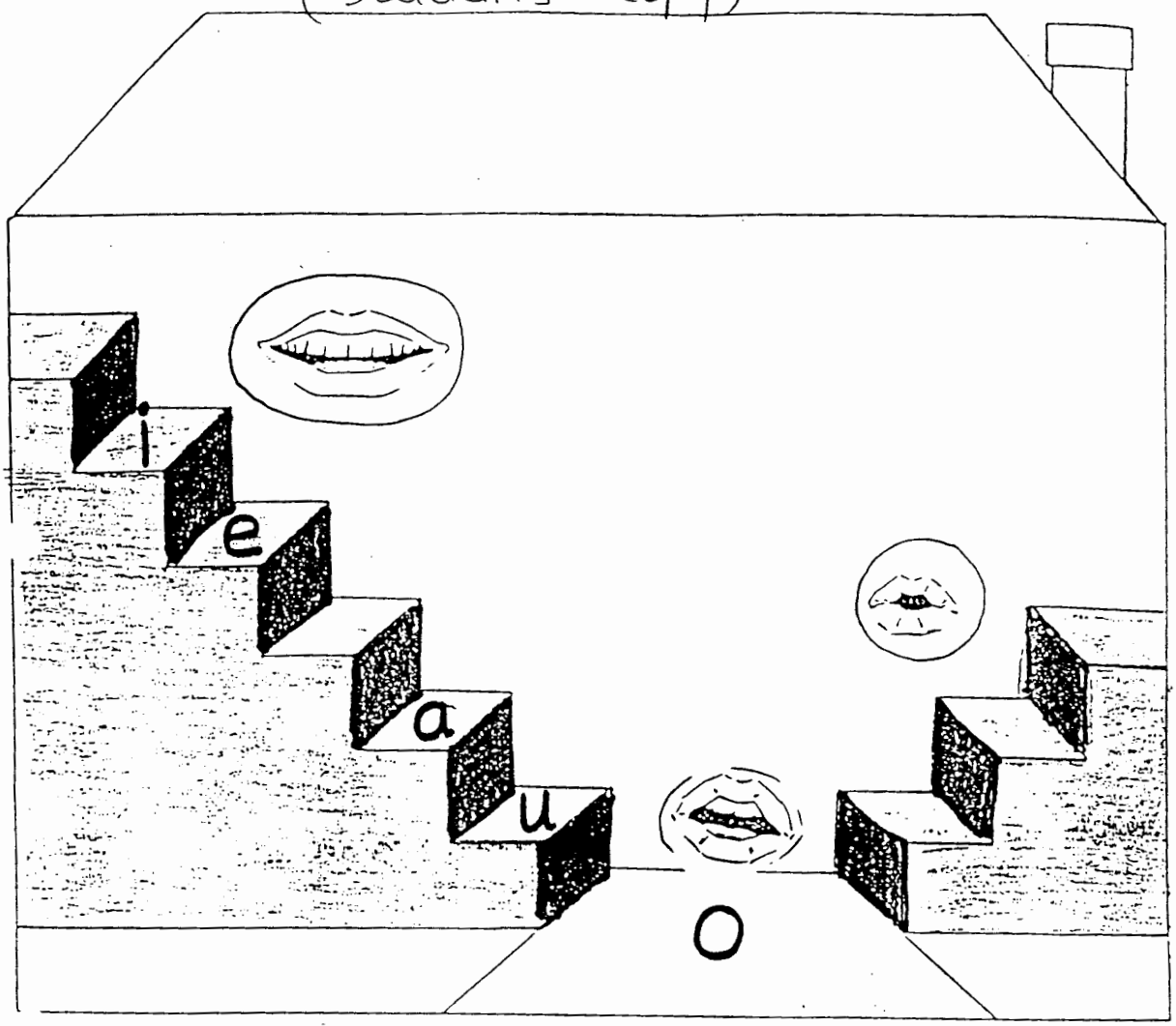
Appendix 10

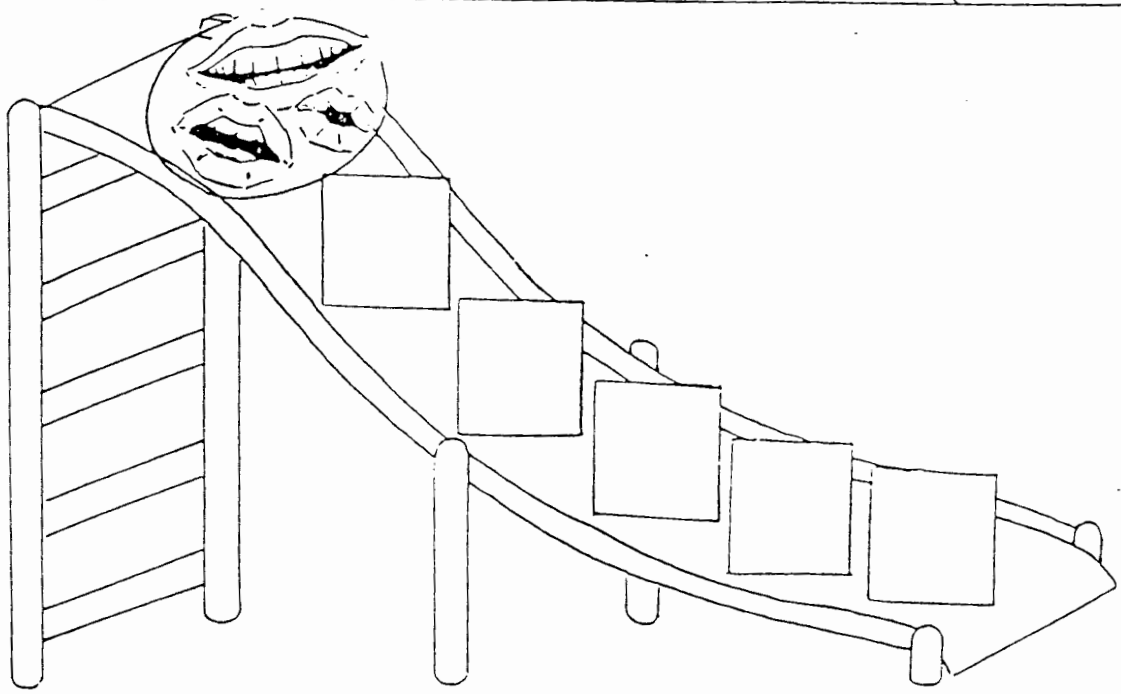
Sample Vowel House





(student's copy)

