

UNIVERSITY OF SOUTHERN QUEENSLAND

Faculty of Education



“WE SPEAK WITH OUR EARS”

**The Assessment of Children’s Capacity to Pronounce Isolated
Phonemes and Their Capacity to Read or Say Words Aloud in the
English Language: Implications for Learning to Read**

A thesis submitted by

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Abstract

The research in this thesis was initiated in the hope to make a contribution to the field of education and the lives of people who experienced difficulty learning to read. The research compared children's capacity to pronounce isolated phonemes and their capacity to read or say words aloud, with the view to designing a short version adapted from the International Phonemic Alphabet that can be used as a testing tool and can be made accessible to all teachers and other educational professionals.

The thesis investigates children's development of the processes underpinning phonemic awareness, auditory conceptualisation, and discrimination of sounds and articulation of words. The questions framing the thesis focus on the relationship with children's capacity to pronounce isolated phonemes, children's capacity to read or say words aloud, and finding a tool to assess children's capacity in these areas.

A sample of 898 children was tested from the metropolitan area of Brisbane, Australia. Data were collected by using the following instruments: a survey questionnaire; a word picture test, the St Lucia Graded Word Reading [aloud] Test (GWRT), and the International Phonetic Alphabet (IPA) adapted to test phonemes.

The results of the research allowed a short version of the IPA test to be constructed which any teacher can use to discover if a child has problems in producing isolated phonemes in the classroom.

It was concluded in the statistical analysis of the data that there is a correlation between saying and reading words aloud and phonemic awareness in children from Pre-school to grade 8. This research has been conducted up to grade 8, as I found that there are significant reading difficulties not only in the earlier years but also from Grade 4 to Grade 8.

Two trial studies – (Test 1), a pilot test sample of 6 children; and (Test 2), a study of 84 children – were also tested where the same assessment instruments used for

the research were administered in a clinic for testing children and providing remedial programs in the same region. In these trial studies the children had the same background characteristics such as location, socio-economic level, language background, gender, and grade level, but they had been identified as having reading problems.

The final common pathway in all oral communication involves acquisition of phonemic knowledge and the capacity to articulate whole words; phonemes are the core of language as we speak with our ears. It is crucial for children to have the capacity to pronounce isolated phonemes and to have the capacity to read or say words aloud.

The contribution to knowledge by this thesis is the results of the children's performance with regards to phonemic knowledge for the age range moving into adolescence, and the creation of a user-friendly diagnostic test for teachers to speed up the diagnostic process, given that it is well established that phonemic awareness is a prerequisite for learning to read and children who have auditory conceptualisation difficulties will be the ones who begin the long journey of first, second and third wave assessments and treatments, thus sending them on the pathway of failure and the Stanovich effect. Furthermore, my experience with working with children with learning difficulties has helped me design and conduct the testing with close to one thousand children.

Statement Of Originality

This work has not previously been submitted for a degree or diploma in any university. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference is made in the thesis itself.

Patricia Anne Mongard Collette Tyrer

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A Special Note From Chile, An Inspiration

Patricia was born in Wales, from an English mother and a French, Chilean father. She lived in England and France but was taken to Chile at an early age. During this time she learnt English, French and Spanish. Leaving Chile as a dancer and teacher, she taught in Chile, Peru, Guatemala, England and Australia, where she became registered as a dance teacher with The Royal Academy of Dancing.

A change of profession came with the achievement of several degrees, BA Linguistics & Psychology, Grad Dip Education, Grad Dip Counselling, MA Applied Linguistics, and MA Counselling Social Science, leading Patricia to work with Professor John H. Tyrer who was a famous Physician, Neurologist and Linguist. They had a very successful clinic that specialised in children with learning difficulties. They designed programs, which were very helpful, seeing eight to ten children a day.

The training gained from Professor Tyrer was valuable experience for the research in this study. His knowledge of and insight into the problems of children's learning difficulties were taught to Patricia through their work together.

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GLOSSARY OF LINGUISTIC TERMS

A

Affix: a morpheme, which can only be used when added to another morpheme (such as *sun-* and *-ish* in *unselfish*).

Alphabet: a type of writing system in which a set of symbols (letters) represents the distinctive sounds of a language.

B

Bilingual: having the capacity to speak two languages.

C

Capacity: Capacity to perform or produce, the power or capacity to do something.

Clitic: a form, which resembles a word, but cannot stand on its own, being dependent on a neighbouring word. An example of a clitic is the *'m* in *I'm*.

Colloquial: describes a variety of a language used in informal speaking situations.

Consonant: a speech sound made by a narrowing in the vocal tract so that airflow is blocked or restricted; the written symbol used to represent such a sound.

D

Diacritic: a mark, such as an accent, underline, or bar, which is added to a written symbol to indicate an alteration of how the symbol should be pronounced.

Dialect: a regionally or socially distinctive variety of a language, characterized by a particular set of words and grammatical structures. Any language with a reasonable number of speakers will develop dialects, especially if there are geographical barriers separating groups of speakers.

Dyslexia: Is a learning difficulty those with dyslexia have problems with some or all of the following: decoding words, blending letters, reading fluently, reading orally, and comprehending what they read. Dyslexia defined is a neurological, often genetic disorder, which interferes with processing language.

E

Endangered language: a language with less than 200 fluent speakers.

G

Grammar: (1) the system of structural relationships in a language: how words and part of words combine to form sentences. (2) A systematic description of a language. Comprehensive descriptions of the word structure and sentence structure of a language are known as *reference grammars*, while *teaching grammars* are descriptions designed specifically for teaching or learning a language.

H

High (er) language: a more formal variety of a language, sometimes only used in special situations, such as ceremonies.

I

International Phonetic Alphabet (IPA): the alphabet used by linguists to uniquely represent the sounds of the world's languages. A transcription of a word in the IPA can show every phonetic detail of how each sound is pronounced.

Isolate, isolated language: a language with little or no structural or historical relationship to any other languages. Isolates in B.C. include Ktunaxa, Nuxalk, and X̱aaydaa Kil.

L

Language: the abstract system underlying the speech (and if applicable, writing system) of a community. It is usually said that people speak different languages if

they are not able to understand each other's speech. There are over 34 distinct First Nations languages in British Columbia.

Language authority: an assembly, which represents a language or speech community. Some language authorities involve all communities within a First Nation. In other cases, where dialect differences are great, it is useful to have more than one language authority.

Language family: A group of languages, which historically developed from a common source or "parent language". According to linguists, eight of the eleven major aboriginal language families of Canada are found in B.C.: Algonquian, Dene (Athapaskan), Salish, Tlingit, Tsimshianic, and Wakashan, plus the language isolates Ktunaxa and X̱aaydaa Kil.

Groupings within a language family may be referred to as *sub-families* - such as Coast Salish and Interior Salish within the Salish family. A language can be described at various levels of classification within language families and sub-families. English can be classified as Anglo-Frisian, West Germanic, Germanic, or Indo-European. Similarly, SENĆŦEN can be described as Northern Straits Salish, South-Central Salish, Coast Salish, or at the broadest level of classification, simply Salish.

Language isolate: see isolated language.

Language planning: a deliberate attempt to address the communication issues of a community by studying its languages and dialects and developing an official language policy.

Language revitalization strategy: a program of support and/or teaching designed to improve the use of an endangered or minority language.

Lexical item: a unit of vocabulary - a word or part of a word.

Lexicon: a complete inventory of the lexical items of a language; a dictionary.

Linguistics: the scientific study of language.

Linguistic orthography: a writing system based on the International Phonetic Alphabet (IPA). In British Columbia, linguistic orthographies generally use local forms of the Americanism variant of the IPA, containing symbols such as: ɹ, x^w, ʁ, and ỵ. A few BC languages, such as Nl̓eɣkepmxcín and Hən̓q̓əmin̓əm, have adopted linguistic orthographies as their standard.

M

Morpheme: the smallest meaningful unit of language. A word (such as *self*) can be a morpheme, but a morpheme can also be a part of a word, which cannot stand on its own (such as *un-* and *-ish* in *unselfish*).

Morphology: the study or description of the structure or forms of words.

N

Native speaker: someone for whom a particular language is a first language, learned naturally during childhood.

Neurology: is a medical specialty dealing with disorders of the nervous system.

O

Orthography: a standardized system for writing a specific language – including both the symbols used to write the language, and the conventions for which symbol refers to which sound.

P

Phoneme: the minimal unit in the sound system of a language, which identifies a contrast in meaning. For example, in English, the sounds [p] and [b] are different phonemes because substituting one for the other changes the meaning of the word - e.g. *pin* to *bin*. Orthographies which show a close correspondence between letters and sounds – ideally, one distinct letter for each distinct sound - are described as *phonemic*. A phonemic transcription of a word shows only the details of

pronunciation, which are unpredictable based on the sound structure of the language.

Pronounce: to use the organs of speech to make a word or a speech sound, utter

Plural: a form of a word, which refers to more than one thing.

Practical orthography: an alphabet or syllabary developed for writing and teaching a language, often using symbols that are already familiar and accessible to language speakers. Practical orthographies for BC First Nations Languages generally try to use only those symbols found on an English typewriter keyboard, although a few extra letters or diacritics (such as accents, underlines, or bars) are often needed.

Prefix: a morpheme added to the beginning of a root word (such as *un-* in *unselfish*).

R

Reduplication: a process of repetition where the form of a prefix or suffix reflects some or all of the characteristics of the root word. For example, in Nisga'a, the singular form of the word for "blue" is *gwisgwooskw* and the plural form is *gwixgwisgwooskw*. Part of the root word is duplicated to form the prefix.

Root: the basic form of a word, which cannot be broken down. For example, *teach* is the root in the word *teacher*. Roots may also include "bound" forms, which are not complete words by themselves, such as *ceive* in *receive*, *deceive*, *conceive*, etc.

S

Schwa or shwa: a vowel sound heard, for example, at the beginnings of the English words *ago* and *amaze*. In BC First Nations orthographies, this sound may be represented with the International Phonetic Alphabet letter or by e, u, or other vowel symbols.

Singular: a form of a word, which refers to just one thing.

Sister languages: two or more languages, which derived historically from the same source. (See language family.)

Sleeping language: a language, which currently has no fluent speakers.

Standard: a prestigious variety of a language used within a speech community. A standard variety of a language cuts across regional differences and provides a unified means of communication and a norm, which can be used in writing and teaching the language.

Stress: the degree of force used in producing a syllable. A stressed syllable may be longer, louder, or higher pitched than nearby unstressed syllables. A stressed syllable may sometimes be marked with an accent, or followed by a single straight quote.

Syllabary: a writing system in which each symbol represents a syllable (usually a sequence of consonant + vowel) rather than a single sound. Syllabaries are used to write many Algonquian languages in central Canada, such as Nehiyawewin, or Plains Cree, and have also been used for Dene languages in British Columbia, Alberta, and the Yukon, such as Dakelh, Dene Tha, and Dane-zaa.

Suffix: a morpheme added to the end of a root word (such as -ish in unselfish).

Syntax: the rules governing the way words are combined to form sentences in a language.

T

Tone: the distinctive pitch level of a syllable. In many languages, including Halq'eméylem, the tone carried by a word is an essential indicator of the meaning of the word.

Trade language: a new language formed by two or more communities who can't understand each other's languages attempting to communicate.

Transcription: a method of writing down speech sounds in a systematic and consistent way.

V

Vowel: a speech sound made without complete closure or friction in the mouth, so that the air escapes easily over the centre of the tongue; the written symbol used to represent such a sound.

W

Word: a unit of expression, which is intuitively recognized as a unit by all native speakers of a language.

Crystal (2003)

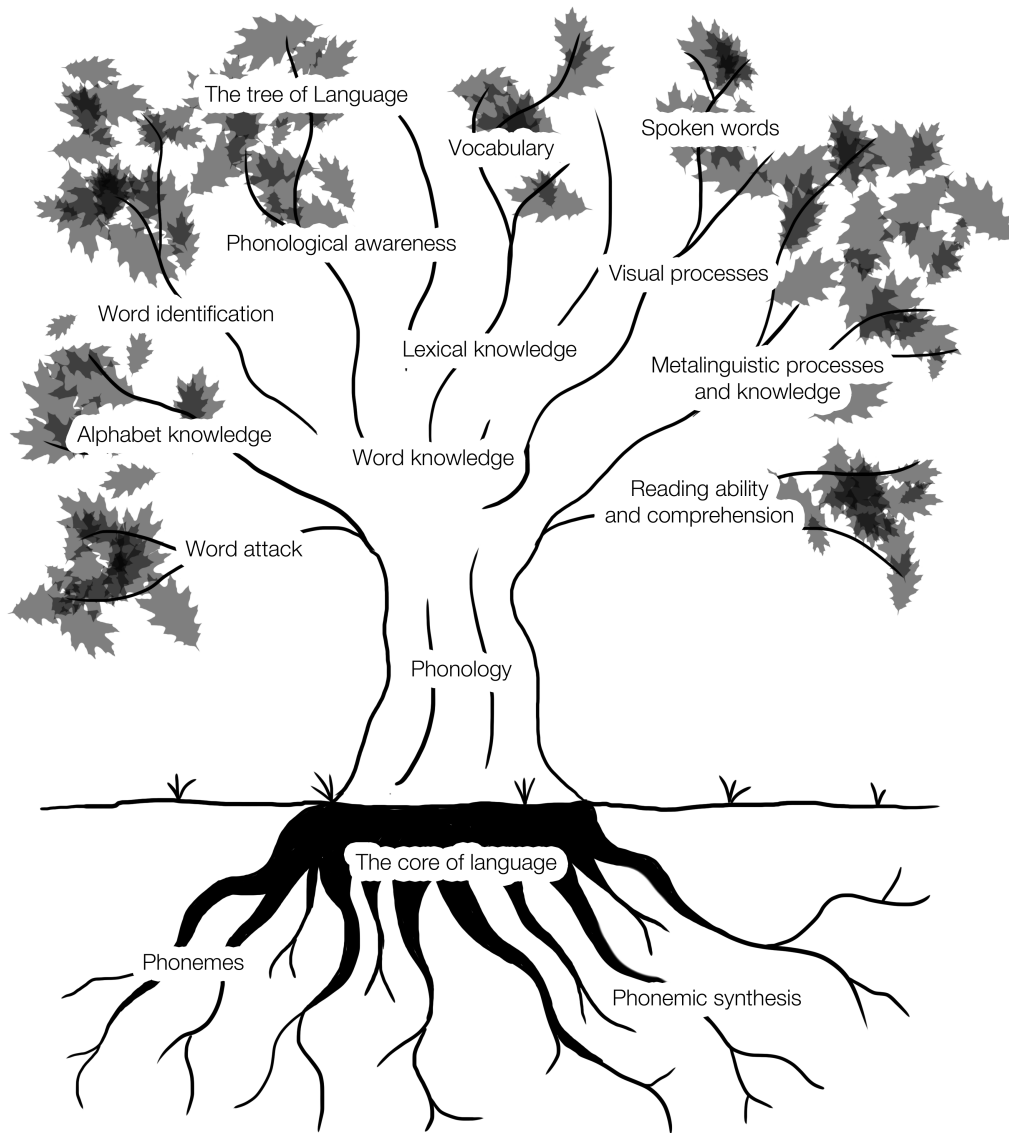


Figure 1-1 The core of language Tyrer P. (2012)

Chapter 1

INTRODUCTION

I took it for granted that phonemic analysis was the unchallengeable core of linguistic theory.
(Chomsky, 1985, p. 29)

When we study human language, we are approaching what some might call the human essence; the distinctive qualities of mind that are, so far as we know, unique to man and that are inseparable from any critical phase of human existence, personal or social. Hence the fascination of this study, and no less, its frustration. The frustration arises from the coming to grips with the core problem of human language, which I take to be this: having mastered a language, one is able to understand an indefinite number of expressions that are new to one's experience, that bear no simple physical resemblance and are in no simple way analogous to the expressions that constitute one's linguistic experience; and one is able ... to produce such expressions on an appropriate occasion, despite their novelty. The normal use of language is, in this sense, a creative activity. This creative aspect of normal language use is one fundamental factor that distinguishes human language from any known system of animal communication. (Chomsky, 1928)

1.1 Introduction

Earlier studies for my Master of Arts thesis at Bond University indicated that attempting to elicit subject's oral responses by picture description general questions (spoken or written) or during conversation did not evoke a comprehensive and representative group of phonemes and phoneme combinations from test subjects, however cooperative. Not only did different subjects use quite different phonemes (making comparisons of performance with phonemes difficult or impossible) but the subjects would often avoid phonemes they found difficult. Using a carefully prepared printed text did allow systematic testing of a comprehensive range of English language phonemes, either by subjects reading aloud from the text or by subjects repeating phonemes and words read aloud by the tester.

For the present study (PhD) I have used the International Phonemic Alphabet (IPA) as a preliminary but comprehensive screening test of English phonemes. The phonemes were examined first in isolation and could be used in constructing the more detailed test of functionally grouped phonemes in articulated speech. I used this screening test to put the phonemes of the IPA in order of difficulty for children of the Brisbane metropolitan area. This test is a valuable test in its own right and helped to arrange the Basic English language phonemes in order of difficulty and standardised based on children of various age groups for the later test construction. Also the data from the IPA test provided information for the correlation of the children's capacity to pronounce isolated single phonemes with the capacity to pronounce these phonemes in the functional groups used in articulating speech.

I included children who spoke a language other than English at home and this allowed comparison of these children's performance with those of children who only spoke English at home. The co-operation of the Queensland Department of Education was sought and a list of all schools was made, public and private, in the Brisbane metropolitan area. I chose a random sample of the Brisbane schools for testing.

The results of the research allowed a short version of the IPA test to be constructed, which any teacher can use to discover if a child has difficulties in producing isolated phonemes in the classroom. It is crucial for children to have the capacity to pronounce isolated phonemes and to have the capacity to read or say words aloud. The final common pathway in all oral communication involves the acquisition of phonemic knowledge and the capacity to articulate whole words. It is important for teachers to have such a test, as noted above, to use in their everyday work with children.

In the future I plan to design a systematic test of phonemes in the principal functional groups used in articulated speech (words, phrases, etc.) and put these test items also in order of predicted difficulty, before standardisation. I propose in the future to apply this screening test, as well as the more complex test still to be

constructed and standardised, to speakers learning English as a second language, comparing the results with those obtained from variously aged Brisbane children learning English as a first language.

Chapter 1 provides important background information to set the research problem in focus and to present the research aims. This thesis aim is to test children's capacity to pronounce isolated phonemes and their capacity to read or say words aloud in the English language and the implications to read, also to investigate children's development of the processes underpinning phonemic awareness, phonology, auditory conceptualisation and discrimination of sounds and articulation of words. It also explored methods of assessing children's levels of phonological development, with a view to designing an assessment device to be used by teachers of reading and other workers in the field.

Attention was given to the role of phonology, phonemic awareness and auditory conceptualisation in learning to read and recent research findings, which suggested the need for further research into children's development of phonemic knowledge and their capacity to pronounce words. There is an argument to suggest that children's' capacity to discriminate sounds will impact on their capacity not only to decode words but also to articulate words. If this were true then assessing learners' phonemic awareness knowledge and skill auditory conceptualisation function would be crucial to the design and development of reading programs not only with younger children but also with children through to adolescence and adulthood (Harwell, Williams, & Jackson, 2008).

Attention to the role of phonology and phonemic awareness in learning to read and children's performance is discussed in relation to their phonemic knowledge and their capacity to pronounce words. Auditory processing is defined, and a contemporary model of the reading process illustrates its importance in the overall process of learning to read which impacts on children's development of literacy skills and in turn on language testing. Since children's capacity to discriminate sounds impacts on their capacity not only to decode words but also to articulate words, teachers' understanding of assessing of children's phonemic-awareness

knowledge can be used for the development of reading programs and a choice of teaching approaches.

This study also highlights the need to recognise that the phonemic knowledge and skills underpinning learning to read apply to children in the middle years as well as in early childhood. Phonological awareness needs to be included in the teaching approach for older children as well as adults.

Phonological principles can provide a framework for identifying broad deviation patterns. Early language skills play an important role for the acquisition of reading, learning language and learning to read, these are related but distinct domains. Over the past 20 years, researchers have made important advances in understanding the role of children's awareness of the spoken language. Most spoken words contain more than one phoneme, and the awareness of phonemes themselves is the best predictor of reading (Senechal 2009). Phoneme awareness helps children learn to read because it allows them to understand that letters correspond to the sounds of spoken language.

Importantly, for the present research there are few valid and reliable testing tools for the use of teachers in the classroom. So teachers are limited to be able to find out at an early stage if children have trouble with sounds before being formally taught to read. The key to learning to read is becoming what is known in the field as being phonologically aware. Phonological awareness means the knowledge that words can actually be broken down into smaller parts called phonemes. The phonemes build words both for oral language and for written language and children who have difficulty with the smaller sounds inside words (phonemes) will have trouble with their speech and their reading skills (Tallai, 2011).

Phonologically based reading difficulties are characterised by difficulties acquiring phonetic reading strategies (Harwell & Jackson, 2008). Children who have difficulty learning to read tend to have difficulty to grasp the concept that letters have sounds and they are slow to encode those sounds. Children's phonemic awareness is a strong predictor of their future levels of reading and spelling achievement (Nancollis, Lawrie, & Dodd, 2005).

Inclusion of instruction in phonemic awareness is a strategy that may prevent many children from needing to enter early intervention programs or other remedial programs. Children's phonemic awareness and phonic skills leads to the need to involve these children in practising these skills with a variety of interesting texts. It has been found that there is an increase in secondary school children having learning disabilities and the requisite reading skills to meet academic expectations. These skills deficits included, in particular, reading, spelling, and mathematics. This is interesting, as phonemic awareness has been known for some time and these children have not received the necessary help, which means they will have fewer choices for their future careers (Learner & Kline, 2006).

While there has been a debate about the basic methods of and approaches to the teaching reading for young children for the last fifty years, today the ground has shifted in several ways. Children are now growing up in an information rich environment where reading involves more than printed hard copy texts. They need to be able to read to access the Internet, and search and research using mobile phones, computers and e-mail, and a multiple of other electronic media (Makin, Diaz, & McLachlan, 2007). Learning experiences now include information literacy skills, which require children to be independent in reading much earlier. Children are also more likely to find themselves in learning environments where they need to communicate with children and teachers from diverse linguistic and cultural backgrounds. So the move from learning to read, to reading to learn or reading to communicate with friends and family for everyday purposes is occurring much earlier, at the same time for many young children at the start of their education journey if they are embracing modern technology.

There is a serious lack of a transformative pedagogical approach that would allow teachers to use evidenced-based practice, make practical assessment tools, make their own professional judgements and use critical reflection to maximise children's learning. On this basis, this research is significant because its outcomes give teachers the use of a diagnostic tool to assess phonemic awareness and children's capacity to articulate words, which are central to building their decoding capacity (resource one of the Four Resources Model). Luke and Freebody (1999) Four

Resources Model of the reading process is seen as encapsulating the multi-literate requirements for reading effectively in a multimodal world.

Antsey and Bull (2004, p. 75) cite Luke and Freebody (1999) definition of literacy as a repertoire of capabilities. Being literate means being able to: (1) decode written text, (2) understand and compose meaningful texts; (3) use texts functionally, and (4) analyse text critically. All these four resources are of equal importance, as readers need to engage with all of them with different emphases depending on the task. It also highlights the importance of these skills to children's early learning and establishing the important graph phonics connection. Graph phonics refers to the sound relationship between the orthography (symbols) and the phonology (sounds) of a language (Harris & Hodges, 1995).

1.1.1 Auditory processing

It has also been found that auditory processing is a critical function in reading. It is only logical, that phonemic processing is a necessary ingredient in the reading process since it is not possible to memorise the visual shapes of all the words in the English language, or to guess all of them accurately based on contextual cues. It is critical to decode accurately since decoding errors can change imagery and change comprehension.

Individuals of all ages and backgrounds may have an auditory conceptual dysfunction that impairs their capacity to decode words and the treatment to overcome this focuses on another modality, which supports and ultimately develops auditory segmentation. The organs of speech, which are the sources of sounds –tongue, lips and soft palate, these organs change the sounds to produce different vowels and consonants. Individuals can be taught to perceive sounds by experiencing the motor movements of the sounds.

In the clinic I noted the disturbingly high number of children who had progressed to adolescence without success in reading. The world is difficult for those who cannot learn to read and the inherent complexities of a written language should not be forgotten. The change of the spoken language into writing is not easy, as a child

must cope with the phonetic properties of sound and the meanings of the words. It is also important to remember that the nature of words and the part they play in speech are of fundamental importance. If children are severely limited in their speech, without the essential skills to find, classify and transcribe speech sounds and look at how phonemes relate to one another in their function and form, they will have learning difficulties and will be unable to progress through school life as this underlying knowledge and skill play a significant role when it comes to either children or adults learning to read, in any language.

1.2 Background to the research

Learning to decode or “crack the code” is a complex business. Readers need to have the phonological skills to convert letters into sounds, including the capacity to understand and apply the related rules. Children need to be able to show letters, phonemes and graphemes (the visual Gestalt of words to use to access a previously learned sound). The knowledge and contextual information that readers bring to reading cannot be activated to make meaning without the capacity to build a bank of words in the form of a mental lexicon (a dictionary like memory store). This knowledge includes word meanings, the way in which words can be joined (collocations), how they are placed in sentence structures, and syntactical and semantic information (Tomblin, 2005).

Of note is the finding that auditory processing is a critical function in the reading process and that phonemic processing is also a necessary ingredient since it is not possible to memorise the visual shapes of all the words in the English language, or to guess all of them accurately based on contextual cues. Katz (2008) found that children with reading difficulties often struggle when they try to detect subtle differences between the smallest units of speech (phonemes). These readers, who are unable to detect subtle phonemic differences, will find learning to read very difficult. This is because of problems with the shape of their tongue and mouth such that they are unable to enunciate sounds and words clearly (Lerner & Kline, 2006). Schlagal (2001) points out that many children with reading difficulties can

improve their phonological skills such that they are more able to show single words and apply spelling skills and word attack skills.

A small amount of high poverty children's reading skills rose above the United States standards set by the "No Child Left Behind" policy (No Child Left Behind Act, 2001, Public Law, pp. 107-110). This policy aimed to improve the reading skills of United States primary and secondary schools by increasing the standards of accountability for states, school districts and schools. It promoted an increased focus on reading and reauthorised the Elementary and Secondary Education Act of 1965 (ESEA) (Promoting Educational Excellence for Americans, 2007). The problem of improving reading levels and literacy standards is also uppermost in Australia with national testing of Grades 3, 5, 7 and 9 children in 2008 showing relatively poor results. Low reading levels have also been reported across Australian society in general (Australian Bureau of Statistics, 2001, 2006), thus overall pointing to a need for improved strategies to find out those with reading difficulties and both recognition and action to the vital prediction of phonemic awareness results and children's articulation/pronunciation of words. Auditory processing is an important part of the reading process for teachers to understand (Schlagal, 2001).

Lindamood (2006) also points out that those difficulties in learning to read lead to adverse consequences for children, including maladaptive mental and emotional health. Traditionally, linguists argued that a good reader should only have the capacity to process words phonetically, but linking the teaching of reading to phonics instruction led to a minimisation of the importance of deriving meaning from print in the reading process. The Australian National Curriculum for English (ACARA, 2009) specifies that English should be organised around three interrelated strands for K-10. The Language strand involves the development of a coherent, dynamic and evolving body of knowledge about the English language and how it works. Children learn to interpret, appreciate, check and create literacy texts such as narrative, poetry, prose, plays, film and multimodal texts in spoken, print and digital online contexts.

Research has continued to show the problems that children have in learning to read. Schulz (2011) found that 20% of Australian children have challenges in learning, and that 15% have multiple learning difficulties. So the importance of examining phonological development and auditory discrimination through to adolescent learners is further substantiated, since becoming literate in English is dependent upon reading. Being able to read and take part in education and society is essential for people's general health, work and lifelong learning. Center (2005) also asserts that the systematic, explicit teaching of phonics is a necessary condition for the teaching of reading. Cowen's (2003) research studies of approaches for beginner readers concluded that reading for meaning and understanding cannot be taught separately from direct phonics instruction.

The key research findings of Coltheart (2005) showed that, since systematic, explicit phonics approaches are much more effective than non-systematic approaches for children with and without reading difficulties, it is vital that children should initially be provided with direct instruction in phonics as an essential part of a comprehensive and integrated reading program that includes meaning centred approaches. Fromkin, Rodman, Hyams and Amberber (2005) argue that it is important to understand the interaction of speech and its effect on reading and writing, and the way teaching strategies may take advantage of the children's innate linguistic knowledge to enable them to relate sounds to letters. Lemos (2004) wrote that teaching strategies that do not relate to children's auditory conceptualisation are both ineffective and inappropriate. Phonetic processing awareness in early literacy is important because if children do not have an awareness of the sound structure of language they cannot attend to the separate sounds in spoken words and are unable to show letter sound correspondences (Norris & Hoffman, 2002).

1.2.1 Reasons for this research

This research has been inspired from my work in a clinic for children with learning and behavioural difficulties. I was aware that this was a big study, which would involve frustration and tenacity as I tested close to one thousand children, and

collected five thousand pieces of data for statistical analysis. I wanted to explore methods of assessing children's levels of phonological development so I could design an assessment device for teachers and others in the field of education for the purpose of finding out children's capacity to pronounce isolated phonemes and their capacity to read or say words aloud. The designing of the testing tool also contributed to language testing, as well as to theoretical and methodological knowledge. Through this research I have shown that auditory processing and phonemic awareness are essential for the learning of reading. They are the most powerful predictors of later reading capacity for children from Pre-school to Grade eight.

It is for this reason that the 21st century classroom teachers need the diagnostic tools of assessment to find out if the children have auditory dysfunction, and the pedagogical skills to respond effectively. Effective skills give children the opportunity to do well in English and so in other areas of the curriculum and the freedom of further education. This is to help teachers by having easily accessible testing tools to assess children if they are lagging behind with their learning in the classroom.

This study has also shown that children with learning difficulties are able to improve dramatically with learning with intensive suitable programs. Recent studies have shown that intensive training in a variety of cognitive and sensorimotor skills can result in changes in grey matter volume (Krafnick, Flowers, Napoliello, & Eden, 2010), thereby helping with learning skills. The reason of why some children have difficulty learning to read has been the focus of a great deal of research over the past four decades and much has been learned about the probable and improbable causes of such difficulty. There is no evidence that inadequate facility in word identification, owing in most cases to more basic phonological (letter sound) skills deficiencies associated with phonological coding deficits, is the cause of the problem (Snow, 2001).

From working with so many children with learning difficulties of all ages, I realised that reading difficulties affect how well children learn in other areas such as

learning history or physical education. Lindamood (2011) found that some of the difficulties may occur in relation to phonological and phonemic knowledge of words and skills that are necessary for success in reading and writing such as having a proper knowledge of words, sentences and longer text. Even generally accepted everyday conveniences such as road maps, basic instructions and forms become daunting tasks for those who cannot read. Only those children with the greatest lag receive specialist assessment. In addition, by the time a specialist assessment is approved and administered months have usually gone by.

Phonological processing is defined and a number of required abilities for the reading process are mentioned to illustrate the importance in the overall process of learning to read and the development of literacy skills. As Harwell, Williams and Jackson (2008) found, phonologically based reading difficulties are characterised by difficulties acquiring phonetic reading strategies. They also found that children who have difficulty learning to read are slow to grasp the concept that letters have sounds and are slow to encode those sounds.

Rief (2005) states that there is a very strong association between a child's capacity to read and his or her capacity to segment words into phonemes. Children's auditory processing and phonemic awareness can predict their levels of reading and spelling achievement even years later and it is a more powerful predictor of reading progress than IQ (Intelligence Test). From my experience, providing instruction in phonemic awareness and help with auditory processing prevented many children from needing to enter special education programs. The need for a diagnostic test that applies to older children as well is very important as many older children go through school without been able to read, this has serious repercussions for their future.

1.2.2 Aim of this research

The aim of the research is to assess children's capacity to pronounce isolated phonemes and their capacity to read or say words aloud in the English language: implications to read, with the view of designing a short version adapted from the

International Phonemic Alphabet that could be used as a testing tool and accessible to all teachers and other educational professionals.

1.2.3 Objectives of the study

The objectives of the study are as follows:

- 1) To show which phonemes children of Pre-school to Grade 8 found difficult to master.
- 2) To investigate the way phonological skills correlate with the reading capacity of children in Pre-school to Grade 8.
- 3) To elicit the smallest possible sample of phonemes from testing with the IPA that can be used as a basis for an assessment tool.
- 4) To investigate differences between children from ESB (English Speaking Background) and NESB (Non-English Speaking Background) in their knowledge of phonemic competence in English, and their capacity to pronounce isolated phonemes and to read words aloud.

1.2.4 Research questions

This study investigates children's capacity to pronounce phonemes and whole words in relation to English language and literacy, given the importance of auditory processing skills in learning to read. The research questions for the study are as follows:

- 1) How do phonological skills correlate with reading words aloud of children in Pre-school to Grade 8?
- 2) Which phonemes do children of Pre-school to Grade 8 find difficult to master?
- 3) In what ways can a practical assessment tool be developed for classroom teachers to test children's phonemic knowledge and awareness?
- 4) What differences can be found between children from ESB (English Speaking Background) and NESB (Non-English Speaking Background) in their development of phonemic competence in English, and their capacity to pronounce isolated phonemes and to read words aloud?

1.3 The outline of the thesis

Chapter 2 discusses the theoretical basis for the study, in which I explain the conceptual framework for the research, which is about children's development of phonemic knowledge and articulation of whole words and the problem of auditory conceptualisation dysfunction. Through my work I found that the acquisition of phonemes, phonological awareness and the decoding process are shown to be essential to the development of reading. Phonological knowledge and phonemic awareness are among the most powerful predictors of later reading capacity.

Chapter 3 summarises this thesis's investigation into children's capacity to pronounce phonemes and whole words in relation to learning to read, a skill crucial to the English language acquisition and development of English literacy. The importance of auditory processing skills in learning to read derives from noting literacy being integral to success in contemporary society, including education and lifelong learning, as well as the social interactions, involved in leisure, work, communications and business. An investigation of children's capacity to pronounce phonemes and whole words from early childhood to adolescence is considered both timely and informative. It is beneficial to the teaching, learning and assessment cycle in providing information about developmental similarities and differences important to teachers, children and the community in our globalised world, where reading/information processing demands are rapidly increasing.

A range of tests related to children's phonemic knowledge and reading capacity are examined. Issues emerging from the literature review are identified and discussed, and conclusions are drawn in terms of their impact on the research questions and the research design.

Chapter 4 outlines the method for the research and shows how, on the basis of the above discussions, the following tools were used for the testing: a survey questionnaire, which collected demographic data and contained questions to create a 'test friendly' context (Appendix 1); The International Phonetic Alphabet (IPA) adapted to test phonemes (Appendix 2); The St. Lucia Graded Word Reading Test table of norms (GWRT) (Appendix 3); The Picture Word Test (PWRT) for non-

readers/Pre-school children, (Appendix 4). These tests were applied to investigate the way phonological skills impact on reading capacity for children in the early years of schooling through Pre-school to adolescence and find which phonemes children of various ages find difficult to master, in keeping with the research aim of this thesis.

The research focused on a sample of children (Pre-school through to Grade 8) from schools in the metropolitan area of Brisbane (Queensland, Australia). Data were collected about children's capacity to pronounce phonemes and read and say words aloud. Demographic data were also collected to find and group children's responses according to age, grade of schooling, and language background. A total of four data collection instruments were used.

The trial of the test explains the short test of the IPA conducted in a real world condition with 84 children from my clinic, using the tools that were tested in this thesis initially, and reports the findings involved in the study, for the purpose of finding out the usefulness of the test designed for this research, which was previously tested in the metropolitan schools of Brisbane. The children were tested with the IPA and with the St. Lucia Word Graded Reading Test and The Picture Word Reading Test, before and after intensive treatment with programs that were tailored for each child's needs. The research showed that teachers could effectively use these tests in the schools to test children's phonological awareness and their reading age as a first investigation of children with reading difficulties.

Chapter 5 presents the results of the analyses performed on the data collected from the children's population which was administered with the International Phonetic Alphabet (IPA.), the St Lucia Graded Word Reading Test (GWRT), the Picture Word Reading Test (PWRT), and the questionnaire detailed in chapter four. Statistical analyses were performed on the responses obtained from the testing of the IPA and the PWRT to Pre-school (Ps) children, and on the responses obtained from the testing of the IPA and the responses from children with the testing of the GWRT. This was done with children from Grade 1 (G1) through to Grade 8 (G8) children. Each of these groups was divided into children from an English Speaking

Background (ESB) and children from a Non-English Speaking Background (NESB) and then broken down by gender.

Pearson product-moment correlations were calculated to decide whether significant correlations existed between children's performance on the reading test (PWRT or GWRT) and the variables of grade, language background, and gender. The item analysis of the IPA was also performed with the idea of constructing a shorter version based on the order of difficulties in relation to children's capacity to pronounce isolated phonemes, which could be used for teachers in the classroom to find out if children have difficulty with reading.

Chapter 6 shows the research hypotheses and how they were tested to decide whether the degree of association between ESB (English-speaking background) and NESB (non-English speaking background) children's capacity to pronounce whole English words could be predicted based on the phonemes of the IPA and the words analysis of the GWRT. The IPA and the PWRT also showed strong correlation for ESB and NESB children. It was found that in Pre-school and grade one girls performed better than boys.

Chapter 7 highlights the need to recognise that the phonemic knowledge and skills underpinning learning to read apply to children in the middle years as well as early childhood. The assessment and later intervention programs were done with people who had speech, spelling, or reading problems. It was found that age, gender, language background, and socio-economic factors did not seem to relate directly to these problems. Such problems could not be traced to a specific teaching approach.

21st century classroom teachers need the diagnostic tools of assessment to find auditory dysfunction and the pedagogical skills to respond effectively. An effective skill in reading gives children the opportunity to do well in English and so in other areas of the curriculum and the freedom of further education.

Conclusion and Recommendations show there is an argument to suggest that children's capacity to discriminate sounds will impact on their capacity not only to

decode words but also to articulate words. If this is so, then the assessment of learners' phonemic awareness/phonemic knowledge and skill/auditory conceptualisation function would be crucial to the design and development of reading programs/support programs not only with younger children but also with children through to adolescence and adulthood. The short test designed in this thesis is a contribution to the knowledge base of teachers and laypersons to find out if children have problems with the pronunciation of phonemes.

The final common pathway in all oral communication involves acquisition of phonemic knowledge and the capacity to articulate whole words; phonemes are the core of language. It is crucial for children to have the capacity to pronounce isolated phonemes and to have the capacity to read or say words aloud. "We speak with our ears".

1.4 Conclusion

Following on from this chapter, which has outlined the research problem, and the importance of the research along with the research questions, Chapter 2 discusses the theoretical basis of the study, in which I explain the conceptual framework for the research, which is about children's development of phonemic knowledge and articulation of whole words and the problem of auditory conceptualisation dysfunction and language assessment. Through my work I found that the learning of phonemes, phonological awareness and the decoding process are shown to be essential to the development of reading. Phonological knowledge and phonemic awareness are among the most powerful predictors of later reading capacity. The purpose of the research is to develop a test from the International Phonetic Alphabet suitable for classroom teachers, based on a large-scale research project in the Brisbane metropolitan area.

Chapter 2

THEORETICAL BACKGROUND

Often the images of the words I have employed are an integral part of thought and even the thought itself in the case of abstractions from reality is made possible to me by words. Then the idea of the word and of the thought arrives in my mind at the same time. In any case, thinking of a word, whatever the word signifies, is it a thought, but can I think without words? Or use words without thinking? I need words to answer this.

As I speak or think, I may be more conscious of the images of words or of the images of what the words stand for. I find that there are often rapid, complex manipulations of whole series of words as signs with encoded meanings that come to me, and that I have formed automatically or semi-automatically from years of habit and practice.

The language scaffolding such as abstracting words, that stand for things which are condemned to be absent forever and which were never present allows me to carry out certain operations and even if I am working in fiction, these abstracting words were created to solve dilemmas. Other words are on the grammar scaffolding. As I close my eyes I see the vocabulary scaffolding, and the weight of words bends the scaffolding.

2.1 Introduction

This chapter discusses the theoretical base for the study, in which I explain the conceptual framework for the research. A framework is simply the structure of the research idea or concept and how it is put together. A conceptual framework elaborates the research problem with relevant literature. This framework may summarise the major dependent and independent variables in the research. The framework may be summarised in a schematic diagram that presents the major variables and their hypothesised relationships.

The conceptual framework for the research I have named “Words on the Scaffold”, which is about children’s development of phonemic knowledge and articulation of whole words and the problem of auditory conceptualisation dysfunction. Why Words? We may play with words or their images as a child plays with blocks or a sportsman with balls. But words are concrete signs with encoded meanings and containing semantic value. They have been socially codified by mutually accepted meanings and by rules of grammar. Words may signify things, processes, qualities and relationships. Encoded meanings change and words have different meaning for different people. We are conditioned by the words and word formulae of our language and the words we inherit teach us many things. Names help us see things when we meet them, like a tree with its leaves and twigs, its branches and roots.

Verbs help us name actions, adjectives and adverbs are for quality and processes, a thin branch ... a thick branch, climb slowly, climb fast and prepositions specify relationships in space and time ... above the tree, after the tree ... we need words to describe them. When words pour forth from the mouth they are not like stones falling from a hole in a sack, free, detached and independent. Words simply connected like beads strung out in lines on a thread of time, word tied to word in simple linear fashion so in this way we make words play. Words have sounds, the core of language and without them we cannot say the words.

Through my work I found that the obtaining of phonemes, phonological awareness and the decoding processes are essential to the development of speaking and learning to read. Phonological knowledge and phonemic awareness are among the most powerful predictors of later reading capacity. The conceptual framework designed for this thesis consists of the following.

The conceptual framework I have utilised for the research of this thesis is based on the capacity of a child to pronounce phonemes and say words aloud. The awareness at the level of the phoneme has particular significance for the acquisition of reading because of its role in learning the alphabet.

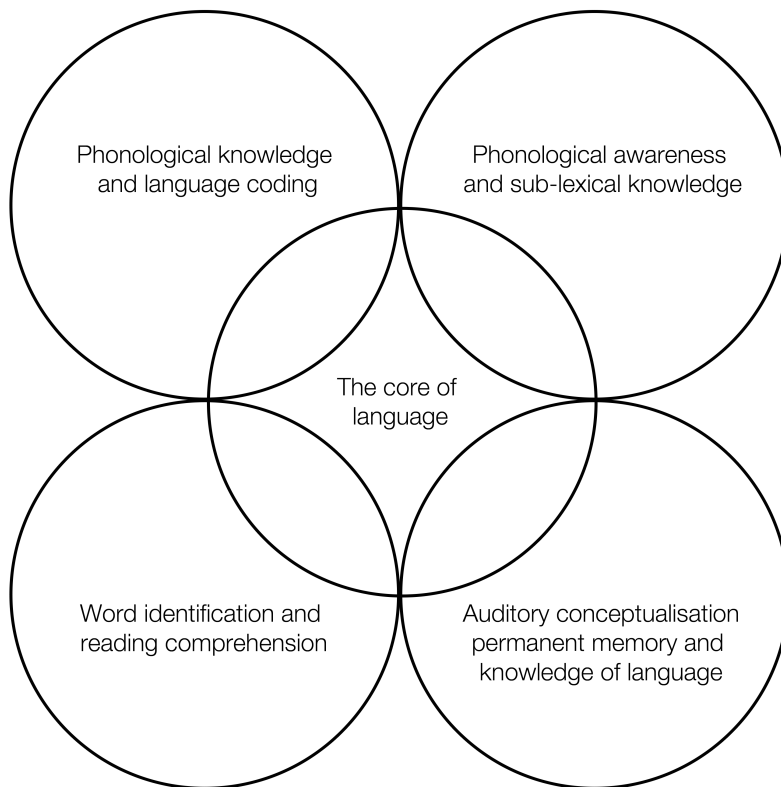


Figure 2-1 Conceptual framework

2.1.1 Phonological knowledge: Implications for reading

The knowledge of the science of speech sounds includes the history of the theory of sound changes in language. Phonology is a branch of linguistics that studies the sound systems of language and it is the overall name for phonemes, phonetics and other aspects of speech sounds. Phonemic is the study of phonemes, the smallest units of linguistically distinctive speech sounds peculiar to a given language. Phonetics is the study of the production and perception of sounds of languages in general. Phonological variations refer to different surface- phonetic realisations of underlying phonemes in different phonemic contexts.