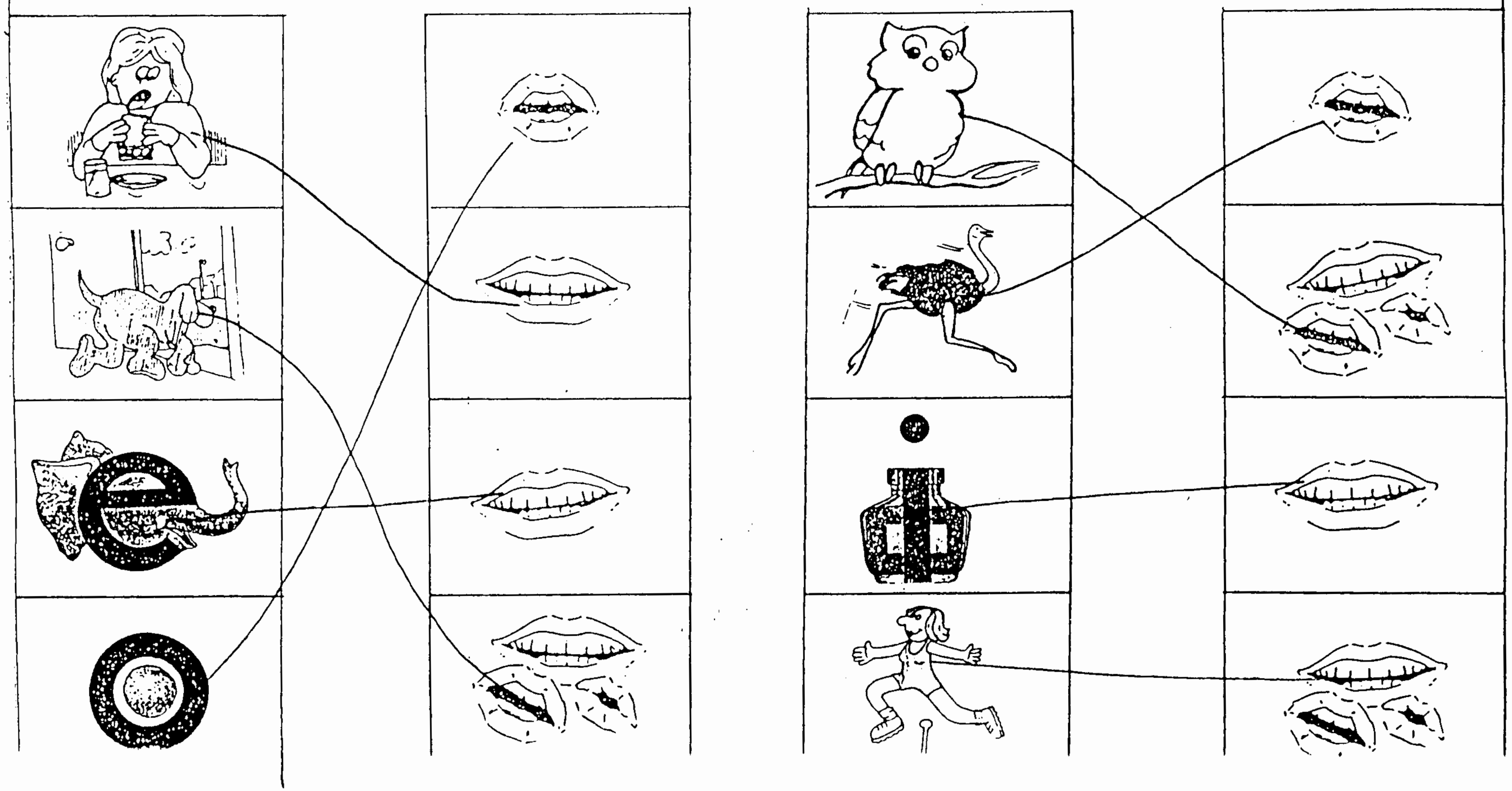




Appendix 11

Word Initial segmentation. Vowel Consonant (VC) words.

Listen to the first vowel sound in the word. How does it feel ?(use mouth form labels). Then, draw a line to its mouth shape. Answers: eat (smile), out (slider), elephant (smile), orange(open), owl (slider), ostrich (open) ink (smile), over (slider).



Appendix 12

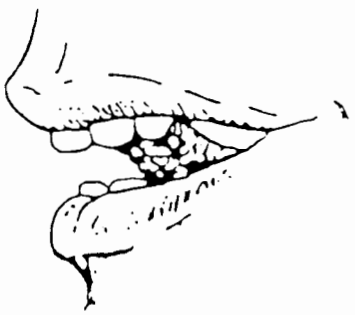
Segmentation of Phonemes. Vowel Consonant (VC) words.

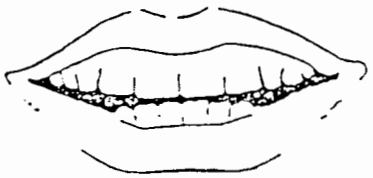
Materials:
Use together with children's consonant and vowel mouth form cards, worksheets 7 b and 7 c.

Demonstration item: TEA
What is the sound at the beginning of TEA ? /t/.
How does /t/ feel ? (it taps up)
Find your mouth form picture for /t/. Put it in the first block.
What is the vowel sound at the end of TEA ? (/ee/).
How does /ee/ feel (like a smile).