Decoding is the capacity to figure out how to read unknown words by using knowledge of letters, sounds, and word patterns. Decoding skills are essential to being a fluent reader (Loakes, 2012). Sub-lexical linguistic modelling models on the construction of words from sub-word units using available linguistic knowledge and

higher sub-lexical knowledge, such as morphology and syllabication, which can help formalise and constrain generic sub-word structure.

A definition of reading provides an important perspective on evaluating approaches to teaching word identification skills. Reading is the process of constructing meaning from written texts and word identification is the process of determining the pronunciation and to some degree of meaning of an unknown word, as unlocking the pronunciation leads to the word's meaning. Reading comprehension is understanding a text that is read, or the process of constructing meaning from text (Partnership for Reading, 2005).

Phonological awareness is any of the abstract units of the phonemic system of a language that correspond to a set of similar speech sounds which are perceived to be single distinctive sound in the language or, in other words, a sound (Merriam Webster Online Dictionary). A definition of reading provides an important perspective on evaluating approaches to teaching word identification skills. Reading is the process of constructing meaning from written texts and word identification is the process of determining the pronunciation and some degree of meaning of an unknown word, as unlocking the pronunciation leads to the word's meaning (Merriam Webster Online Dictionary).

Permanent memory and knowledge of language can be traced to a neural system and to the cellular changes that are possible for behavioural changes. The repeated association of stimuli causes a persistent change in the neurones and the flow of potassium ions through channels in the membranes is reduced. Human memory is often considered to have two parts, long-term memory, which is all our factual knowledge, and a short-term or working memory, which holds the information we are now processing. Learning words through the activity of visual images increases the chance that the word will be recalled later owing to an effect of dual encoding.

This research is also beneficial to the teaching, learning and assessment cycle in providing information about developmental similarities and differences important to teachers, children's learning and the community. A test for teachers in the classroom, which can find out children's capacity to pronounce phonemes, is a tool

that can help many children who cannot read. This could indicate if these children may need further assessment and help.

2.1.2 The core of language

The core of language is a very important part of human cognition, which distinguishes us from other animals, and the capacity to use language sets us humans apart from other animals. Noam Chomsky (1996) Brown (1991), Clark (1997), Gould (1981), believe that part of the brain have evolved over time specifically for producing and understanding language. Language is a tool simple enough for a child to grasp effortlessly, yet so complex that we may never completely understand just how genetics and experience interact to produce this most integral human trait. The capacity to comprehend and use language is one of the most reliable indications of the grade of mental development. The recognition of gestures comes first and the comprehension of language heard next, the capacity to repeat words and sentences mechanically, and finally, the capacity to use language as a means of communication.

The chief functions of language are that it is an instrument for thinking, a means of expressing and communicating thought. Language gives the power of analysing complex tasks such as writing. Language also shortens the process of thinking and the possible formation of concepts. Body language, word language, picture language, is how we express thoughts and feelings with these three, but words are perhaps humanity's most beautiful and most dangerous creation. Words can cut or caress. A dozen words can inflame or kill a passion. Words assembled into manifestoes may rouse the enthusiasm of crowds or make war, and with words people betray their countries and friends, so words dominate our lives. Linguistic science gives us statements and pistils of the flower, but not the beauty and power of words in play.

Language is a social product studied in linguistics and it is found that linguistic language in humanity is manifested in an infinite diversity of language. A language is the product of society and societies are different and they do not have the same language. As language is the way countries keep their identity so they are

influenced by the culture of the country they belong to. In the 20th century, there was speculation on the origin of language. It became the interest in the fields of linguistics at the end of the century.

In my research I have tested the sounds of language in children using the International Phonetic Alphabet (IPA). The history of the sound systems in human languages began when alphabets were invented and used in poetry, oratory and drama. It was orthography that inspired Martianus Capella, the Icelander known as the first grammarian, and Henry Sweet (1875) to consider what today we call phonemes. In the 19th century a great deal was done in the study of phonetics, leading to changes in the study of sounds by Rask (1787 to 1832), and Saussure (1857 to 1913). At the end of the century the sound system could be recorded, allowing phonetics to become a scientific study. Furthermore the distinction between phonetics and phonology followed from work accomplished by Sweet (1875) and the Prague School.

For centuries people have sought to combine all languages into one universal language so that all the people of the earth could easily communicate with one another, the International Phonetic Alphabet accomplishes this goal. Borrowing from the Latin language, The International Phonetic Alphabet originally had each symbol qualifying as a different sound in each alphabet. Paul Passy who was a French linguist, founder of the International Phonetic Association in 1886. He took part in the elaboration of the International Phonetic Alphabet a linguist and a group of his fellow peers established a revision of the IPA in 1888 to make a uniform set of symbols to be used in all languages.

The IPA is meant to combine all languages in one uniform language of sound and symbols and its usage today is very particular to one main group of professionals. Linguists use the IPA the most to help learn the etymology of a word or to teach specific sounds and languages to new learners of a language.

The International Phonetic Alphabet (IPA) is an alphabetic system of phonetic notation based primarily on the Latin alphabet. It was developed by International Phonetics as a standardised representation of the sounds of spoken language. The

IPA is designed to represent only those qualities of speech that are distinctive in spoken language such as phonemes, intonation, and separation of words and syllables.

The main principles of the IPA are that there is a separate symbol for each distinctive speech sound, and that the same symbol should be used for that sound in any language, with an alphabet system. One of the features of this alphabet was that it should consist of as many known symbols as possible, using new symbols and diacritics only when necessary. The same principles are still used today to work out pronunciation. Over time the IPA has been modified and extended.

Scoring for the screening test was taken from the number of correct responses given out of the 52 listed phonemes based on the IPA. (International Phonetic Alphabet), the screening test was created with the isolated phonemes based on the IPA, and to be utilised to assess children's phonological development for the purpose of the research for this thesis. I then used this screening test to put the isolable phonemes of the IPA in order of difficulty for children in the Brisbane metropolitan area. And I hope in the future to build a systematic test of phonemes in the principal functional groups used in articulate speech, such as words and phrases, and put these test items also in order of predicted difficulty before standardisation. This could be done for further study.

In combination with the IPA I used the St Lucia Graded Word Reading Test (Andrews, 1973). This test is an individual reading test consisting of 100 words, graded in order of difficulty, which are intended to give an accurate estimate of word reading capacity for children in primary school grades. In addition to providing a reading age for these children, it can be used to advantage in preliminary diagnosis of children's reading difficulties by revealing methods of word attack employed and allowing an analysis of error patterns. These errors may include tendencies to reverse words or word parts.

The development of the test was designed for Australian children. The difficulty levels of all words in the items were calculated and those words selected were allocated proper positions in the word list and a satisfactory level of gradation was

thereby obtained. The standardisation of the test was undertaken to produce a table of norms directly related to the number of words read correctly by each child. The normative sample consisted of 435 children who were chosen randomly from children enrolled in 12 selected Brisbane primary schools. Test- retest reliability of the test, on a group of 105 children in grades 4 and 5, was calculated at $r=+0.947$. A reading age for each child was obtained by establishing the number of test words a child was able to read.

The underlying complexities of English vocabulary, semantics, grammar, syntax, language interference and code switching from other languages that are relevant to speaking English show that the last common pathway in all oral communication involves the acquisition of phonemic knowledge and the capacity to articulate whole words.

Phonological knowledge is the knowledge of sound patterns. For us to make sense of any written text that we read, phonological knowledge helps us by giving us the way for linking letter clusters with the way we speak words. It is necessary to connect the written words with our spoken knowledge or what we know about how words are said and it also helps us to detect sounds in spoken words. Children acquire phonological knowledge as they develop from Pre-school years to the third and fourth grade. Most children do this easily and others have difficulty saying words and reading words, as the written words do not coincide with their spoken words, and they omit or substitute sounds and syllables.

The acquisition of phonology starts with the first words being generally monosyllabic (Fromkin, Rodman, Hyams, Collins, & Amberber, 2005). It has been suggested that children first acquire the small set of sounds common to all languages of the world, and in later stages they acquire the less common sounds of their own language. Children who do not develop babbling within typical expectations risk further communication impairment, as late talkers who have not yet entered the meaningful stage of speech scored much lower than age matched peers on all measures of phonemic complexity (Glaspey & Stoel-Gammon, 2007).

Early language skills play an important role in the learning of reading. Learning language and learning to read are related but over the past 20 years, important advances in understanding the role of children's awareness of the spoken language and phonemic awareness have been studied, which refers to the capacity to identify, compare and manipulate the smallest units of spoken words, being the phoneme. Most spoken words contain more than one phoneme; it is of great importance for the child to have the- capacity to be aware of phonemes themselves, as this is the best predictor of reading. Phonemic awareness is thought to help children learn to read because it allows children to understand that letters correspond to the sounds of spoken language (Senechal, 2009).

Lack of motor skills in producing English phonemes may also be an important factor hindering children from learning to speak effectively. Language disorders are important in the child's development, and the impact of such disorders increases the importance of having good assessment tools and programs to support young children's language acquisition. Children with early language disorders are at risk of social and behavioural problems as well as academic failure, including literacy difficulties. Thiemann and Warren (2005) found that effective intervention requires an ideal language-learning situation, and the use of proper assessment of the child's language is vitally important. Some children may have a physical impairment, causing the child to have speech and learning difficulties (Fromkin, Rodman, Hyams, Collins, & Amberber, 2005).

There is a great variation on the pronunciation of the first words an infant says. Some words might be almost perfect adult phonemes, others comprehensible only to the infant's closest family. The infant represents words in terms of phonemes, with pronunciation that becomes systematic and predictable if in a normal language environment. When infants learn the phonemes of their native language, they first master sounds, which closely resemble, but yet differ from, one another. The first words with meaning that the infant learns are often "ma ma" and "pa pa" in English. With the sounds / m / and / p / a bilabial stop is pronounced; the passage of air is blocked, but the vocal track is wide open in the low back vowel / a / bilabial made in the front of the mouth, while by contrast / k / is formed in the back.

One may make probable generalisations, as the processes in an infant's speech development are somewhat predictable, since similar processes are found in all child speech development. The infant begins using a large number of phonemes, and eliminating others as adult pronunciation is achieved. There is a maturation part that continues to be clear in the form of babbling in children with normal hearing through the first year. Phonology experts view children mastering the pronunciation of their language as problem solvers. They develop a variety of temporary strategies for producing sounds, so that they may say adult words within their range of physical and cognitive capabilities.

The fact that infants are sensitive to sounds and respond to phonological information is well established. As early as 1979 research by Benedict concluded that by 18 months the average child might have a vocabulary of about 50 spoken words. At this age many researchers have also observed that the child starts to give words meaning. It seems that this is when babies start linking labels to things they see or hear. Babies seem to realise, about this time, that words can attach to things. Later studies found that at first the small number of sounds they are able to control limits children's production of phonemes.

Children, as they grow, apply systematic strategies to simplify words to improve their phonological capabilities. Children can point to a correct picture when presented with words, which have adult pronunciation and comprehension is clearly ahead of production. Bartlett (2000) found that early language problems were considered highly predictive of later communication problems, including problems in learning and reading. The development of verbal language is one of the best predictors of school performance and an indicator of general cognitive development.

School entry generally marks the time at which earlier language problems surface as learning problems, as children begin to connect spoken and written language. Those who do not easily learn to read and write often have difficulty learning the alphabetic system and the relationship of sounds and letters. Further exploration of how children develop over the years of schooling and acquire, support or otherwise

develop their phonemic knowledge will give important information for teachers, parents, curriculum developers and those creating learning materials for both early childhood and later reading intervention programs.

Both educators and laypersons have found it difficult to understand auditory conceptualisation dysfunction. Parents and teachers would ask me, does it mean that the children don't hear well? The answer is *no*. Usually the children hear the word very well. Auditory acuity itself is usually not impaired, but the impairment lies in not being able to perceive the sounds that are in a syllable/word. Such children cannot engage in auditory segmentation of the word into parts. This is the exact reverse of children with a language comprehension dysfunction, who perceive a few parts but not the whole. As one would expect, children with this specific auditory conceptual dysfunction have difficulty decoding words. They usually track the first or last sounds in a word but the interiors of words scramble or wash for them at the auditory level but not at the visual level.

For the child learning to read, the development of phonemic awareness, the learning of phonemes and a high level of auditory acuity are typical requirements. While reading readiness tests (Bell, 1997), usually test the child's knowledge of letter names, sounds and basic concepts about print, the holistic testing of children's knowledge of the phonemes and level of phonological development underpinning the English language receives limited emphasis, either for reading instruction or for detection of learning difficulties (Lindamood 2011).

Gleason (1989) in the following figure illustrates the processes that a child in Grade 1 would use to decode the word "cat".

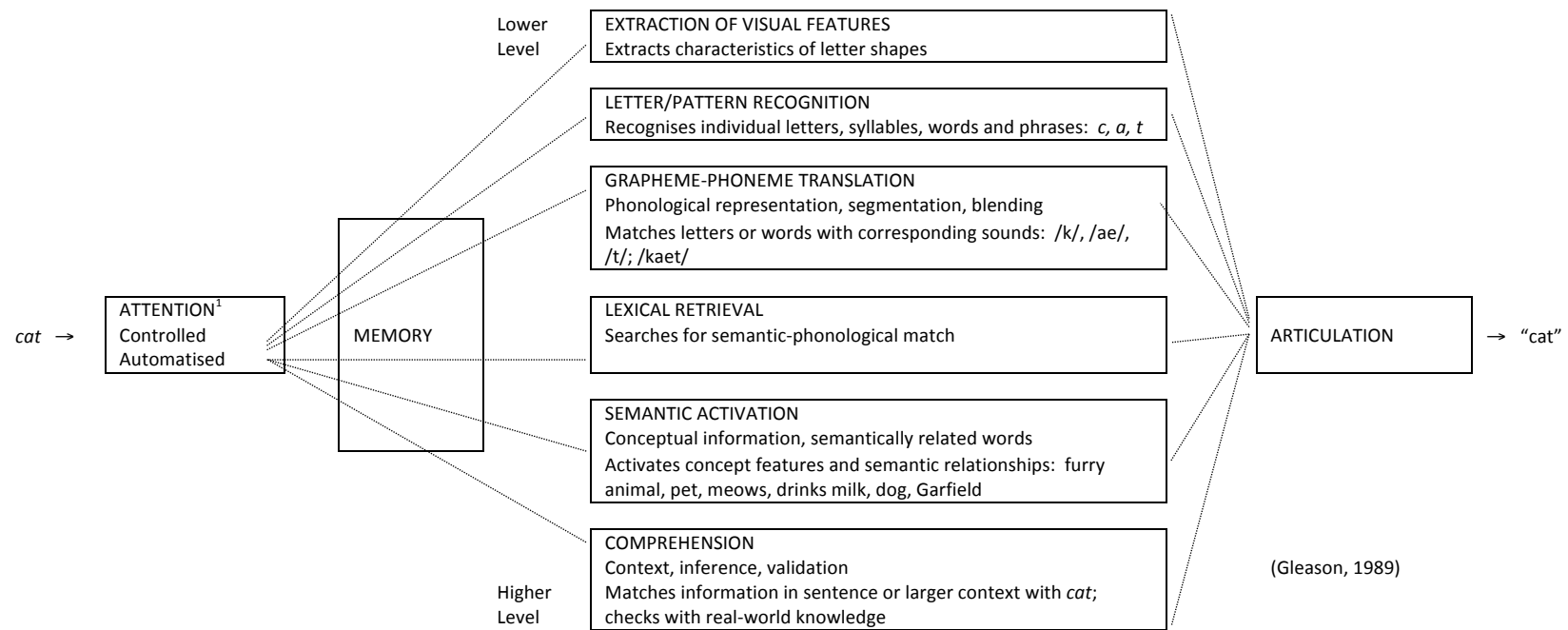


Figure 2-2 The decoding process (Gleason, 1989) p 159

In Figure 2-2 (Gleason, 1989) the process of language coding, emphasises the importance of how learners must attend to the print extract, and the visual features, recognise the graphemes/morphemes, and then translate them into their corresponding sounds, using knowledge of phonology and orthography. They must also search and retrieve phonological and semantic (lexical) information about the word, integrating any available contextual information, drawing inferences, and validating or refuting the targeted word accordingly. Readers need to be able to name letters, phoneme / graphemes, which are skills that rely upon the reader's short-term memory in order to keep the various pieces of information. These are sequentially extracted from written material (Lindamood, 2006).

2.2 Phonological awareness in childhood to adolescence

Children's acquisition of phonemes and phonological awareness reveals that they may regress at certain times in their development, and that phonological awareness is a gradual and changing process, which may be informed by a range of factors. This raises the question about children who move from early childhood to adolescence and fail to read by being slow readers and who have lagged behind in phonological development. These children with developmental phonological difficulties need skilled help or phonological therapy to master the sound system of their native language. To do this, I designed individual programs and guidelines in my clinic to accelerate the child's phonological development, but this was not easy without access to a test of phonemes that was easy to administer regardless of a child's age or situation. Phonological therapy aims to help the child to systematically in learning the sounds of the language and how they are organised for speech. But again in the teaching and learning cycle it was important to give feedback to both the teacher and the child to make learning and improvement explicit. The use of the IPA in a short version in order of difficulty is a helpful tool for fulfilling this aim.

Most children who are discovered to be lacking in learning the sounds of language must seek professional help for assessment. As for assessing Pre-school children's level of awareness, one must remember that to make them more comprehensible

may be relatively minimal. They seem to make adjustments without being fully aware of the changes they have made. The conscious awareness increases dramatically when children begin attempting to read and write. Children can depict divisions between words and roughly reveal distinctions between phonemes, but to read and write children need to map units of speech to the correct symbols. In order to do this, children must first be able to focus on the correct units in their own speech, which is difficult, because words and phonemes are not clearly marked in speech, and young children are not aware that they are distinct units.

Phonological awareness can be shown in children as young as three years old. It was important to include this age group in my research by testing them with The Picture Word Reading Test. This may show if a child could experience difficulties when going to school as many children develop a high level of phonological awareness during the early Pre-school years. As a result of reading instruction in alphabetic systems that stress sound-symbol correspondences, many children experienced great difficulty attending to phonemes. This fact is reflected in the finding that varied measures of phonological awareness have been strongly related to reading in Grade 1, again substantiating the need for a teacher-testing device. Many children from Grade 1 and over need help with the letters in words instead of treating words as graphic patterns, a tendency seen in non-readers. As they learn to map phonemes to print, children are often able to develop systems for transcribing speech and so begin to learn how to read.

The development of phonological awareness is generally acknowledged for early childhood readers, but its relevance to older children who have not learnt to read in spite of several years of schooling has received limited attention unless these children come under the category of speech pathology needs. In the education field, working with phonics and phonemic awareness is strongly associated with teaching in early childhood and typically baby work, which seems out-of-place, particularly when the children in need are adolescents. One of the challenges of providing intervention programs for adolescents and adults is to give learning activities which develop phonological awareness, but which also are socially and cognitively valid for the learner.

Delays or differences in development are by no means definitive signs of intellectual retardation or cognitive disorder. Such variations on normal intelligence may be just deviations, and may be accompanied by superior abilities in other areas of cognitive functioning. The fact that a child cannot read or write does not mean that s/he is not of normal intelligence and could not develop these skills with specialised programs. In addition to serving as a prerequisite for basic reading skills, phonological awareness and processing appear highly related to expressive language development.

Readers with core deficits in phonological processing problems may have difficulty segmenting phonemes, retrieving the names of common objects and letters, storing phonological codes in short-term memory, categorising phonemes, and producing some speech sounds. Reading and comprehension depend, for the most part, upon the rapid and automatic capacity to decode single words.

2.3 Testing children's knowledge of the phonemes

The holistic testing of children's knowledge of the phonemes and level of phonological development underpinning the English language receives limited emphasis. The development of a test for teachers would help bridge this gap and be an asset to assessing children's phonemic knowledge as the process of sub-lexical knowledge emphasises the importance of how children must attend to the print extract and the visual features, recognise the graphemes/morphemes, and then translate them into their corresponding sounds, using knowledge of phonology and orthography.

The level of detail may be exceptionally high where sometimes a single isolated sound in English can at the same time be a phoneme, a morpheme and a word – e.g., 'a' as in 'ago' or 'a book'; 'Sh' as in 'Sh!' or 'shed'. Phonemes also may be in different positions within a word – e.g., 't' as in 'tap', 'pat' and 'patter'.

It is important to understand that auditory processing and phonemic awareness skills are potentially key elements of underpinning reading, and consequent literacy skills for all those learning to read and those experiencing problems,

regardless of age. Concepts about books and how print works are also necessary for children who are moving towards literacy, who then begin to attend to aspects of the print that surrounds them. Along with this are the growth of phonemic awareness and the acquisition of phoneme-grapheme knowledge.

In the questionnaire used for this research to build rapport with children, I found that many children grow up in homes where books are not shared, and opportunities to hear and produce language are limited, whilst in other cases cognitive processing deficiencies block the growth of their learning. To join up developing phonological skills and the capacity to pronounce phonemes, children must be aware of language in terms of both small and large units of meaning.

McLachlan (2007) confirms through his research that children with auditory processing disorders can be helped, mainly achieved through change to the acoustic environment and sound delivery to the ears, and through auditory and speech training. Recent advances in sensory learning research have led to recommendations that include the use of specific training stimuli using phonemes, and keeping the child on task and with challenging learning resources. Auditory processing is a critical function in what may be termed reading. It is only logical then that phonemic processing is a necessary ingredient in the reading process since it is not possible to memorise the visual shapes of all the words in the English language, or to guess all of them accurately based on contextual cues. It is critical to decode accurately since decoding errors can change imagery and change comprehension

2.3.1 English as a second Language

Being aware of the multicultural nature of schools where the research was to be conducted, was deemed necessary to be aware of the implications of the research for children with English as their second language. Many children in the Brisbane metropolitan area have English as a second language. At home they speak their first language L1 and at school they speak English as a second language L2. When a child learns two languages there is a parallel in the development in phonetics, morphology and syntax, and the child soon becomes aware of her/his bilingualism

and translates messages from one language into the other. At a later stage in his/her life the child's usage will reflect functional specialisation brought about in part by schooling. Because children must distinguish sounds they hear before they can distinguish sounds they say, it is important that children who speak English as a second language learn to distinguish the sounds they hear in words in their primary language before they have to distinguish sounds in the second language.

Acquisition of phonemic awareness for the English language may be more difficult for them and/or perhaps if their first language has quite different sounds from English then there may be some inter-language impact.

English as a second language (ESL) refers to the process of producing bilinguals by teaching English as an L2 to learners in an English-speaking context. ESL is distinguished from English as a foreign language (EFL), which is instruction delivered in a context where English is not used regularly outside the classroom, using the instructional techniques and the intensity of instruction required to achieve success. The term ESOL (English for speakers of other languages) is meant to encompass both ESL and EFL.

2.4 Reading comprehension and the role of phonology for older children in secondary schools

Reading comprehension is defined as the level of understanding of text. This understanding comes from the interaction between the words that are written and how they trigger knowledge outside the text. Proficient reading depends on the capacity to recognise words quickly and effortlessly. If word recognition is difficult, children use too much of their processing capacity to read words, which interferes with their capacity to comprehend what is read. During the last century comprehension lessons usually comprised children's answering questions but in the later research studies it has been concluded that there are much more effective ways to teach comprehension, such as summarising what you have read, monitoring your reading to see if it makes sense, and analysing the structure of the text.

Typically, by the time a child is having difficulties learning to read they have experienced significant feelings of failure, despite the quality of the classroom (O'Neill & Gish, 2008). Winch, Johnston, March, Ljungdahl and Holliday (2006) refer to reading as crucial to the development and success of young people. Effective skills give children the opportunity to do well in English and in other areas of the curriculum. It was Armbruster (2003) who began to investigate the role of phonology for older children in secondary schools.

Goldston (2007) states that adolescents with poor reading skills showed higher rates of current attention-deficit, hyperactivity disorder, and anxiety disorders, and that adolescents with poor reading evidenced more functional impairment across multiple areas than youths with typical reading skills. The increased psychiatric morbidity and functional impairment of adolescents with reading problems highlight the importance of developing interventions that help these youths address reading deficits and associated vulnerabilities during the years of secondary school.

The knowledge and contextual information that readers bring to reading cannot be activated to make meaning without the capacity to build a bank of words in the form of a mental lexicon which is a dictionary like a memory store. This knowledge includes word meanings, knowledge the way in which words can be joined or collocation, how they are placed in a sentence structure, and how it gives syntactical and semantic information.

As reading is the door to acquiring knowledge, the capacity to read and comprehend depends on the rapid and automatic recognition of single words. All words are usually unfamiliar when shown for the first time and a powerful strategy is for the student to use phonological knowledge to find the word. Children recognise the unfamiliar word by identifying and blending its phonological sounds and comparing that sound pattern to the sound patterns of words in their oral vocabulary (Hay, Elias, & Brooker, 2005). The child must learn to decode some thousands of words that are initially visually unfamiliar and to commit those visual patterns to memory.

Tomblin (2005) says that reading is a complex, interactive, multi-process, learning process, and as such can in theory be disrupted in many ways. Of note is the finding that auditory processing is a critical function in the reading process and that phonemic processing is also a necessary ingredient. It is vital, for readers to decode written texts accurately because if a reader makes decoding errors the imagery will be changed and in turn so will comprehension.

2.4.1 Poor readers

Rief (2005) drew attention to the fact that most reading specialists agree that a core linguistic deficit underlies poor reading at all ages, and that poor readers as a group exhibit weaknesses in phonological processing and word-recognition speed as well as accuracy. This applies to all poor readers rather than what is typically emphasised in relation to young children in the early years of schooling.

Many children entering school with varying degrees of competence in speaking their language have very little knowledge about how to read and write. Literacy instruction in school education involves helping children master the challenges of linking written and spoken language. This includes the acquisition of the alphabetic system, learning to decode new words, building a vocabulary that can be memorised and read, and becoming able to build, integrate, interpret and remember meanings represented in text (Center, 2005).

Children recognise unfamiliar words by identifying and blending their phonological sounds and comparing these sound patterns to the sound patterns of words in their oral vocabulary. Despite the research-based recognition of the essential phonemic knowledge and awareness for learning to read, no reading method used over the years has been found to help directly with phonemic awareness. The National Reading Panel (2008) says that the literature and curriculum materials may include the theory that emphasises the importance of phonemic awareness to learning to read. On the other hand, class teachers do not necessarily understand its importance or know how to incorporate it into reading pedagogy, particularly as children grow older yet still experience reading difficulties. A danger is that teachers are hearing and seeing the term phonemic awareness, but do not

understand the difference between a teaching interaction that elicits the development of phonemic awareness and an instruction that attempts to exercise it only through phonic activities.

The National Reading Panel (2008) found that phonemic awareness improves children's word reading and reading comprehension, as well as helping children learn to spell. Importantly, phonemic awareness is the basis for learning phonics. Wehby, Falk, Barton-Arwood, and Cooley (2003), Emmitt, Komesaroff and Pollock (2007) writes that learning to read involves learning to use language to achieve authentic purposes in particular contexts. Melby-Lervab, (2011), says that a strong sociocultural emphasis on reading raises critical questions about language use. Critical literacy theories stress the importance of viewing literacy users as meaning makers. Earlier Bishop and Freeman (1995) agreed that the reading process requires readers to join meaning by bringing what they know about the world and language to help them predict and make sense of the visual cues on the page. Contemporary research shows that the issues are more serious and the debates about the problems have increased.

It has been found that children in the early years of schooling who fail to learn to read typically become a disadvantaged population in middle and secondary school, since they are unable to engage in the class programs, which require the capacity to read and work independently. As reflected in community literacy levels, these children remain disabled readers in spite of their years at school and the services of remedial reading specialists and tutors.

2.4.2 Children with learning difficulties

Furthermore, there is a strong argument that the capacity to deal explicitly with the phonetic units of speech is not acquired spontaneously by either child or adult. Additionally, it would seem that, rather than awareness of the phonetic structure of speech being a precondition for learning to read, the cognitive capacity of becoming aware of phonemes during the first stages of the learning process is the facilitator. Metaphonological abilities are an important facilitator for those with normal phonological and auditory perceptual development and experience. In the

context of complex cognitive skills such as reading and spelling, the search for true prerequisites might be of less value, because such skills are highly flexible, and are probably learnt in many ways.

More importantly, the direction of causality provides strong evidence to support the focus of this thesis research into phonological development. Of further consideration is that the child's-metaphonological skills arise from his or her acquaintance with orthography. The teaching of reading and spelling might well include activities and tasks designed to train and improve certain metaphonological abilities, such as sound segmentation and sound blending, making reading and spelling easier. If this were the case, then teaching methods that incorporate such features would be expected to be more successful for most children.

While this thesis focuses on phonological development and auditory acuity, it is important to appreciate the contribution of this aspect of the reading process and its influence on teaching methods. In view of the literature discussed, which provides strong support for the importance of phonemic awareness and phonetic processing skills in learning to read, it seems that the teacher would be able to design more appropriate learning activities to meet children's needs more effectively if they had knowledge of their children's level of phonological development and phonemic awareness. In this way the review of the literature provides evidence to suggest first, that phonological awareness can be developed before children have the capacity to read independently and secondly, that phonological awareness and auditory processing are strong success factors and almost causal factors in later reading acquisition.

In reading, the fundamental illumination that words on a page have meaning is ideally achieved in early childhood. This illumination then provides the motivation to learn the basic component skills of reading one by one, letter sounds, word recognition, spelling, grammar, and so on. Gradually the components are integrated into an almost automatic set of strategies used in meaningful, logical, verbal, sequential, and analytic thinking.

Comprehending written texts is a complex process that involves fluent word recognition as well as the activation of word and world knowledge, making inferences and integrating parts into a coherent whole. Children's vocabulary development is one part of oral language that is necessary for reading comprehension (Senechal, 2005).

2.4.3 Paradigm for the reading process

Lindamood (2011) presents a paradigm for the reading process, which illustrates the need to integrate the three primary functions of phonological processing (word attack), orthographic processing (sight word recognition) and contextual reading (vocabulary).

- 1) The importance of phonetic processing awareness in early literacy is that children who do not have an awareness of the sound structure of language cannot attend to the separate sounds in spoken words and are unable to show letter sound correspondences (Norris & Hoffman, 2002).
- 2) Sight word recognition is important to help learners to read. For example, words such as, *there, was, said, and come*, are irregular words that cannot be sounded out. Words that are governed by more complex spelling rules that have not yet been taught, such as *boy and eat*, and others such as *Spiderman and horse*, that are more complex words are likely to be of interest to the learner.
- 3) Contextual constraints and oral vocabulary, which is the correction of errors, and imagery for comprehension, the process of forming mental images of what they read to improve reading comprehension.

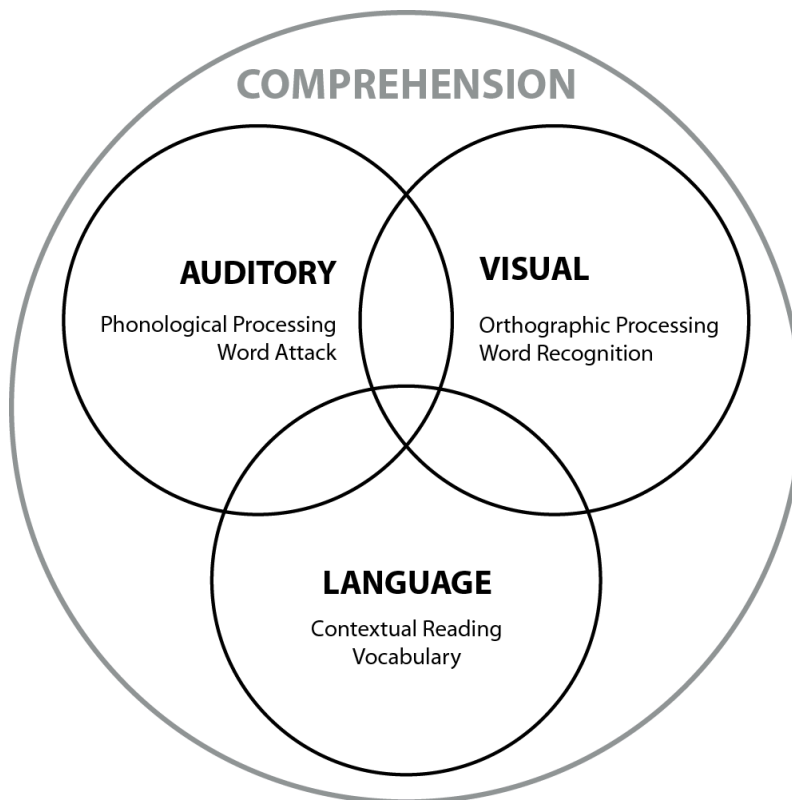


Figure 2-3 "Reading circles diagram" (Lindamood, 2011, p. 5)

Both oral and written language comprehension are necessary for a skill in reading and understanding. Lindamood (2011) overall philosophy of language is represented in Figure 2-3 above, which illustrates the integration of the underlying domains involved in language processing, this is a key statement for understanding how reading takes place.

The larger outer circle represents the holistic concept of reading comprehension. The three overlapping circles illustrate the multiprocessing involved in making meaning through reading. The auditory circle represents phonetic processing, which involves the capacity to sound out a word accurately and fluently. It is critical because a total reading vocabulary of the English language cannot be memorised.

The visual circle represents sight word recognition. This is the capacity to recognise a base of words instantly, without the need for phonetic processing. A well-established sight word base is critical to the reading process since, without it, the reader would have to process phonetically every individual word as s/he reads. This would be slow and laborious and it would impede the understanding.

The language circle represents vocabulary and the use of context. This is the capacity to understand the meaning of isolated words orally and the use of contextual cues based on the semantics (meaning) and syntax (grammar) of the written material. Words can often be anticipated based on context, so that good readers have the capacity to presume the sense. When this is not possible, a person may have an auditory conceptual dysfunction. Comprehension occurs when all three functions work simultaneously during the interactive process of reading.

2.4.4 Auditory conceptual dysfunction

Figure 2-4 below may also be used to illustrate an auditory conceptual dysfunction showing weakness in the auditory part as the undeveloped circle. Weakness in the auditory component impacts on both the visual and the language circles and ultimately on comprehension.

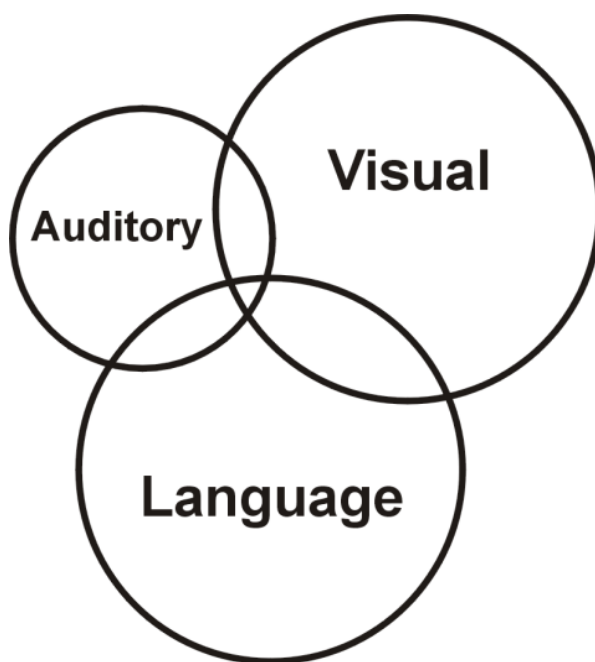


Figure 2-4 Auditory conceptual dysfunction (Bell, 1991a, p. 231)

Individuals of all ages and backgrounds can have an auditory conceptual dysfunction that impairs their capacity to decode words; the treatment to overcome this focuses on phonological awareness, which is the explicit

understanding of a word structure. This is the efficient decoding of printed words and the capacity to form connections between sounds and letters when spelling, which ultimately develops auditory segmentation. The organs of speech, which are the source of sounds –tongue, lips and soft palette –, change these sounds to produce different vowels and consonants. Individuals can be taught to perceive sounds by experiencing the motor movement of the sounds. This procedure begins with isolated sounds consonants and vowels and moves to the syllable and multi-syllable levels. In this way, through a series of specific steps, all children of all ages can develop their auditory conceptualisation, thereby developing their word attack and decoding skills. In general, the teaching of reading is an area, which is not commonly treated in- depth beyond learning the sounds of the consonants and vowels.

2.4.5 Conceptual framework for early reading fluency

CRUCIAL FOR READING COMPREHENSION

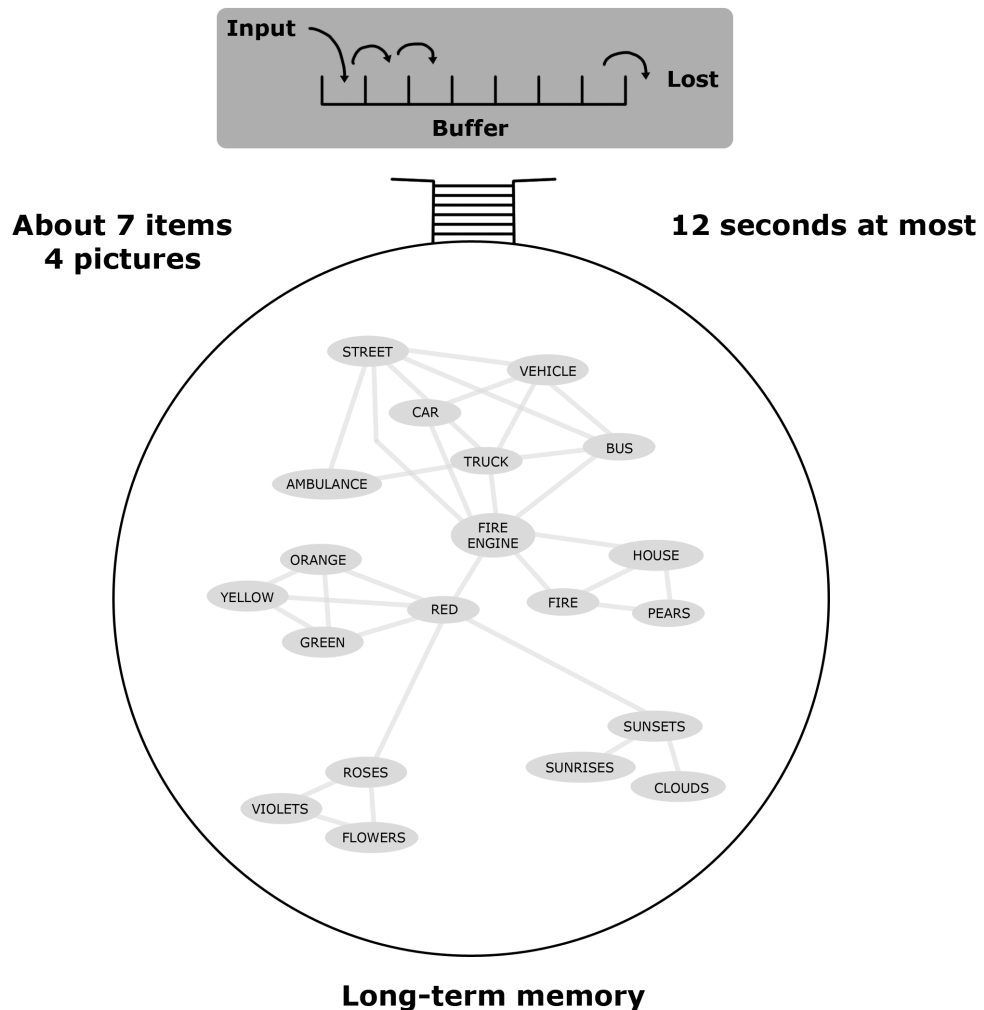


Figure 2-5 Insights from monitoring indicators found from cognitive neuroscience (Abadzi, 2008)

It has been found that children read at least a word per 1-1.5 seconds, with a 95% accuracy (correlates .87 with speed, 7 words in 12 seconds= 45-60 words per minute, but that they need some processing time) To get through the narrow opening, the mind creates chunks of information and letters and small items become larger pieces and pass as one through working memory. Figure 2-5 above shows this process.

Small items must be chunked and practised to the point of fluent performance and this is how children decode ever-larger units, from syllables to words. How do children get to fluency? A special brain area becomes activated (occipital-temporal

lobe). There are three primary reading areas in the brain: one is for single letters and slow reading, secondly the nerve wiring then develops in children's brains, and the third is for automatic reading. It has been found that all are used automatically, and that white matter in the brain is needed for reading and larger working memory (Nagy, 2005).

2.4.6 Testing phonemic knowledge awareness

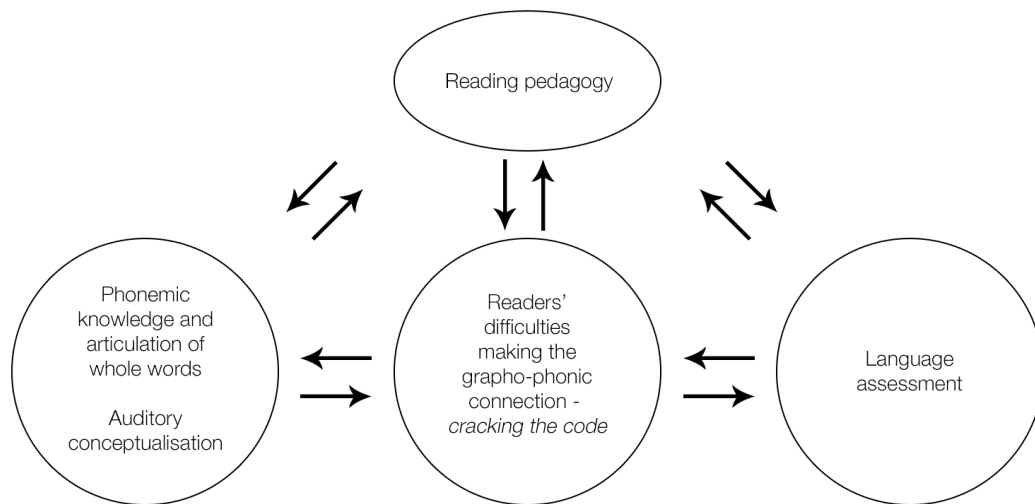


Figure 2-6 Reading pedagogy

Figure 2-6 Reading pedagogy demonstrates the importance of phonological skills and word attack, sounds and segmentation, in the approaches to phonemic knowledge and assessment of reading readiness and testing phonemic knowledge awareness, auditory conceptualisation and the need for assessment for teachers in the classroom. The research showed that auditory conceptualisation was a critical factor common to this group. Regardless of whether children had been referred to the clinic for language or literacy difficulties, it was found that while they were able to make gross judgements of sameness or difference with respect to spoken syllables or word pairs, they could not make precise judgements about how and where two syllables or words differed. The capacity to respond to relatively small differences at the oral comprehension level, in no way ensures that judgement can also be made about how the individual phonemes in minimally different words compare and contrast.

According to Glaspey and Stoel-Gammon (2007), assessment in phonological difficulties provides different information about a child's skills and development. They describe two types of assessment: dynamic assessments this evaluates a child's phonological system when given support, where as static assessments test skills without support. Hattie and Timperley (2007) research shows that feedback to children is at the top of the list in terms of fostering learning so a new user-friendly diagnostic tool for teachers in the classroom to enhance teaching reading/reading pedagogy is an important asset.