Find your mouth form picture for smiley /ee/. Put it in the last b.ock.
Say each sound in the word TEA. /t/ /ee/.

Answer Key for Worksheet 7 c (work down each row)

cow	see	bee	pay
two	pie	sew	paw
jaw	knee	bow	tie
toe	boy	pie	four





Appendix 13

Manipulation of Initial Phoneme in Consonant Vowel Consonant (CVC) words.

Materials: coloured discs and child's mouth form cards.

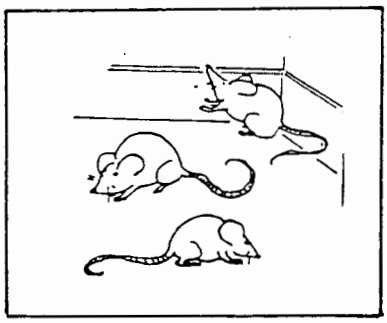
Demonstration Item: Mice : Ice

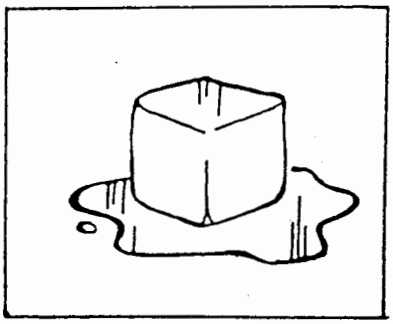
A) What sound is missing in ice that was in mice ? Now write the missing letter in block below.

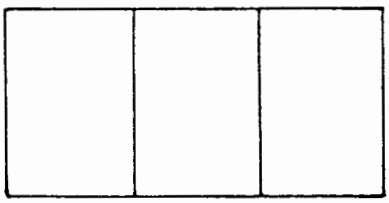
B) If the child has difficulty say each *sound* in the word: /m/ /ie/ /s/, and place a disc in each square to represent each sound. Do the same for the word ice: /ie/ /s/. Indicate that the sound that is missing in ice is the /m/ from mice.