Teachers in the classroom are limited to find out at an early stage if children have trouble with the pronunciation of sounds before them being formally taught to read, this is because all the test are mainly to be used by psychologist. Recent Teaching Reading reports refer to the approach to testing young children which reflects the method preferred by Marion de Lamos (2004), who criticised assessments of reading that evaluate the capacity to get meaning from text via a variety of strategies, but who thought that using phonics could be the key to raising the levels of attainment of literacy tests.

This research is also beneficial to the teaching, learning, and assessment cycle in providing information about developmental similarities and differences, important to teachers, children, and the community in our globalised world, where reading/information processing demands are rapidly increasing. Owing to the fact that Australia is a multicultural society, it is important to consider the difficulties non-English speaking background children have and their difficulties when learning to read.

2.5 Conclusion

Testing phonemic knowledge awareness, articulation of whole words, auditory conceptualisation and language assessment is the focus of this study. Reading pedagogy demonstrates the importance of phonological skills and word attack, sounds and segmentation in the approaches to phonemic knowledge and assessment of reading readiness and testing phonemic knowledge awareness and

auditory conceptualisation and the need for assessment for teachers in the classroom.

In summary, this thesis investigates children's capacity to pronounce phonemes and whole words in relation to learning to read, a skill crucial to the English language acquisition and the development of English literacy with the aim to develop a testing tool for teachers to use in the classroom. This being of importance for auditory processing skills in learning to read, and noting the importance of literacy being integral to success in contemporary society, including education, lifelong learning, social interactions, leisure, work, communications and business, it is also an important part of the information revolution.

Chapter 3 reviews the literature and elaborates the relationships between the role of phonemic awareness and knowledge in the decoding and reading process, the role of phonology in language development, children's development, and issues of assessment. Language testing is defined and a range of tests related to children's phonemic knowledge and reading capacity are examined, relevant to the research in the field. Finally, the basis of the study's research design is foreshadowed, and a justification is provided for the approach taken to researching the assessment of children's phonemic awareness and knowledge.

Chapter 3

LITERATURE REVIEW

3.1 Introduction

Chapter three focuses on the importance of phonemic knowledge to reading and literacy development, the reading process and the development of skills in this area. The nature of language assessment is discussed, as the aim of this research is to conduct an assessment of children's capacity to pronounce isolated phonemes and their capacity to read or say words aloud in the English language: implications to read, with the idea of designing a potentially useful test for teachers. I further discuss the influence of changing views of reading approaches and how it affects child development and reading skills, the use of phonology processing, speech perception, reading strategies in the schools, the acquisition of phonemes and phonological awareness, the decoding process related to children's phonological development, and language testing.

Phonemic awareness is a subset of phonological awareness in which listeners are able to hear, find and manipulate phonemes, and these are the smallest units of sound that can differentiate meaning. It is critical for very skilful reading fluency (pronunciation) and literacy (spelling and reading). As noted in Chapter one, phonological awareness is an important and reliable predictor of later reading capacity, and it is often confused with phonics, but it is different. Phonics requires children to match letters or letter patterns to sounds, in other words they need to be able to decode using their knowledge of the spoken language to read the written words from a page. However, phonological awareness relates only to speech sounds, not to alphabet letters or sound spelling. Phonological knowledge is an important factor in the process of reading and ultimately children need to make meaning from the written text.

This study highlights the need to recognise that the phonemic knowledge and skills underpinning learning to read apply to children in the middle years as well as early

childhood. Many teachers of older children may not see themselves as teachers of reading and for that matter neither do parents think that older children need help. Phonological awareness needs to be included in the pedagogical approach for older children as well as adults, despite the fact that there is usually a stigma attached to the teaching of phonics as it is commonly associated with early childhood education and nursery rhymes and the like.

The importance of phonological considerations to all children with reading difficulties is well recognised. Harwell and Jackson (2008) found that phonologically based reading disabilities are characterized by difficulties acquiring phonetic reading strategies. The currently available assessment testing tools are mainly for speech language pathologists and psychologists. So teachers are limited to find out at an early stage if children have trouble with the pronunciation of sounds before they are formally taught to read. Language testing is defined and discussed. It is important for to look at other selections of assessment instruments in the field, and to discuss the importance of being able to use proper testing for learning difficulties. The considerations also for non-English speaking background children and difficulties they might have in learning to read are reported.

Reading pedagogy focuses on the importance of phonetic knowledge to reading and literacy development in the reading process and the development of skills in this area, the influence of the changing views on how to learn to read, and the effects this has on children's development in their reading skills through time. An investigation of the capacity of individual children to pronounce phonemes and words at various ages and stages of language development is viewed as being of great value in ultimately supporting teachers in both understanding problems in learning to read and responding to them more effectively. This also applies to children beyond preschool and Year 1, where phonemic awareness may still be lacking and remains an essential foundation for learning to read for all ages (Walsh & Goldstone, 2006).

3.1.1 The difference between phonology and phonetics

With regard to the difference between phonology and phonetics, phonology refers to the logos or science of sounds, while phonetics means pertaining to sounds.

Phonetics is the science, which studies the characteristics of human sound making, especially those sounds used in speech, and provides methods for their description, classification and transcription. Phonetics is divided into two branches: articulatory phonetics, the study of the way speech sounds are made by the vocal organs, and acoustic phonetics, which studies the physical properties of speech sound, as mediated by ear, auditory nerve and brain. Phonetics is a branch of linguistics (Crystal, 2008).

3.1.2 Defining phonological processing and the acquisition of phonology

Researchers Stemberger (2009); Nittrouer, Shune, Lowenstein (2006), Cacace McFarland (2007) and Tyrer (2001), have found that there are several aspects of phonological processing, which are mentioned. These are the probable causes of problems in the acquisition of reading skills. One must ask which aspect of phonological processing the child finds difficult when reading and how this can be helped with special programs. There are several aspects of phonological processing:

- 1) Phonological awareness;
- 2) Awareness of the sound structure of language;
- 3) Phonological recoding in lexical access – recording written symbols into sound based representational systems to get from the written word to its lexical referent;
- 4) Phonemic recoding in working memory;
- 5) Recoding written symbols into a sound-based representation system to maintain them efficiently in working memory.

Phonological processing is an auditory processing skill. It relates to words but occurs in the absence of print. It involves detecting and discriminating differences in phonemes in speech sounds under conditions of little or no distraction or

distortion. A child with phonological needs may have difficulty in one of many different detection or discrimination tasks involving speech sounds in words. This might be manifested through errors in speech production or in misperception of spoken language. Children seemed to pass through a series of more or less fixed stages, or milestones of language, the age of onset of these might vary considerably, while the relative chronology remained the same.

Table 3-1 The normal sequences of phonetic development for a child

Average age by which the speech sound listed is 75% correct during a child's speech	Speech sounds written in phonetic symbols	Manner in which speech sounds are produced
3 years		Voiceless fricative Voiced fricative Voiced glides Voiced nasal Voiceless stops Voiced stops
3 years 6 months		Voiceless fricative
4 years	tʃ	Voiced liquid Voiceless fricative Voiceless affricate
4 years 6 months	dʒ	Voiced affricate Voiceless fricative Voiced fricative
5 years		Voiced liquid
6 years	v	Voiced fricative
8 years	ð	Voiced fricative
8 years 6 months	θ	Voiceless fricative

(Bowen, 1998, p. 5)

Linguists and speech-language pathologists are fond of saying that speech sounds in languages form patterns. One of the most readily recognised sets of patterns relates to the many voiced and voiceless pairs of sounds that occur in English (Bowen, 1998, p. 4). The child knows the correct sound in his/her mind, and s/he

makes these simplifications outlining a range of phonological processes applicable to normal speech and sound development in chronological sequence.

Table 3-2 Chronology of phonological processes in normal speech sound development

Phonological process	Example	Gone by approximately
Context sensitive voicing and word - final de-voicing	pig = pick pig = big car = gar	3 years
Final consonant deletion	boat = bow up = uh soon = soo	3 years 3 months
Fronting	car = tar go = doe ship = sip	3 years 6 months
Consonant harmony	mine = mime kittycat = tittycat	3 years 9 months
Weak syllable deletion	elephant = efant potato = tato television = TV banana = nana	4 years
Cluster reduction	spoon = poon train = chain clean = keen	4 years
Gliding of liquids	run = one leg = weg leg = yeg	5 years

Phonological process	Example	Gone by approximately
Stopping	fish = tish	3 years
	soap = slope	3 years
	very = berry	3 years 6 months
	zoo = doo	3 years 6 months
	shop = dop	4 years 6 months
	jump = dump	4 years 6 months
	chair = tear	4 years 6 months
	thing = ting	5 years
	that = dat	5 years

(Bowen, 1998, p. 12)

All phonological processes are normally gone by five years of age, although each child may show some variation on this chronology. Children below the age of about 4.06 years may not have enough capacity to co-ordinate fully the movement of their vocal apparatus. As a result, certain sounds, sound combinations or transitions from one sound to another may be too difficult. The child may therefore simplify the production of complex words. In the typically developing child, these simplifications are not random but fairly predictable. As children stop using phonological processes, their speech becomes more understandable (Bowen, 1998).

This allows them to become better communicators. For example, between 1½ and 2 years of age, typically developing children may produce around 50 words. Between the ages of 4½ and 5 years, children are able to produce up to 2,000 words. When children continue to apply these processes or patterns to their speech and learn new words at the same time, their speech can become very difficult to understand. Many times the children do not hear the differences in the words and will say one word to mean three different ones. For example, children who continue to drop the first consonant from a word may say "all" to mean each of these words: fall, ball, wall (Bowen, 1998). Of interest for this research is the investigation needed to discover whether children have problems after five years of age.

In school, children often have difficulty associating the speech sounds with letters when reading and spelling. When difficulty in pronouncing phonemes correctly is blocking fluent oral expression, it is clearly important to find and treat such difficulties early. Auditory processing and phonemic awareness skills are potentially key elements of underpinning reading, and consequent literacy, skills for all those learning to read and those experiencing problems regardless of age.

Senechal (2009) found that early language skills play an important role in the acquisition of reading, and that learning language and learning to read are related but distinct domains. Over the past 20 years, researchers have made important advances in understanding the role of children's awareness of the spoken language. Most spoken words contain more than one phoneme and awareness of phonemes themselves is the best predictor of reading. Winch, Johnston, March, Ljungdahl and Holliday (2006) refer to reading as crucial to the development and success of young people. Effective skills give children the opportunity to do well in English and so in other areas of the curriculum.

3.2 Considerations for non-English speaking background children

In a multicultural society such as Australia it is of importance to learn how children who have English as a second language develop in terms of phonology and phonemic awareness. Standard Australian English is the national language of Australia and it is essential that all children growing up in Australia have access to opportunities to become proficient speakers of English. Children who are learning English as a second (or other language) speak a language other than English bring rich and diverse cultural and linguistic knowledge to the early childhood and school settings (The Department of Education, and Early Childhood Development. English as a Second Language. Unit, 2007).

Children learning English as a second language need explicit modelling and language teaching, appropriate time to acquire the new language and quality exposure to English. This requires early childhood professionals to be knowledgeable about the way children learn a second language, the stages of acquisition and the recognition that children differ in their rate of acquisition.

Language is the most powerful tool in the development of any human being. It is undeniably the greatest asset we own. A good grasp of language is synonymous with a sound capacity to think. In other words language and thought are inseparable (Vygotsky, 1986). Language has a major role in supporting children's process of identity formation and in helping them understand where they fit in the new environment they are entering. The acquisition of language is essential not only to children's cognitive development, but also to their social development and wellbeing.

First and second language learning is divided into three phases: First language acquisition (L1) and second language (L2) learning is divided into three phases, the first one is the initial state, which many linguists and psychologist's believe includes the underlying knowledge of language structures and principles that are in the child's head at the very start of first and second language acquisition. The second phase is the intermediate state, which covers all stages of basic language development, including the maturation changes which take place as the child's grammar development takes place known as learner language, the third phase is the last stage, which is the outcome of L1 and L2 learning (Mitchell, and Myles, 2004).

It was important to be aware of the multicultural nature of schools where my research is to be conducted, and I thought it was deemed necessary to consider the implications of the research for children with English as their second language, as an interesting way of comparing L1 and L2 in my statistical analysis. If professionals working with young children suspect language delay, then it is essential when diagnosing language delay to test both the home language and the development of English. Language delay always occurs in both languages. A child whose language skills seem noticeably deficient for their age may have delayed language. Children learning English as a second language are not considered as language delayed unless other symptoms are present. About five per cent of children will experience language delay. Any part of language learning may be affected, including pronunciation, articulation, understanding, grammar, social uses or the capacity to remember words (Dopke, 2007).

In the case of these children it is likely that they have acquired sensitivity to both similar and different sounds to and from those of English, apart from a range of other potential linguistic influences such as Interlingua considerations, and their language background and experience in general. In multicultural classrooms of today, such as those in Queensland, there are substantial numbers of children from non-English speaking backgrounds, so it is as relevant to consider the phonological development of this group of children as it is to consider those from English speaking backgrounds. Loizou and Stuart (2003) from their research and results found that English-Greek bilingual children performed much better than Greek-English bilingual, especially on tasks requiring phoneme awareness. This accords well with suggestions that learning to read in an alphabetic language promotes this level of phonological awareness.

3.3 Multicultural Education in Queensland and its Policy

Multicultural education in Queensland supports a vision of making a world of difference in Education and the arts, and to enhance the community, which values and benefits from its cultural and linguistic diversity to fully realise its social, cultural, and economic potential (Multicultural and Communities, 2005). Cultural Diversity and Community Relations Policy has been designed for the benefit of the education of children who are from other cultures than English speakers. Education in schools outlines the responsibilities of schools to give teaching and learning programs that enable children from all cultures and communities to identify as Australians within a democratic multicultural society and to develop the knowledge, skills and values for participation as active citizens (Multicultural Affairs Queensland, Department of the premier and Cabinet, 2011).

Schools make sure inclusive teaching practices, which recognise and value the backgrounds and cultures of all children and promote an open and tolerant attitude towards different cultures, religions and worldviews. Strategies to help in implementing the Multicultural Queensland Policy include Cultural Diversity Strategy and consultation strategy. Education Queensland undertakes a number of initiatives that support implementation of the Multicultural Queensland Policy.

The Principles of Multiculturalism provides the framework within which multicultural education is implemented. The principles recognise and value the different linguistic, religious and ethnic backgrounds of the people of Queensland. They promote the equal rights and responsibilities of all the people of the state within a cohesive and harmonious multicultural society in which diversity is regarded as strength and an asset, individuals share a commitment to Australia, and English is the common language.

The most recent definition of Australian multicultural policy was made by the present government in October 2010, in a publication called *The People of: Australia's Multicultural Policy* which is based upon the Australian Multicultural Advisory Council's advice and recommendations to government of April 2010. The Australian Government is unwavering in its commitment to a multicultural Australia. Australia's multicultural composition is at the heart of our national identity and is intrinsic to our history and character. Multiculturalism is in Australia's national interest and speaks to fairness and inclusion. It enhances respect and support for cultural, religious and linguistic diversity (Koleth 2010).

Australia is a multicultural nation, since 1945, people have migrated to Australia. It is found today, that many people living in Australia were born overseas and speak other languages than English. Australia is and will remain a multicultural society. The support of cultures and the multilingual workforce give Australia a distinct competitive advantage in the global economy. These rights and liberties include Australians of all backgrounds being entitled to celebrate, practise and maintain their cultural heritage, also their traditions and language within the law and free from discrimination. The present policy definition also establishes specific government services and programs under policies of multiculturalism (Multicultural Affairs Queensland, Department of the premier and Cabinet, 2011).

One of the recommendations of the policy is: *Strengthening Access and Equity*. The aim is: To make sure that government programs and services are responsive to Australians from culturally and linguistically diverse backgrounds. In response to this recommendation the Government will: Ask the new Australian Multicultural

Council (AMC) to manage the access and equity strategy from 2012 to help strengthen the independence of access and equity reporting from government and give a more robust reporting framework.

The government will conduct an inquiry into the responsiveness of Australian Government services to clients disadvantaged by cultural or linguistic barriers. The outcome of this inquiry would give the Government with a comprehensive view on how existing services are performing and how they could be improved. This will be seen as a great improvement for the understanding of different multicultural communities.

Further the government will work with the state and territory governments under the Council of Australian Governments (COAG) to ensure that data collected by government agencies on client services can be disaggregated by markers of cultural diversity, such as country-of-birth, ancestry, languages spoken at home and level of English proficiency. This will feed into the yearly Report on Government Services (ROGS), which is coordinated by the Productivity Commission (Multicultural Affairs Queensland, Department of the premier and Cabinet, 2011).

The English language requirement for Australian visa applicants, are to claim points for proficient or superior English language for all applicants, they will need to complete an English language test. The test must be completed before the visa application is lodged. The following are the points test awards for English.

Superior English needs a score of at least 8 in each of four components of the IELTS test (International English Language Testing System) or the equal standard in a specified test. This is equivalent to 20 points for the application of the visa.

Proficiency English needs a score of at least 7 in each of four components of the IELTS test, or the equivalent standard in a specified test. This is equivalent to 10 points for the application of a visa (Department of Immigration and Citizenship).

3.3.1 Reading is a complex business

Reading is a complex business that requires a number of abilities. These include:

- 1) Phonological skills. (Converting letters into sounds but applying certain rules).
- 2) Letter identification skills.
- 3) Grapheme skills.
- 4) Sequencing skills in which a number of sounds are analysed and joined in a sequence.
- 5) Short-term memory skills. (To retain pieces of information of language as they are sequentially extracted from written material).
- 6) Analytical reading that primarily focuses on phonological processing of words.

Reading is a complex, interactive, multi-process, multi-stage behaviour, and as such can in theory be disrupted in many ways (Diaz and McLachlan, 2007).

The vast amount of information available through the web has made educators think carefully about the importance of helping children develop critical literacy skills that will enable them to seek, sift, assess and use information. Learning to read is a vitally important skill. It has also been found that auditory processing is a critical function in what may be termed "reading". Reading is all about constructing meaning from text. The meaning is derived from what readers bring to the text as well as what they discern from the text. That meaning is dependent on the rapid, automatic, and effortless recognition of words. In order to read and write fluently with comprehension and meaning, children must be able to automatically read and spell the most frequent words. As the store of words they can automatically read and their spelling capacity increases, so will their speed and comprehension (Cunningham, 2000).

It is only logical that phonemic processing is a necessary ingredient in the reading process since it is not possible to memorize the visual shapes of all the words in the English language, or to guess all of them accurately, based on contextual cues. It is

critical to decode accurately since decoding errors can change imagery and change comprehension, learning to read is becoming what is known in the field as being phonologically aware (Tallai, 2011). Phonological awareness means the knowledge that words can actually be broken down into smaller parts is called phonemes. The phonemes build words both for oral language and for written language, and children who have difficulty with the smaller sounds inside of words (phonemes) will have trouble with their speech and their reading skills.

It has been found that children in the early years of schooling who fail to learn to read typically become the disadvantaged population in middle and secondary school, since they are unable to engage in the class programs, which require the capacity to read and work independently. Individuals vary in their tendency toward these processes, but must acquire them in order to be competent, independent readers. The failure to acquire reading skills is productively and predominantly due to a specific sensory cognitive reason, and not to an array of weak cognitive processes (Lindamood, 2007).

3.4 Phonological awareness and the decoding process

Phonemic awareness is a subset of phonological awareness in which listeners are able to hear, identify and manipulate phonemes, the smallest units of sound that can differentiate meaning. It is critical for masterful reading fluency (pronunciation) and literacy (spelling and reading), phonological awareness is an important and reliable predictor of later reading capacity, and it is often confused with phonics, but it is different.

Phonics requires children to match letters or letter patterns to sounds, in other words they need to be able to decode using their knowledge of the spoken language to read the written words from a page. Phonological knowledge is an important factor in the process of reading and ultimately children need to make meaning from the written text. The minimal units of linguistic sounds are phonemes. Technically there are differences within phonemes, such as the difference in the first sound produced when the word 'pig' is spoken and the last sound produced in the spoken word 'stop', the phoneme signals a difference

between words and meaning. Awareness is essential to the child's capacity to apply the phonemes. Children's phonemic awareness is a strong predictor of their future levels of reading and spelling achievement (Nancollis, Lawrie, Dodd 2005).

The inclusion of instruction in phonemic awareness is seen as a strategy that may prevent many children from needing to enter early intervention programs or other remedial programs. An increase in secondary school children having learning disabilities and the requisite reading skills to meet academic expectations. These skills deficits included, in particular, reading, spelling, and mathematics (Learner and Kline, 2006). What, then, is known about speech that might lead us to expect a child, who readily perceives speech, to find explicit segmentation into phonemes more difficult than explicit segmentation into syllables? If the acoustic structure of speech bore a simple one-to-one relation to the phonemic structure, just as the letters do (at least in the orthographically regular case), it would indeed be hard to see why phonemic analysis should pose special problems. That is, if there were in the word "bat" three acoustic segments, one for each of the three phonemes, then the segmentation of the word that is represented in its spelling would presumably be readily clear (Lieberman, 1973). In perceiving a spoken message, the listener need not be explicit about its phonemic structure, than s/he need be about its syntax.

The possibility is that many of the poor readers who are delayed in the acquisition of phonological skills may never catch up with their non-delayed peers, several of the special characteristics of disabled readers in the elementary school years still hold in adolescence. Delays in early language development might associate with inferior language skills at maturity, perhaps because of the interaction with other biological factors to produce a premature plateau in the normal maturation sequence. This adds further support to the need to investigate the phonological development of children beyond the early years, and the need for an appropriate assessment device, which can be used by teachers in the classroom and other learning environments, to enable them to take appropriate measures when planning programs to help children with reading problems. As with most people,

children typically use language as a tool to communicate thoughts, wishes and feelings, but usually give little thought to the tool of language itself.

To read and write a child must develop language awareness. Pre-school children's level of awareness to make them more comprehensible may be relatively minimal; they seem to make adjustments without being fully aware of the changes they have made. The conscious awareness increases dramatically when children begin attempting to read and write. Children can orally depict divisions between words, and roughly reveal distinctions between phonemes, but in order to read and write children need to sequence units of speech sounds into the correct visual symbols and *vice versa* for reading aloud. In order to do this, children must first be able to focus on the correct units of their own speech sounds. This is difficult because words and phonemes are not clearly marked in speech, and young children often are not aware that they are distinct units (Lieberman, 1973).

Tyrer (2001) who spent years working with children as a Neurologist and Linguist (neurologist is a doctor who specializes in disorders of the brain and central nervous system) and Linguist (the science of Language) found that a typical child with learning difficulties appears to be of normal or above average intelligence before entering school, and learns to speak at about the usual age. But during the first two or three years at school, the child does not learn to read normally. The incapacity may not be discovered until about the age of 8 or 9 years. Then, while spoken language skills may seem to be normal, written language skills may be at about the level of a 5 or 6- year- old.

Reading, writing, and spelling are affected and the child may fail continually in these skills and in subjects depending on them. As children find themselves falling behind their peers in their written work they may become frustrated and unhappy, often feeling stupid and inferior. This may undermine their self-confidence and discourage them from further learning. They may be regarded as unintelligent or lazy or both. Crystal referred to 'the blighted school career of such children, when no one recognizes their handicap'. The incidence of learning difficulties has been

variously estimated as between 5 and 10% of the child population, boys being affected 3-5 times more often than girls.

More than one member of a family may be affected. Clinically, the children seem to have difficulty in dividing their spoken words into the component sounds, and correlating these with the letters and syllables of written words. This may obviously lead to problems with written words, since the latter are derived and codified from the sounds of spoken words. On reading aloud from a text, children may omit words, phrases, or even sentences. They may make substitutions, e.g. 'all' for 'some' or change words e.g. 'sifters' for 'suffers'. They may invert words e.g. saying 'on' for 'no', 'saw' for 'was'. They may interpolate letters or words of their own. All this handicaps the child from understanding the text clearly. Spontaneous writing, including written answers to questions and writing to dictation, may be comparably affected. Severely impaired scores for verbal tests compared to performance tests are of key importance in the diagnosis of learning difficulties. When treating children with learning difficulties it is essential to have a caring and sympathetic teacher who will help them achieve or regain self-confidence and a wish to learn. Patient but intensive individual teaching is desirable and progress should be gradual from simple tasks to complex ones. The teacher must ensure that each letter of the alphabet is perceived correctly, checking for any confusion between letters, such as 'b' and 'd', or 'p' and 'q'. An analytic method is valuable, printed words causing difficulty are analysed into individual letters or sounds corresponding to those of the spoken word. Instructional programs that are effective with children who have learning difficulties provide structured opportunities to learn phonological processing skills with a significant print component. These children have a neurophysiology-processing problem as a lack of auditory conceptual function, phonological awareness, and phonemic awareness. In addition, the neurologist Tyrer (2001) points to studies of behavioural genetics and neurobiology, which support the belief that the principal cause of reading difficulty is a deficiency in phonemic awareness. Children with phonemic awareness problems and delay in speech and language development have been labelled "language learning impaired."

Neurologists have long suspected that children's reading impairments were due to language dysfunction, but from the teaching viewpoint the reading process was seen as the extraction of meaning, context and inference, which involved a high level of linguistic processing and auditory processing. Textbooks under this direction stressed these processes in reading acquisition, and de-emphasised phonic skills because it was believed children would learn to read without direct instruction. Language disorders are important in the child's development and the impact of such disorders increases the importance of having assessment tools and programs to support young children's language acquisition. Children with early language disorders are at risk for social and behavioural problems as well as literacy difficulties and academic failure. It is vitally important to have effective intervention, which requires the provision of ideal language learning situations, and the use of proper assessment of the child's language capacity. Some children may have a physical impairment, as they might have problems with the production of sounds, which starts with the movement of a dome - shaped muscle system called the diaphragm, which is poised between the chest cavity and the abdomen. This muscle flexes downward creating a vacuum, which draws air into the lungs. When the diaphragm is relaxed again a volume of air is expelled up the windpipe and through the vocal folds of the larynx (Thiemann and Warren, 2005).

When difficulty in pronouncing phonemes correctly is blocking fluent oral expression, it is clearly important to identify and treat such difficulties early. Fromkin Rodman, Hams, Collins & Am Berber (2005). Fluent oral expression is recognised as playing a vital part in achieving literacy. So auditory processing and phonemic awareness skills are potentially key elements of underpinning reading, and consequent literacy, skills for all those learning to read and those experiencing problems regardless of age. Researchers (Cress, Stirrup and Hold, 2003) found that children with severe expressive impairments might show different speech sound acquisition patterns from those of typically developing children.

3.4.1 Reading difficulties is a deficiency in phonemic awareness

In a sizable group of children the capacity to read is well below the potentiality for learning in general as measured by clinical observation and intelligence tests.

Although a number of different conditions contribute to the problem of learning to read. In the course of normal development the complex mechanisms requisite for the understanding and reproduction of graphic language are acquired at a much later period than the auditory and coordinating mechanisms necessary for understanding and use of spoken language.

Most children can be taught to read and write by about six years, and about eight years for the large majority who have received training can read simple books easily. Reading difficulty is the major cause of school retardation. More children fail in first grade than in any other, and nearly all failures are due to reading difficulty. The age at which children start to read varies considerably. Many investigators (Tyrer, 2001) accept a retardation of two years in reading below what is obtained in performance tests as the criterion of reading difficulty. A two-year retardation in a ten year old that should have read for four years is a more serious handicap than in a fourteen year old who should have read for eight years. The percentage of retardation in the ten year old is fifty percent as compared to twenty five percent in the fourteen-year -old. The measure for reading difficulty might be more revealing if stated in percentage than in years. Specific reading difficulty is sometimes referred to dyslexia and developmental dyslexia.

Tyrer (2001) Dyslexia is a learning difficulty, those with dyslexia have problems with some or all of the following: decoding words, blending letters, reading fluently, reading orally, and comprehending what they have read. Dyslexia defined is a neurological, often genetic, disorder, which interferes with processing language.

Although dyslexia appears to be a visual problem, it is not. It is actually more about hearing than seeing. More specifically, dyslexia is associated with difficulties in receptive and expressive language, including phonological processing.

Developmental dyslexia is when reading development lags behind other academic

development. Achieved reading skills are limited, reading is slow and word reading is impaired. Developmental dyslexia affects about 10-20 % of the population, 4% severely.

The effect of reading difficulty on the emotional status of the child and on his future emotional and mental development may be profound. This is especially regrettable, since, through early recognition much can be done to reduce the condition. Responsibility for recognizing a reading defect rests primarily on the school. Although teachers are becoming increasingly aware of the problem, they do not ordinarily detect the poor reader until year two. The large majority of reading difficulties may be included under the headings of specific reading difficulty representing a developmental abnormality. The characteristic feature is an inborn difficulty in comprehending written language. There is no history of neurological injury and no clinical evidence of neurological disease. This group has been referred to as primary reading difficulty.

Other children have cerebral damage, a third group is made up of children who are retarded on read up tests, but who show no defect in basic reading learning capacity. The potential for reading is normal, but it has not been used because of factors such as anxiety, negativism, emotional block up, visual defects and limited learning opportunity. In a fourth group the incapacity to read appears to be due to a developmental lag. Such children do not begin to read until they are ten to fourteen years. Specific reading difficulty is a syndrome characterized by difficulty in comprehending written language, disturbance in speech, unusual clumsiness, a history of language difficulties in other members of the family and emotional disturbances arising out of the subject's incapacity to read.

The clinical picture presented by the poor reader is fairly uniform. The child is considered bright, until he/she enters school. He/she may have enjoyed being read to and have shown normal interest in numbers and letters, and no problem of any sort is clear. During the first two years in school he does not learn to read; since much of the reading of this level depends on memorizing, the nature of the defect may not be apparent until later. If the child goes to a progressive school when there

is no insistence on reading until spontaneous interest is shown, the difficulty may remain unrecognized for three to four years. At first the child only finds reading and spelling difficult. Letters, syllables and whole words are often reversed. More commonly individual letters are written backwards and even upside down. The letters b and d are frequently confused, as are p and q. Words such as "was" and "saw", "on" and "no" are stumbling blocks, and there may be confusion between words such as "from" and "form". In rare instances the child can read only right to left. The handwriting may be poor, but usually copying is done accurately and neatly. The child with reading difficulties often shows unusual talent in drawing, mechanics and athletics they like listening to stories, discussions and conversations.

For decades there has been controversy among educators over how to teach reading. Pedagogy has included the phonics method, the sight word method and the whole language method. These have been incorporated in a succession of approaches that have emerged in the 1950s and 1960s, all of which were successful with some children, but not with others. Linguists made a strong entry into the controversy, claiming that teaching individual letter and sounds as in phonics was wrong, because they considered the syllable the basic unit of language. This resulted in a more phonics approach that resulted in contrived reading texts made from the words that children could sound out and read phonetically "The fat rat sat on the mat", (Bloomfield & Barnhart, 1961). In the 1990s there was a general move for educators to use all the methods available in accord with what worked best to meet children's needs. This was called the 'balanced approach' (International Reading Association, 1997) but unfortunately the balanced approach does not recognize and address individual differences in sensory cognitive functions that are basic to children becoming independent and fully competent with respect to literacy skills. Despite the research-based recognition of the essential phonemic knowledge and awareness for learning to read, no reading method used over the years has been found to directly stimulate phonemic awareness support this claim.

The situation for children who have difficulty learning to read is painfully obvious since their reading aloud typically involves frequently stopping and starting, with

mispronunciation of words and skipping of others entirely. The first casualty of their predicament is their self-esteem. They grow ashamed as they struggle with a skill that most of their classmate's master easily (Lindamood, 1998). In relation to self-esteem, it was found that this was exacerbated by children who were seen as not having appropriate skills being placed in low capacity groups thus creating a negative impact on self-esteem (Lindamood (2011).

In later year levels, when schooling requires children to switch from 'learning to read' to 'reading to learn' in secondary school, those with reading difficulties are set to fail academically. They are unable to read effectively to learn in subjects such as science, history, literature and mathematics or read to access today's wealth of information that is presented in print in text and on the web. Chan and Dally (2000) found that it has been estimated that twenty per cent of primary school children underachieve in literacy and numeracy and three per cent's of these children are severely affected.

The neurologist John Tyrer, (2001) points to studies of behavioural genetics and neurobiology, which support the belief that the principal cause of reading difficulties is a deficiency in phonemic awareness. Children with phonemic awareness problems and delay in speech and language development have been labelled "language learning impaired". In summary it may be argued that teachers need to have the skill to assess children's phonological knowledge and awareness if they are to maintain their opportunities to learn to read as early as possible (Tyrer, 2001). The effect of reading difficulty on the emotional status of the child and on his future emotional and mental development may be profound. This is especially regrettable, since, through early recognition much can be done to alleviate the condition. The child is considered bright, often unusually so, until he enters school. He/she may have enjoyed being read to and have shown normal interest in numbers and letters. No problem of any sort is evident. During the first two years in school he/she does not learn to read and since much of the reading of this level depends on memorizing, the nature of the defect may not be apparent until later.

Skills Australia, The Department of Education, Employment and Work Place, The Australian Industry Group and The Australian Bureau of Statistics found that since 2006 Adult Literacy and Life skill revealed that Language, Literacy and Numeracy levels have shown little improvement in the decade since 1996 International Adult Literacy Survey. It found that approximately 7 million adults, that is 46% had literacy scores below the minimum level needed to function fully in life and work, and approximately 7.9 million 53% had numeracy scores below the minimum needed.

3.4.2 Stages of language development

Children seemed to pass through a series of more or less fixed stages or milestones of language development. The age of onset of these might vary considerably but the relative chronology remains the same.

Table 3-3 Stages of language development

Language Stage	Beginning Age
Crying	Birth
Cooing	6 weeks
Babbling	6 months
Intonation patterns	8 months
10 word utterances	1 year
20 word utterances	18 months
Word inflections	2 years
Questions, negatives	2 and a quarter years
Rare or complex constructions	5 years
Mature speech	10 years

(Aitcheson, 1989, p. 3)

Infants may also babble for social reward such as when their parents encourage them, knowing it will lead to talking, giving the child important experience with the social rewards of speech, and their first experience of the social character of language. If infants are not encouraged to babble, they may stop doing so. The importance of babbling is that the baby is beginning to be aware of sounds, and so imitates them and mixes them with its babbling. The acquisition of phonology

involves the understanding of sounds making up words and linking these sounds to meanings, a capacity which usually develops around the age of 12 to 16 months when the infant begins to learn words linking to referents in her/his everyday environment as previously shown in Table 3-3.

There is great variation in pronunciation of the first words an infant says, even with the same words in the same mother tongue. Some words might be almost perfect adult phonemes, others comprehensible only to the infant's closest family. The infant represents words in terms of phonemes, with pronunciation that becomes systematic and predictable if in a normal language environment. When infants learn the phonemes of their native language, they first master sounds, which closely resemble, but yet differ from, one another. The first words with meaning that the infant learns are often "ma ma" and "pa pa" in English. With the sounds / m / and / p / a bilabial stop is pronounced, the passage of air is blocked, but the vocal track is wide open in the low back vowel / a /. Bilabial are made in the front of the mouth, while by contrast / k / is formed in the back. One may make probable generalisations, as the processes in an infant's speech development are somewhat predictable, since similar processes are found in all child speech development. The infant begins using a large number of phonemes, and eliminating others as adult pronunciation is achieved.

3.4.3 Phonology processing, speech perception, and reading

Speech perception is the process by which humans are able to interpret and understand the sounds used in language. It is how we recognize speech sounds and how we use this information to understand spoken language.

Table 3-4 Phonology Processes in Typical Speech Development

Phonological Process (Phonological Deviation)	Example	Description
Context sensitive voicing	"Pig" is pronounced as "big" "Car" is pronounced as	A voiceless sound is replaced by a voiced sound. In the sample given /p/ is replaced by /b/and

	"gar"	/k/ is replaced by /g/ other examples might include /t/ being replaced by /d/ or /f/ being replaced by /v/.
Word final devoicing	"Red" is pronounced as "ret" "Bag" is pronounced as "bak"	A final voiced consonant in a word is replaced by a voiceless consonant. Here /d/ has been replaced by /t/ and /g/ has been replaced by /k/.
Final consonant deletion	"Home" is pronounced as "hoe" "Calf" is pronounced as "cah"	The final consonant in the word is omitted. In these examples /m/ is omitted (or deleted) from "home" and /f/ is omitted from "calf"
Velar fronting	"Kiss" is pronounced as "tiss" "Give" is pronounced as "div" "Wing" is pronounced as "win"	A velar consonant, that is a sound that is normally made with the middle of the tongue in contact with the palate towards the back of the mouth, is replaced with consonant produced at the front of the mouth. Hence /k/ is replaced by /t/, /g/ is replaced by /d/ and /ŋ/ is replaced by /n/
Palatal fronting	"Ship" is pronounced as "sip" "Measure" is pronounced as "mezsa"	The fricative consonants 'sh' and 'zh' are replaced by fricatives that are made further forward on the palate towards the front teeth 'sh' is replaced with 's' and 'zh' is replaced with 'z'.
Consonant harmony	"Cupboard" is pronounced as "pubbed"	The pronunciation of the whole word is influenced by the presence of a particular sound in

	<p>"Dog" is pronounced as "gog"</p>	<p>the word. In these examples: (1) the /b/ in "cupboard" causes the /k/ to be replaced /p/ which is the voiceless cognate of /b/ and (2) the /g/ in "dog" causes /d/ to be replaced by /g/.</p>
Weak syllable deletion	<p>"Telephone" is pronounced as "teffone"</p> <p>"Tidying" is pronounced as "tying"</p>	<p>Syllables are either stressed or unstressed. In "telephone" and "tidying" the second syllable is weak or unstressed. In this phonological process weak syllables are omitted when the child says the word.</p>
Cluster reduction	<p>"Spider" is pronounced as "pider"</p> <p>"Ant" is pronounced as "at"</p>	<p>Consonant clusters occur when two or three consonants occur in a sequence in a word. In cluster reduction part of the cluster is omitted. In these examples /s/ has been deleted from "spider" and /n/ from "ant".</p>
Gliding of liquids	<p>"Real" is pronounced as "weal"</p> <p>"Leg" is pronounced as "yeg"</p>	<p>The liquid consonants /l/ and /r/ are replaced by /w/ or 'y'. In these examples /r/ in "real" is replaced by /w/ and /l/ in "leg" is replaced by /y/.</p>
Stopping	<p>"Funny" is pronounced as "punny"</p> <p>"Jump" is pronounced as "dump"</p>	<p>A fricative consonant (/f/ /v/ /s/ /z/, 'sh', 'zh', 'th' or /h/), or an affricate consonant ('ch' or /j/) is replaced by a stop consonant (/p/ /b/ /t/ /d/ /k/ or /g/). In these examples, /f/ in "funny" is replaced by /p/ and 'j' in jump is replaced by /d/.</p>

(Bowen, C. 1998, p. 8-9)

Bowen (1998) sought to distinguish between phonetics and phonology, and argued that phonetics can be approached in two ways: by examining the physiological mechanism of speech production and by studying the physics of speech sounds. They regarded phonology as the component of a grammar made up of the categories and principles that determine how sounds form patterns in a language. Thus, in phonology the organisation of sounds and of sound patterns in the language is the focus of their study. There are three main theoretical perspectives on speech perception motor theory of speech perception, this choice was guided by a belief that the objects of speech perception must be about environmental with respect to phonemes or feature sets and by a further belief that such requirements was satisfied only by neurone-motor commands. The next was the direct realist theory of speech perception, which is that the objects speech perception is articulatory and not acoustic events. And thirdly general auditory and learning approaches to speech perception, which is the capacity of human infants to learn the phoneme categories of their native language has been attributed to specialized processes of categorization or to an attention or learning bias for speech sounds.

Crystal (1994) takes a more in depth view, which is useful for this thesis when examining the link among phonetics, phonology and the reading process. He emphasises that phonetics study the characters of sounds used in speech, providing methods for their description, classification and transcription. He describes phonology as demonstrating the patterns of distinctive sounds in a language, and makes general statements about sound systems, and their range and function in different languages of the world, so that phonology could be regarded as "functional phonetics".

Crystal (1994) also emphasised that phonetics is the study of how speech sounds are made, transmitted, and received. He argued it is a subject that requires as its source of data, a human being with an intact auditory mechanism and a functioning set of vocal organs, refers to phonology as the capacity to learn and store important sounds in the language called phonemes, as well as the rules for combining the sounds into meaningful units such as words, which are single speech sounds, deficits in phonology have been identified as a major reason, explaining

why most children and adults with communication and learning disorders have problems in language-based activities such as learning to read.

Children seemed to pass through a series of more or less fixed stages, or milestones of language; the age of onset of these might vary considerably, the relative chronology remains the same. Key to phonetic symbols: The following symbols represent the sounds that are underlined in the words next to them. For example, /j/ represents the 'y' sound in the word 'you'.

Linguists and speech-language pathologists are fond of saying that speech sounds in languages form patterns. One of the most readily recognised sets of patterns relates to the many voiced and voiceless pairs of sounds that occur in English by the time children start to speak, they have a large source of information about sound contrasts. The need to consider the way in which the sound system is organised in terms of the way it is stored in the mind, the way it is actually articulated, and the way phonological rules or processes are applied to make speech and meaning (Hogan, Cotts, & Little, 2005) the child knows the correct sound in his/her mind, and s/he makes these simplifications outlining a range of phonological processes applicable to normal speech and sound development in chronological sequence.

All phonological processes are normally gone by five years of age, although individual children may show some variation from this chronology of interest for my research is if the investigation will discover whether children have problems after five years of age (Bowen, 1998). Because not all children progress normally through the milestones of language development; in fact some may be quite delayed, continuing to use gestures or sounds rather than speech to communicate their needs. Other children progress normally in some areas of speech and language, such as following spoken directions and attending to commands, but have trouble finding the words to express themselves clearly.

3.4.4 Language is one of the best predictor of school performance

The National Reading Panel 2008 wrote that although the literature and curriculum materials may include the theory that emphasises the importance of phonemic awareness to learning to read, it has been found that many class teachers do not necessarily understand its importance or know how to incorporate it into reading pedagogy. This is more noticeable as children grow older, yet still experience reading difficulties. It is possible that the problem teachers have is that they are hearing and seeing the term phonemic awareness, but are not understanding the difference between teaching for the development of phonemic awareness, and instruction that only attempts to exercise it through phonic activities.

The situation for children who have difficulty learning to read is painfully obvious since their reading aloud typically involves frequently stopping and starting, with mispronunciation of words and skipping of others entirely. The first casualty of their predicament is their self-esteem. They grow ashamed as they struggle with a skill that most of their classmate's master easily (Lindamood, 1998).

Lindamood, (2011) in more recent studies found that the explanation given about children who have difficulties learning to read is most likely to be in terms of the knowledge and skills that are necessary for success in reading and writing. In relation to self-esteem, it was found that this was exacerbated by children who were seen as not having appropriate skills being placed in low capacity groups thus creating a negative impact on self-esteem.

Further, Chan and Dally (2000) from their research have been able to estimate that in the past, twenty per cent of primary school children underachieve in literacy and numeracy and three per cent's of these children are severely affected. Further to this, Bartlett & Moody, (2000) found that children are also barred from the new technology, and they are not able to take advantage of the web as easily as others, and are left behind in the technological information revolution. Problems learning to read and low literacy skills are not new. In the 1990's Bowen (1996) reported that about 10,000,000 children had difficulties learning to read in the United States, Britain, and Australia. Of concern is that between 10% and 15% of children

eventually dropped out of high school, and only 2% of the 10,000,000 complete a college program. It also showed from surveys of adolescents and young adults with criminal records that about 50% of them could not read. Reading is learning to process very specific kinds of linguistic information and build networks that coordinate phonological processing to the patterns of printed symbols that the eye sees, and it is also connected to meaning and the building of vocabulary (Kirsch *et al.*, 1993).