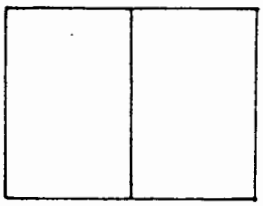
Answer Key:

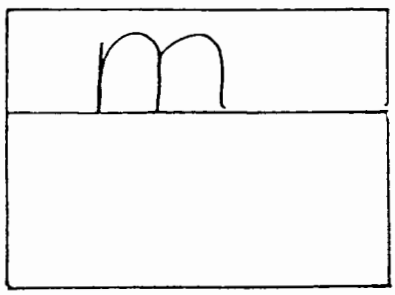
(11 b) couch - ouch gate - eight (11c) tin - in leg - egg (11 d) beg - egg cup - up











Appendix 14

Raw data for individual subjects on the TOPA-Kindergarten, Yopp-Singer test of phoneme segmentation, The Test of Auditory Analysis Skills (TAAS), letter knowledge, reading and spelling measures

Raw data for individual subjects on the pre- and post-treatment TOPA-Kindergarten measures

Subject	Group 1=Exp 2=Control	TOPA-Same Pre-Treatment	TOPA-Same Post-Treatment	TOPA-Different Pre-Treatment	TOPA-Different Post-Treatment	Full TOPA Pre-Treatment	Full TOPA Post-Treatment
1	1	4	8	4	8	8	16
2	1	3	7	3	0	6	7
3	1	3	7	1	4	4	11
4	1	2	10	2	7	4	17
5	1	3	9	4	3	7	12
6	1	4	6	3	7	7	13
7	1	2	7	3	2	5	9
8	1	3	7	2	10	5	17
9	1	2	10	4	8	6	18
10	1	1	10	1	8	2	18
11	1	2	6	2	4	4	10
12	1	3	6	3	2	6	8
13	1	5	6	1	4	6	10
14	1	2	5	5	5	7	10
15	1	3	3	0	3	3	6
16	1	9	10	6	5	15	15
17	1	4	8	3	6	7	14
18	1	7	10	2	3	9	13
19	1	5	8	2	4	7	12
20	1	2	8	3	4	5	12
21	2	3	3	3	4	6	7
22	2	4	4	4	4	7	8
23	2	5	6	5	4	10	10
24	2	1	4	4	3	5	7
25	2	3	7	1	6	4	13
26	2	3	3	4	4	7	7
27	2	4	6	3	1	7	7
28	2	7	6	3	2	10	8
29	2	5	6	3	1	8	7
30	2	8	8	4	8	12	16
31	2	5	6	3	1	8	7
32	2	4	2	3	2	7	4
33	2	7	9	6	8	13	17
34	2	4	7	2	3	6	10
35	2	2	3	4	1	6	4
36	2	3	9	3	5	6	14
37	2	5	8	1	7	6	15
38	2	4	5	2	0	6	5
39	2	5	10	1	6	6	16
40	2	7	7	2	1	9	8

Raw data for each subject on the Yopp-Singer test of phoneme segmentation, The Test of Auditory Analysis Skills (TAAS), letter knowledge, reading and spelling measures

Subject	Group 1=Exp 2=Control	Yopp Test	TAAS	Letter Knowledge Pre-Treatment	Letter Knowledge Post-Treatment	Total Reading Scores	Total raw Spelling Scores
1	1	16	4	8	24	9	3
2	1	6	0	4	22	10	3
3	1	17	3	4	26	11	17
4	1	17	5	6	25	26	17
5	1	13	4	4	28	22	15
6	1	6	0	3	25	4	5
7	1	11	2	7	27	11	6
8	1	20	7	4	26	29	17
9	1	19	7	5	27	15	15
10	1	20	6	10	28	26	21
11	1	15	3	7	26	4	2
12	1	8	1	3	17	5	0
13	1	3	1	6	26	7	7
14	1	16	2	7	21	8	4
15	1	2	2	0	17	4	0
16	1	20	3	7	27	25	12
17	1	19	3	5	20	10	2
18	1	20	8	6	26	27	13
19	1	20	3	5	26	24	19
20	1	20	4	3	27	12	14
21	2	0	0	1	1	0	0
22	2	0	0	0	1	0	0
23	2	5	3	1	4	1	0
24	2	1	2	5	9	2	0
25	2	16	2	11	24	10	2
26	2	1	0	1	7	1	0
27	2	2	3	3	12	5	3
28	2	1	2	3	10	2	0
29	2	0	0	3	3	0	0
30	2	0	3	2	6	0	0
31	2	0	3	5	10	2	1
32	2	0	not tested	1	0	0	0
33	2	21	9	10	28	26	22
34	2	0	3	7	23	4	3
35	2	0	3	3	19	1	0
36	2	0	3	3	11	0	0
37	2	0	0	3	10	1	1
38	2	0	3	1	17	1	0
39	2	6	3	4	21	7	5
40	2	0	3	3	15	1	0