Children who enter kindergarten and elementary school who are at risk for reading failure, can learn to read at average or above levels, but only if they are identified early and provided with systematic, explicit, and intensive instruction in phonemic awareness, phonics, reading fluency, vocabulary, and reading comprehension strategies. Failure to develop basic reading skills by age nine predicts a lifetime of illiteracy. Unless these children receive the appropriate instruction, over 70 % of the children entering first grade who are at risk for reading failure will continue to have reading problems into adulthood. The early identification of children at risk for reading failure and provision of comprehensive early reading intervention can reduce the percentage of children reading below the basic level in the fourth grade. Children as young as four years of age benefit from instruction in phonemic awareness and the alphabetic principle preparing them for their future years at school.

Lewis and Paik (2001) found that learning to read is not just one of the goals of schooling. It is essential if children are to succeed in any grade and in any subject. According to the National Reading Panel, only about 5% of children learn to read effortlessly. About 60% find early reading difficult, from that number, 20-30% really struggle. By fourth grade, the seriousness of the problem for these children becomes obvious. From their research Fletcher, Bergman and Breir (2002) have found that children with learning difficulties showed distinctly low activation profiles featuring little or no activation of the posterior portion of the superior temporal gyrus, an area normally involved in phonology processing. Intervention following successful remedial training produced significant improvement in reading skills. It was in 1970 that the World Federation of Neurology (a medical speciality

dealing with disorders of the nervous system) defined dyslexia as one of the learning difficulties, manifested by difficulty in learning to read despite conventional instruction, adequate intelligence, and sociocultural opportunity'.

As reflected in community literacy levels these children with learning difficulties remain disabled readers in spite of their years at school and the services of remedial reading specialists and tutors. Johnstone (2011) says that five per cent of the state's ten year olds fail to achieve minimum standards in reading, this is in the schools in Queensland, and in general girls do better than boys (Lindamood 2011). Educators have long debated which method works best for improving reading comprehension. Some teachers have stressed that using phonics to sound out and introduce new words is effective and others emphasize the importance of contextual clues in reading. Lindamood Bell's teaching draws on all of these methods so that these skills can work in unison to strength the comprehension, she also points out that there is no dispute that everyone does not respond equally to any particular method of reading instruction, but that does not necessarily mean the sensory cognitive demands of the reading process are different for everyone. It is hypothesised that the reading process requires the same basic sensory cognitive processes, whether acquired through instruction or through genetics. Individuals vary in their tendency toward these processes, but must acquire them in order to be competent, independent readers. The failure to acquire reading skills is productively and predominantly due to a specific sensory cognitive factor, and not to an array of weak cognitive processes (Lindamood 2011).

3.4.5 First and second language learning is divided into three phases
First language acquisition (L1) and second language (L2) learning is divided into three phases, the first one is the initial state, which many linguists and psychologist's believe includes the underlying knowledge of language structures and principles that are in the child's head at the very start of first and second language acquisition. The second phase is the intermediate state, which covers all stages of basic language development, including the maturation changes which take place as the child's grammar development takes place known as learner

language, the third phase is the final stage, which is the outcome of L1 and L2 learning. I thought it was deemed necessary to take into consideration the implications of the research for children with English as their second language, as an interesting way of comparing L1 and L2 in my statistical analysis.

3.4.6 The importance of phonemic knowledge to reading and literacy development

One of the most controversial and crucial education issues today is focused on the importance of reading. Educators subscribe to the view that every effort must be made to help each child to be able to read and develop an interest in this skill. Improvement of reading skills should become an important outcome of classroom teaching procedures, with the recognition of the need for adequate reading skills with each stage of educational development, and despite the introduction of more appropriate and modern methods and materials for teaching, children can be found in every unselected classroom group who are experiencing difficulties.

Thiemann and Warren (2010) found that at preschool, children begin to develop an awareness of how words rhyme and also start to manipulate parts of words, such as taking "baby" apart into two syllables, /ba/ and /be/. This capacity to think about the properties of words is called phonology processing. Substantial literature showing that early reading development in alphabetic languages such as English is dependant upon the integrity of phonology processing abilities.

Learning to read is the central achievement of early schooling, children bring knowledge and skills that facilitate their acquisition of efficient reading skills, initially the child will learn how to read and then will start using reading to learn. Senechal (2009) found that the latest statistics show that a substantial number of children have poor reading skills and it will affect their integration in the workplace one day. Most children who have poor reading skills at the end of Grade 1 will continue to experience difficulties reading later on. Some children enter school with poor skills in listening, speaking and phonology processing there are other children who are sufficiently competent in listening and talking to be viewed as normal, but for whom phonology processing remains poor, and may be viewed as

being at risk for reading disorder. Reading disorder is customarily defined as poor reading achievement occurring after sufficient opportunity to learn to read.

Failure to develop basic reading skills by age nine predicts a lifetime of illiteracy. Unless these children receive the appropriate instruction, over 70 per cent of the children entering first grade who are at risk for reading failure will continue to have reading problems into adulthood. The early identification of children at risk for reading failure and provision of comprehensive early reading intervention can reduce the percentage of children reading below the basic level in the fourth grade. Children as young as four years of age benefit from instruction in phonemic awareness and the alphabetic principle preparing them for their future years at school. I have found that most children will learn to read no matter what method or approach is used to teach them but, "unless they receive special help, at least 20% cannot master the reading process" (National Inquiry Into the Teaching of Literacy, 2005). The definition of literacy is the flexible and sustainable mastery of a repertoire of practices with texts of both traditional and new communications technologies via spoken language, print and multimedia.

Although reading printed text is a vital way for the general population to access information, this has not always been the case, for some. Only a small percentage of the population in many countries were considered literate before the Industrial Revolution, period from the 18th to 19th century, the Industrial Revolution marks a major turning point in human history, almost every aspect of life was influenced in some way by the demand for reading, this changed how we live. Now the information age and technology have given the world a different dimension, making people powerless if they are unable to read (Lindamood, 2011).

3.4.7 The importance of spoken language

Senechal (2009) emphasises that early language skills play an important role in the acquisition of reading but learning language and learning to read, though related are two distinct domains. Phonemic awareness also underpins children's capacity to understand that phonemes link to the corresponding graphical representation in terms of letters and their combinations. Further the National Reading Panel, (2008)

found that Phonemic awareness improves children's word reading and reading comprehension, as well as helping children learn to spell. Importantly, Phonemic awareness is the basis for learning phonics.

I found in my clinic that the situation for children who have difficulty learning to read is painfully obvious since their reading aloud typically involves frequently stopping and starting, with mispronunciation of words and skipping of others entirely. The first casualty of their predicament is their self-esteem as they become ashamed as they struggle with a skill that most of their classmate's master easily. In relation to children's self-esteem I feel that children are happier if they are at a level they can cope with, as it saves been ridiculed in the group if they are unable to read at the same level as their peers (Senechal 2009).

3.4.8 The problems with reading difficulties

Children with learning difficulties are also barred from new technology. Bartlett & Moody, (2000) found, they are not able to take advantage of the web as easily as others, and are left behind in the technological information revolution, as reading is learning to process very specific kinds of linguistic information and build networks that coordinate phonology processing to the patterns of printed symbols that the eye sees and it is also connected to meaning and the building of vocabulary, which is necessary in the world of today. Difficulties may occur in relation to phonology and phonemic knowledge of words and skills that are necessary for success in reading and writing such as having an appropriate knowledge of words, sentences and longer text (Bartlett & Moody, 2000).

Ackerman, Izard, Kobak, Brown, Smith, (2007) assessed the relation between reading problems and internalizing behaviour in 3rd and 5th grades, 8 to 12 year old children, the variable results showed that reading problems predicted change in internalizing behaviour in the context of child and family predictors. This was also my experience with children I work with some had severe psychological problems, and all of the children showed anxiety and behaviour problems, many from Grade 1. The early identification of children at risk for reading failure and provision of

comprehensive early reading intervention can reduce the percentage of children reading below the basic level in the fourth grade.

Learning to read is not just one of the goals of schooling. It is essential if children are to succeed in any grade and in any subject. Interesting is the research conducted by (Lewis and Paik, 2002) who found that children with learning difficulties showed distinctly low activation profiles featuring little or no activation of the posterior portion of the superior temporal gyrus, an area normally involved in phonology processing. This indicates the importance of phonemic awareness so that children can develop their reading capacity.

3.4.9 The Reading Process and the Development of Skills

Reading is an extremely complex activity of sophisticated cognitive processes and skill. This system relies upon the child senses, cognition and language capacity. The views of the process of reading have changed over the years and for the purposes of this thesis approaches to reading were investigated to find a system which would enhance the process of research and which would be compatible with the study of children's phonological development. It was also important to relate the selected approach to current research into reading, and the perceived underlying skills, so that the role of phonological development could be clearly identified and discussed.

Up to 1975 reading was considered primarily as a perceptual, visually based activity, so theories of instruction and remediation were predicted on this assumption. If children had reading difficulties, it was assumed they had visual problems and treated accordingly. It was the psycholinguist Kavanagh and Mattingly, (1972) who challenged these assumptions and replaced the traditional concept of reading with a new view which paid more attention to auditory and phonological considerations. They argued that reading was a deliberately acquired language-based skill, which was dependent upon the speaker-hearer's awareness of certain aspects of primary linguistic activity. This led to the question as to the specific role of phonological processing in reading. Conrad, (1972), who studied how the deaf learn to read,

summarised this position by suggesting that reading may be possible without phonology, but was made considerably easier with it.

By contrast, Lieberman, Shankweiler, Fisher, Carter (1974) focused on the relationship between reading and phonological skills, highlighting the importance of segmentation and phonemic awareness, representing lower level skills (the bottom up approach). Research continues to provide strong support for instructional programs that encourage early phonic skills and awareness of the speech stream.

3.4.10 Approaches to teaching reading in the 21st Century

Reading is occurring much earlier, and also at the same time, for many young children at the start of their education journey if they are embracing modern technology. The 21st century context places increasing demands on children to be effective readers as never before. There is a serious lack of a transformative pedagogical approach that would allow teachers to utilise evidenced-based practice, implement practical assessment tools, make their own professional judgements and employ critical reflection to maximise children's learning. On this basis, this research is significant because its outcomes provide teachers with the use of a diagnostic tool to assess phonemic awareness and also children's capacity to articulate words, which are central to building their decoding capacity (resource one of the Four Resources Model). The growing body of world-wide research in (Lindamood, 1998) on the reading process had documented indisputably that phonemic awareness is the best single predictor of success in learning to read, phonemic awareness as the oral sensory cognitive function that enables one to apply the rules required in reading and spelling (Lindamood, 2011).

Low reading levels have also been reported across Australian society in general the overall, pointing to a need for improved strategies for the identification of those with reading difficulties and both recognition and action in relation to the vital prediction of phonemic awareness results and children's articulation/pronunciation of words (Australian Bureau of Statistics, 2010). Lindamood (2011) also points out

those difficulties in learning to read lead to adverse consequences for children, including maladaptive mental and emotional health.

Traditionally, linguists argued that to be a good reader it was only necessary to have the capacity to process words phonetically. But linking the teaching of reading to phonics instruction led to a minimization of the importance of getting meaning from print in the reading process, the early reading teaching strategies involved children in merely processing words phonetically, without concern for comprehension of the content (Flesch, 1986). Leading up to the 1970s, reading books were typically contrived texts (Basal readers) that were constructed from basic words that could be sounded out through the application of phonics.

Today, phonics and phonemic awareness knowledge, have become part of various commercial programs. For example, THRASS (Teaching Handwriting, Reading & Spelling Skills) (Australian Bureau of Statistics, 1997) is used internationally and in many Queensland schools, along with other phonics based programs like Jolly phonics (Wemhan & Lloyd 2010) to explicitly teach children phonics and the associated metacognitive language and skills. This means as with THRASS children learn the labels such as morpheme and grapheme so that they can talk about their application. There is continuing debate about the way phonics should be dealt with in learning to read and the role of sight words - that is, the teaching of the many words that cannot be sounded out. Burrows (2007) found that up to 20% of children have specific difficulties with reading and writing, due to missing the first building block to literacy, which is phonological awareness.

Phonemic awareness and knowledge still applies to decoding words as Hay, Elias and Brooker (2005) found, they pointed out that the capacity to read and comprehend depends on the rapid and automatic recognition of single words but when children encounter a word for the first time a powerful strategy is for the child to use phonological knowledge to identify at least the first sound. Children recognise unfamiliar words by identifying and blending their phonological sounds and comparing these sound patterns to the sound patterns of words in their oral vocabulary. The reader must learn to decode some thousands of words that are

initially visually unfamiliar and to commit those visual patterns or their salient features to memory.

Lemos (2004) argues that the predominant whole language approach to the teaching of reading is both ineffective and not appropriate, and claims that the initial gains made by children exposed to this approach and intervention programs cannot be sustained unless such children are located in classrooms with teachers who are skilled in providing further support in explicit, systematic phonics instruction for children. Center (2005) in his research that children entering school with varying degrees of competence in speaking their language had very little knowledge about how to read and write. Literacy instruction in school education, involves helping children master the challenges of linking written and spoken language.

For children to be able to link their knowledge of spoken language to their knowledge of written language they must first master the alphabetic code and the system of grapheme and phoneme correspondences that link written words to their pronunciation. Center (2005) also asserts that the systematic, explicit teaching of phonics is a necessary condition for the teaching of reading. Cowen's (2003) research studies of approaches for beginner readers concluded that reading for meaning and understanding cannot be taught separately from direct phonics instruction. Center (2005) says that the whole language approach is a way of creating a rich print environment to stimulate a child's desire to read. The whole language approach is criticised for its lack of focus on phonics (Jones, 1995). The strength of a skills approach is seen as the insistence of explicit instruction of sound symbols associations, both in isolation and in context, to foster both a child's word recognition capacity and word attack skills.

3.4.11 Lack of phonemic awareness means children are unable to engage in reading

The outcomes of schooling during the 1990s showed that at least a third of the Australian population of primary and secondary school children were unable to engage fully in the reading process because of problems with phonics or lack of

phonemic awareness (Australian Bureau of Statistics, 1997). It is argued by Lindamood (1998) that many of these children would have auditory conceptual dysfunction, which means that they cannot perceive sounds in syllable form in words. Typically, children with auditory conceptual dysfunction are unable to perceive the number of sounds in a syllable, the identity of the sounds in a syllable or the order of sounds in a syllable. The challenge here is that though they may have been taught phonics and be able to say 'a' says a, they might look at a word and say "stream" instead of "steam" (making an addition error), or they might look at "immigration" and say instead "imagination" (omission error). They are unable to appreciate their errors. Such errors may occur in reading and speech and exemplify auditory conceptualisation dysfunction. Simply stated, children with an auditory conceptual dysfunction cannot perceive individual sounds within words and so have difficulties learning to read.

Coltheart, (2005) key research findings showed that, since systematic, explicit phonics approaches are significantly more effective than non-systematic approaches for children with and without reading difficulties, it is vital that children should initially be provided with direct instruction in phonics as an essential part of a comprehensive and integrated reading program that includes a meaning centred learning environment For children to be able to link their knowledge of spoken language to their knowledge of written language they must first master the alphabetic code and the system of grapheme and phoneme correspondences that link written words to their pronunciation.

When the teaching of reading in early childhood is considered, there remains debate on teaching methods, with some children learning reading using a skills approach. The focus is on teaching word attack skills that children can use to get meaning, on the assumption that, once children can sound out or recognise printed words, they are able to read and understand the text. Other teaching methods use a whole language approach to teaching reading, and focus on the meaning of a text, relying on children's thinking capacity to abstract and arrive at word attack skills. For teaching reading, it is important to have an understanding of the role of phonology and phonemic awareness in the reading acquisition process and access

to ways of understanding children's knowledge and skills in the area. Lindamood (2011) found that in the pre-reading stage, children up to about six years of age learn letter and number discrimination, scanning and recognition, and also the rudiments of reading so as to recognise their own names and some words. In Years one and two, decoding is the focus and is applied to single words and simple stories. During this stage the child begins to be more in control, as efficiency develops in such lower level skills as letter-sound relationship and discrimination.

As reading is the door to acquiring knowledge the capacity to read and comprehend depends on the rapid and automatic recognition of single words. All words are usually unfamiliar when encountered for the first time and a powerful strategy is for the student to use phonological knowledge to identify the word and children recognise the unfamiliar word by identifying and blending its phonological sounds and comparing that sound pattern to the sound patterns of words in their oral vocabulary (Hay, Elias and Brooker, 2005). Difficulties in learning to read may lead to maladaptive mental and emotional habits that endanger the general health of learning causing children to dislike school and become antisocial.

The importance of phonetic processing awareness in early literacy is that children who do not have an awareness of the sound structure of language cannot attend to the separate sounds in spoken words and are unable to establish letter sound correspondences (Norris and Hoffman, 2002).

- 1) Sight word recognition, are important to help learners to read. For example, words such as "there", "was", "said", "come", these are irregular words that cannot be sounded out. Words that are governed by more complex spelling rules that have yet been taught, such as "boy", "eat", others such as "Spiderman", "horse", that are more complex words but of interest to the child.
- 2) Contextual constraints and oral vocabulary which is the correction of errors, and imagery for comprehension, this is very important to the process of forming mental images of what they read in order to improve reading comprehension.

Both oral and written language comprehension are necessary for the proficiency in reading and understanding and applying math concepts. Swiss psychologist Jean Piaget (1896-1980) who became intrigued with the reasons children gave wrong answers on the questions that required logical thinking, engaged in observing children and after detailed observational studies of cognition in children devised a model describing how humans go about making sense of their world by gathering and organising information, providing an explanation of the development of thinking from infancy to adulthood. He found that our thinking processes change radically from birth to maturity as we constantly strive to make sense of the world and the capacity to use language improves. Piaget was the first psychologist to make a systematic study of cognitive development. Piaget showed that young children think in strikingly different ways compared to adults. According to Piaget, children are born with very basic mental structures, genetically inherited, on which all-subsequent learning and knowledge is based. Piaget says that cognitive development is a progressive reorganization of mental processes as a result of biological maturation and environmental experience. Children construct an understanding of the world around them, and then experience discrepancies between what they already know and what they discover in their environment (Lefrancois, 2006).

Language development over the early years shows that the majority of sounds have been acquired by ages five or six, but that 10% of children continue to have difficulties especially with the sounds of language. I worked with children with problems acquiring sounds that were in their teens and they had gone through the levels of schooling, but unfortunately because of their home environment and their poor behaviour they lacked the capacity to communicate and speak correctly, let alone read.

3.5 The influence of changing views in reading

In order to grasp the logic of a reading system in relation to its spoken language, one must be able to transcode, or translate back and forth, between the specific auditory units that comprise spoken syllables and words and the specific letter

symbols that represent those auditory units. Individuals who are capable of employing this method of transcoding or translating in both directions, from auditory to visual in spelling and from visual to auditory in reading, can easily verify compatibility or incompatibility between the given sounds and their response.

For children to be able to link their knowledge of spoken language to their knowledge of written language they must first master the alphabetic code and the system of grapheme and phoneme correspondences that link written words to their pronunciation. Center (2005) also asserts that the systematic, explicit teaching of phonics is a necessary condition for the teaching of reading. Reading involves two basic processes: learning how to decipher print and understanding what the print means. Reading environmental print is any print found in the natural environment of the child.

3.6 Children's development and reading skills

Reading skills become more automatic as children get older and apply more conceptual knowledge and understanding to make meaning. In the earlier years research by Doehring (1976) showed that comprehension skills begin to emerge, as children are able to read meaningful word groups, since children are able to read meaningful word groups faster than groups of random non-meaningful words. In the year levels (two to four) reading becomes more fluent and more attention is directed to understanding the meaning of what is read. Inferential skills are used to analyse unknown words, and lower level skills become consolidated.

This improvement is dependent on efficient and automatic decoding of text, which in turn assumes competency with the underlying phonemic and phonic skills. Years four to eight mark a major turning point in reading, this was researched later by (Chall, 1983) as children move from an emphasis on decoding to the comprehension of increasingly complex material. At secondary school, lower level processes, like scanning, phonological and orthographic rules, should be firmly established, and the reader's attention directed primarily to more sophisticated comprehension skills like inference and the recognition of different viewpoints.

3.6.1 Children's assessment in schools

The importance of an investigation and the capacity for individual children to pronounce phonemes and words at various ages and stages of language development is viewed as being of great value in supporting teachers to both understand problems in learning to read and to respond to them more effectively. This also applies to children beyond preschool and Year 1, where phonemic awareness may still be lacking and remains an essential foundation for learning to read for all ages. Phonemic awareness is important because it improves children's word reading and articulating words comprehension and it helps children to spell.

3.6.2 Acquiring cognitive development

Coinciding with Piaget's work, in Berk (1989), the stage of formal operations for children from approximately Year nine onwards incorporates a new set of cognitive goals, where new thinking, conceptual integration, and critical judgement are emphasised. Similarly, Hakes (1980) found that cognitive development at this time enables children to have increased control over how they allocate cognitive processing efforts such that, the more fluent the reader, the more control s/he has over where attention is focused. The converse is equally true, and has important implications for the understanding of reading failure.

Many reading-disabled children have great difficulty with grapheme–phoneme correspondence or lexical retrieval in lower level language skills, and because of this, their entire reading performance may be disrupted, and their capacity to learn how to read made very difficult, unless they are given special programs which will attend to their auditory processing problems. It cannot be assumed that older children who have difficulty reading do not have problems with phonemic awareness or phonological knowledge.

3.7 Phonology and learning to read

While phonemic awareness is a recognised prerequisite for learning to read, the role of phonology in language development in relation to reading and literacy has received less attention. Although etymology might suggest that the phonology

refers to the logos or science of sounds, and phonetics means pertaining to sounds, examination of contemporary usage shows that phonemic knowledge has an influence on children's capacity to learn to recognise written words automatically. The individual sounds and sound patterns that children recognise in spoken words determine in large measure the written letter groups they can learn to recognise automatically. The maximum number of sounds that a child can process at once provides an upper limit to the complexity of words the child can learn to read orthographically. Many children display reading disabilities because their phonological knowledge restricts their capacity to learn written word patterns. It is important and clear for this thesis that an investigation of the role of phonology in relation to reading would be of great assistance to preparing learning programs for children who have lacked success in learning to read over the years.

The importance of an investigation and the capacity for individual children to pronounce phonemes and words at various ages and stages of language development is viewed as being of great value in supporting teachers to both understand problems in learning to read and to respond to them more effectively. This also applies to children beyond preschool and Year 1, where phonemic awareness may still be lacking and remains an essential foundation for learning to read for all ages. Phonemic awareness is important because it improves children's word reading and articulating words comprehension and it helps children to spell.

3.7.1 Phonology processing, speech perception, and reading

The distinction between phonetics and phonology can be seen from the following point of view. The human vocal apparatus can produce a very wide range of sounds, but only a small number of these are used in a language to construct all of its words and sentences. Phonetics is the study of all possible speech sounds; phonology is the study of the way in which a language's speakers systematically use a selection of these sounds, in order to express words to convey meaning in a particular language.

It can be appreciated that phonetics and phonology are well recognised as distinct disciplines of linguistics, and have an important role to play in their own right,

within the overall reading process. This underlying knowledge and skill play a significant role when it comes to either children or adults learning to read, in any language. A child must be severely disabled such as some of the children I saw in my clinic who without the essential skills to identify, classify and transcribe speech sounds and examine how phonemes relate to one another in their function and form could not learn how to read. The problem could be approached in two ways: by examining the physiological mechanism of speech production, and by studying the physics of speech sounds.

3.8 Children with learning difficulties supports the focus of this thesis

More importantly, the direction of causality of children with learning difficulties provides strong evidence to support the focus of this thesis's research into metaphonological development. Of further consideration is the work of Ehri (1994), who supported the reverse causal direction that the child's metaphonological skills arise from his or her acquaintance with orthography. Unfortunately it is not quite clear if these authors were referring to the child's learning to read and spell, or to the teaching received by the child in the context of learning to read and spell.

Other research focused on children's phonological coding skills, measured by their oral reading of non-words, and their orthographic coding skills measured by their discrimination of words from homophonic non-words (e.g. rane, rain). These abilities were compared for pairs of older children 10 to 12 years of age with reading difficulties and a younger age range of non-reading-disabled children. Coding was substantially lower for most children with learning difficulties, indicating a unique developmental deficit in phonological coding, rather than an equal developmental lag across all component-reading skills.

Data from identical and fraternal twins indicated that the phonological coding deficit of the children with reading difficulties was highly inheritable and accounted for most of the inheritable variance in their word recognition deficits. Orthographic coding was not significantly inheritable, and it accounted for much of the environmental variance in word recognition deficits.

On the basis of this research and the supporting research of Truch (1993) and Bell (1997), it may be argued that phonological coding can be significantly improved in children who are failing in reading, regardless of the genetic or environmental origins of their deficits. This is in spite of the fact that a few studies have suggested that some types of “phonics-based training” are not effective with readers who have severe deficits in phonological processes (Campbell & Butterworth, 1985). More effective methods than traditional phonics programs may be needed to improve phonological coding and segmental language skills in these children significantly.

The bulk of available evidence indicates that the deficits of disabled readers are verbal rather than nonverbal, and cognitive rather than perceptual in nature. Disabled readers clearly have difficulty with a number of skills, involving bottom-up processing: phonemic awareness, syllabic awareness, the capacity to read individual words accurately and rapidly, and perhaps the use of a phonetic code in short-term memory. Except for slow decoding, these difficulties tend to be characteristic of disabled readers at the beginning, rather than the later, stages of reading.

As previously argued, there is considerable evidence that phonemic awareness is a prerequisite to learning to read and is also causally related to the acquisition of reading skills. Holiday, Johnson, Ljungdahl, March and Winch (2006) state that phonics provides a workable method of teaching children to decode and encode language. Further, phonics is necessarily simplified to provide a workable method for young children to decode and encode language (reading and writing). Less sophisticated kinds of phonemic knowledge, such as that measured by the phoneme deletion task, is a result of reading progress. Considerable evidence has accumulated that phonological awareness is a key component in the development of reading capacity, and that poor phonological awareness is a, or perhaps the, core deficit in reading difficulties.

3.9 Sounds and segmentation

It must be emphasized that the difficulty a child might have in explicit segmentation is not necessarily related to his/her problems, if any, with ordinary speech perception. Young children may, in fact, in the ordinary course of speaking and listening readily distinguish (or identify) words like "bad" and "bat" that differ in only one phonemic segment. There is evidence that shows that infants at one month of age discriminate "ba" from "pa" (and "da" from "ta"), they make this discrimination categorically, just as adults do, when the physical difference between the phonemes is a very small part of the acoustic patterns.

The National Enquiry into the Teaching of Literacy (2005) found that the capacity to read and comprehend depends on the rapid and automatic recognition of single words. Children recognise the unfamiliar word by identifying and blending its phonological elements and comparing that sound pattern to the sound patterns of words in their oral vocabulary. The achievement of the above happens to most Children who are able to acquire the necessary levels of phonological awareness, but there are a certain number of children who do not achieve this and find that they have difficulties reading. By increasing the knowledge of phonological skills the children's capacity to identify single words and spelling is enhanced. Many of the poor readers who are delayed in the acquisition of phonological skills may never catch up with their non-delayed peers. Indeed, several studies are finding that many of the special characteristics of disabled readers in the elementary school years still hold in adolescence. This research suggested that delays in early language development might associate with inferior language skills at maturity, perhaps because of the interaction with other biological factors to produce a premature plateau in the normal maturation sequence. This adds further support to the need to investigate the phonological development of children beyond the early years, and the need for an appropriate assessment device.

3.9.1 Phonemic knowledge and assessment of reading readiness

As with most people, children typically use language as a tool to communicate thoughts, wishes and feelings, but usually give little thought to the tool of

language itself. To read and write a child must develop language awareness. Pre-school children's level of awareness to make them more comprehensible may be relatively minimal, they seem to make adjustments without being fully aware of the changes they have made. The conscious awareness increases dramatically when children begin attempting to read and write. This is difficult because words and phonemes are not clearly marked in speech, and young children often are not aware that they are distinct units. Phonemic awareness can be shown in children as young as three years old, and later the child will show the capacity to isolate initial and final consonants in words. Many children develop a high level of phonemic awareness during the early school years as a result of reading instruction in alphabetic systems that stress sound symbol correspondences.

Some children experience great difficulty in dealing with phonemes. This was reflected in the finding of varied measures of phonemic awareness that have been related to reading in Year one. In contrast to this it is not uncommon for children reared in literate homes to begin to read and write without explicit instruction. These children find literacy as natural as learning how to talk and many other children will need reading instruction to help them learn to attend to the letters in words, instead of treating words as graphic patterns, a tendency seen in non-readers. As they learn to map phonemes to print, children are often able to develop systems for transcribing speech, and so begin to learn how to read. The concepts about books and how print works are of interest to children who are moving towards literacy, and who then begin to attend to aspects of the print that surrounds them. The next step is the growth of phonemic awareness and the acquisition of phoneme-grapheme knowledge.

3.10 The plight of children with learning difficulties

I have found that working with children with learning difficulties is a challenge, each child brings their little world of entangled thoughts and sadness, a child that finds they can't read or write and sees numbers as a very complex issue, he /she finds the view of the world as a very miserable place, specially as his peers can achieve all of the skills they are unable to, further the disappointment to their

parents makes their sorrow much more hurtful, they feel so angry and can't understand what is happening. A big number of the children that came to my clinic were diagnosed by Professor John Tyrer a Neurologist (in the glossary), as having dyslexia (in the glossary) and these children showed distinctly low activation profiles featuring little or no activation of the posterior portion of the superior temporal gyros, an area normally involved in phonology processing. Intervention following successful remedial training produced significant improvement in reading skills. Children who are mildly at risk may be very responsive to early intervention. Those who show persisting signs of dyslexia may also be responsive to instructional intervention. Those with more pervasive language learning difficulties affecting many aspects of their language function and capacity to use language to learn may be slower to respond to instructional interventions. Dyslexia is a treatable disorder, not that this complex disorder is cured after a short-term intervention. It will depend on long term, explicit, but highly intellectual engaging instruction throughout schooling.

It is impossible to tell if a child has learning difficulties by just looking at him or her, how can a parent or a teacher decide that the child needs special help, as the recent literature points out children will have a better chance of being literate if they are tested before grade three, as in the first four months of school, most first graders develop a basic word vocabulary that enables them to begin reading sentences, but a few children can not accomplish this. They also have a lack of coordination between sights and sound, it is a generalized disturbance of language function that interferes with the acquisition of reading skills.

A major clue indicating difficulties is slow word recall. Initially a child may be able to learn required words, and then seem to deteriorate because he or she is unable to retrieve his expanded reading vocabulary. The child may read slowly because he or she finds it hard to recall the words learnt substituting a synonym for a word the child is trying to recall, e.g. "house" may be home or pail may be "bucket". A child with learning difficulties has average or above intelligence and is reading two or more years below his peers when the child is in third grade. The child continue to reverse and invert letters and transpose words, they have difficulty distinguishing

between 'b' and 'd', 'p' and 'd' or 'b', 'g' and 'd' or 'b', to them words with these initial sounds are more confusing when they occur in word lists than they are in sentences often saying "saw" as "was" or "felt" as "left".

The child with learning difficulties has more difficulty retrieving grammar words than content words, he /she mispronounces words such as "what", for, "that", also visual memory for words seem to play an insignificant role in word recognition. The child finds it hard to live with being called stupid, becoming miserable at school and turning into a problem child or withdraws into him or her self. Because each dyslexic is different the teacher through careful observation must determine how to prepare a lesson, by finding out which is the child's strongest teaching channel, auditory, visual or kinaesthetic. Other issues such as does the child have short attention span and can this be lengthened with a combination of activities, and what is the child's learning pace, after a phonics concept has been introduced how much drill and review will be necessary for him or her to understand and use it. But during the first two or three years at school, the child does not learn to read normally.

There are some 220 sounds in the English language that all children should learn as they are used in books all the time, phonics should be taught in a useful order, short vowels, long vowels, consonant digraphs, diphthongs, hard and soft 'c' and 'g', and 'r' controlled vowels. The child may find short vowels sounds very confusing, as the short 'a', 'e', as they seem to sound the same. Looking in a mirror can help use the lips and tongue. Older children who have difficulties may actually know the answers in a test, but be unable to read the questions and spell the words needed in the answers. These children are then considered not to know the subject.

3.11 Testing phonemic knowledge and awareness

In her studies, (Munro 1998) takes the view that phonological knowledge (a knowledge of sounds, patterns of sounds, and sound groups) is but one aspect comprising knowledge of individual speech sounds. Phonics itself is the linking of sound and graphical information – for example, the letters in the alphabet. She specifies that at least five areas of capacity need to be discriminated:

Phonological knowledge: what we know about the sound properties, or phonology of our language. Phonological processes are the ways we use this knowledge.

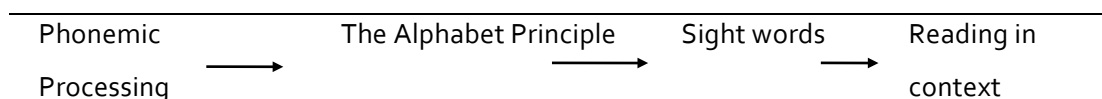
Phonemic awareness: one aspect of phonemic knowledge is our awareness of individual sound patterns in speech, for example, our capacity to detect the sound associated with 'ai' in the spoken word 'pain'.

Phonemic knowledge: what we know about pronouncing individual sounds; the same phoneme can be pronounced in slightly different ways, for example, the 'p' in 'pin' and 'spin'. The 'p' in 'pin' is accompanied by a slight puff of air, while the 'p' in 'spin' is not. This is a phonetic level distinction.

Phonic knowledge: what we know about letter sound patterns; linking sounds with letters and other forms of the alphabetic principle, for example, the use of letter sound knowledge.

Phonological recoding: what we know about the process by which we convert a written string of letters to a matching sequence of sounds (Munro, 1998, p. 3).

Munro's work relates to assessing children's grasp of these various skills and their contribution to the reading process because these areas of capacity underpin the learner's phonological processing capacity and speech perception as necessary to the reading process. For the purpose of this thesis it is essential to consider these areas when designing a test of children's phonological development.



Phonemic processing is a whole area, which has been virtually ignored in teaching the beginning stage of learning to read, since most programs begin at the 'alphabet principle' stage, which assumes that phonemic processing is intact. Even if a program places heavy emphasis on 'phonics', the capacity to identify and sequence the order of phonemes is usually assumed. In spite of the neglect of this

area in the teaching of reading, the area of 'phonemic processing' has undergone substantial study. Lewkowicz (1980) prepared a researched list of 'phonemic processing' skills as follows:

- 1) **Sound to word matching:** this is the child's capacity to recognise, within a word, a previously specified phoneme. This task does not necessarily introduce letters. It is the sounds, which are emphasised in this example. To respond correctly to the question, the child would have to be able to recognise the phoneme itself in the different position presented.
- 2) **Word to word matching:** here the child recognises the fact that a word has the same beginning, middle or final sound as another word.
- 3) **Recognition of rhyme:** this task is widely used in schools in almost all reading approaches.
- 4) **Isolation of a beginning, middle or final sound:** in this task the child is expected to produce the isolated sound when the teacher or tester says it.
- 5) **Phonemic segmentation:** this task is quite an advanced phonemic skill because the child would be asked to articulate all the sounds of the word and their correct order.
- 6) **Counting the phonemes:** here the child is asked to count the number of sounds in a word and show it in some way.
- 7) **Blending:** here the teacher or tester would say some sounds in isolation and see if the child could blend them into the actual word.
- 8) **Deletion of a phoneme:** here the student is asked to say a word without the first sound.
- 9) **Specifying which phoneme has been deleted:** here a word is said and then said again, but with one of the phonemes missing. The child must identify which one is missing.
- 10) **Phoneme substitution:** a new word is formed in this task by substituting one phoneme for another (Lewkowicz 1980).

Lewkowicz (1980) says that there were additional phonemic processing skills of a cognitive nature that are missing from this list. He pointed out that it is necessary that the learner should be able to add, shift, and repeat phonemes as required, as these are complex cognitive phonemic processing skills essential to the acts of decoding and spelling. He also highlighted the importance of the learner's capacity ultimately to pronounce and articulate whole words.

Results from a longitudinal correlational study of 244 children from kindergarten through 2nd grade indicate that young children's phonological processing abilities are well-described by 5 correlated latent abilities: phonological analysis, phonological synthesis, phonological coding in working memory, isolated naming, and serial naming. These abilities are characterized by different developmental rates and remarkably stable individual differences. Decoding did not exert a causal influence on subsequent phonological processing abilities, but letter-name knowledge did. Causal relations between phonological processing abilities and reading-related knowledge are bidirectional: Phonological processing abilities exert strong causal influences on word decoding; letter-name knowledge exerts a more modest causal influence on subsequent phonological processing abilities.

3.11.1 Language Testing

Assessment is used to make decisions. MacWhinney (2000) defines "assessment" as the process of collecting information about something that we are interested in, according to procedures that are systematic and substantively grounded. Tests usefulness can be determined by considering the following measurements qualities of the test such as reliability, construct validity, authenticity, interactivity, impact, and practicality. These qualities can easily describe a good language test's usefulness. The term reliability refers to consistency of measurement (Bachman & Palmer, 1996).

Language tests have been evaluated in terms of several qualities, such as reliability, validity and practicality. In order to justify using the scores from a language test to make inferences, prediction and decisions about individuals, we must be able to

demonstrate how performance on that language test is related to language use in specific situations other than the language test itself.

Lazaraton, (2008) says that reliability has to do with the quality of measurement; reliability is the "consistency" or "repeat reliability" of your measures. First, you have to learn about the foundation of reliability, the true score theory of measurement. Along with that, you need to understand the different types of measurement error because errors in measures play a key role in degrading reliability. We cannot calculate reliability we can only estimate it. Because of this, there are a variety of different types of reliability that each has multiple ways to estimate reliability for that type, it is important to integrate the idea of reliability with the other major criteria for the quality of measurement validity and develop an understanding of the relationships between reliability and validity in measurement. Sampling is the process of selecting units (e.g., people, organizations) from a population of interest so that by studying the sample we may fairly generalize our results back to the population from which they were chosen. Validity is the extent to which a test measures what it claims to measure. It is vital for a test to be valid in order for the results to be accurately applied and interpreted.

Validity isn't determined by a single statistic, but by a body of research that demonstrates the relationship between the test and the behaviour it is intended to measure. A list of the validity types that are typically mentioned in texts and research papers when talking about the quality of measurement: Translation validity Face validity Content validity Criterion-related validity Predictive validity Concurrent validity Convergent validity Discriminant validity.

Since the research aimed to create a test to identify which phonemes children of the age preschool to year 8 have difficulty with, it was also necessary to review ways in which such an assessment might be made. A search for tests and other assessment devices, which considered children's phonological development, awareness, and auditory acuity, was conducted. It was found that comprehensive tests of phonemic processing skills, phonemic development and awareness were

not readily available, although various aspects have featured in a range of tests over the years, which have been related to reading, learning difficulties, and intelligence.

This subsection examines a total of 19 tests, which were identified as most relevant to the aim of the research and the need to design assessment to plot basic phonemic competence of young children through to adolescence. These tests ranged from those used internationally to test a range of reading related items, through to tests devised specifically for the purposes of research into phonology. All had the potential to contribute to the development of the principal research instrument to be used for the purposes of this thesis. The examination of the tests focuses on those parts of each test which are of most relevance to the research, and include test content, relating to phonology, test purpose, age of children, administrative procedure, ease of use, issues of validity and reliability usefulness of outcomes, and relevance to the Queensland context.

3.12 Selection of assessment instruments for the research

A total of 19 tests were identified as the most relevant to the aim of the research. The tests of phonemic awareness were highly interrelated, indicating that they were tapping a similar construct, and thus lending construct validity to the concept of phonemic awareness.

Rhyming capacity is only minimally involved in these factors. Rhyme tasks may tap a different underlying capacity more than other tests of phonemic awareness. For the purpose of this thesis, testing children's phonological knowledge and phonemic awareness using rhyming tasks were treated with caution. Similarly, the auditory discrimination test had low correlations with other tests of phonemic awareness. This finding concurs with the low correlations found by Backman (1983) between auditory discrimination and each of three phonemic awareness tests: phonemic counting, phoneme blending, and phoneme deletion.

Again the research from these tests support the focus on phonemes and whole words rather than discrete auditory discrimination tasks. It is with this in mind that

the examination of tests used, the St. Lucia Graded Word Reading Test and also considered an adaptation of the International Phonetic Alphabet for the purposes of assessment.

3.12.1 The International Phonetic Alphabet (IPA)

The IPA is a set of phonetic symbols for international use, based on the Roman and Greek alphabets with the addition of some special symbols and diacritical marks. Diacritical is the distinguishing, distinctive marks or signs used to indicate different sounds or values of a letter accent, dieresis, and cedilla. Common diacritics are the acute accent (´), the grave accent (`) and cedilla (¸) in French, the tilde (~) in Spanish, and the dieresis or umlaut (ml;) in German.

Crystal (2008) noted that the International Phonetic Association has played an important role in the history of the IPA. This association was started in 1886 by a small group of language teachers in France who had found the practice of phonetics useful in their work and wanted the method to become popular. It was first known as the Phonetic Teachers' Association, changing to its present title in 1897.

Otto Jespersen (1965 [1942]), a member of this association, first suggested that a phonetic alphabet should be developed, and the first version of the IPA was published in 1888. The Association later produced a journal, the contents of which were printed entirely in phonetic transcription.

The main principles of the IPA are that there should be a separate symbol for each distinctive speech sound, and that the same symbol should be used for that sound in any language, with an alphabet in which it appears. One of the features of this alphabet was that it should consist of as many known symbols as possible, using new symbols and diacritics only when necessary. The same principles are still used today. One obvious place is in the standard dictionary to allow the reader to work out pronunciation. Over time the IPA has been modified and extended several times. Table 3-5 lists the items in the IPA.

Table 3-5 International Phonetic Alphabet

IPA	
b as in (bat)	ng as in (sing)
ch as in (chin)	ngg as in (finger)
d as in (dog)	p as in (pet)
th as in (then)	r as in (rat)
f as in (fat)	s as in (sip)
g (except after n) as in (go)	sh as in (ship)
h (except after c, s, t, z) as in (hat)	t as in (tip)
j as in (jam)	th as in (thin)
k as in (kit)	v as in (van)
l as in (lot)	w as in (win)
m as in (mat)	y as in (yet)
n as in (net)	z as in (zip)
	zh as in (vision)
Vowels and Diphthongs	
a as in (fate)	ir as in (fire)
a as in (fat)	o as in (goat)
a as in (ago)	o as in (got)
ah as in (bah)	oi as in (boil)
ar as in (fare)	oo as in (boot)
aw as in (paw)	oor as in (poor)
e as in (meet)	or as in (port)
e as in (met)	ow as in (brow)
er as in (fear)	owr as in (sour)
er as in (fur)	u as in (due)
er as in (taker)	u as in (dug)
i as in (bite)	ur as in (pure)
i as in (bit)	

(Concise Oxford Dictionary, 1982)

The IPA is not a test, although it does provide a basis for the development of an assessment device to test the subject's capacity to pronounce isolated phonemes.

3.12.2 St. Lucia Graded Word Reading Test

The St. Lucia Graded Word Reading Test (GWRT) (Andrews, 1973) requires children individually to read aloud from a list of 100 words graded in difficulty. It is intended to give an accurate estimate of the word reading aloud capacity of children in Years 2 - 7. Reading comprehension questions are not involved. This test was standardised on 435 children chosen randomly from pupils enrolled in Years 2 - 7 from 12 randomly selected primary schools in the Brisbane metropolitan area. A table of norms was produced which relates directly to the number of words correctly pronounced by each child. The purpose of this test is to determine the reading age of the child. It differs from the other tests because it has been created specifically for this purpose. This test has been found to be useful for teachers because it is easy to administer, and helps them discover children with reading difficulties.

3.12.3 Wechsler Intelligence Scale for Children (WISC)

The Wechsler Intelligence Scale for Children (WISC) (1949/1997) was published as an extension of the Wechsler Bellevue Adult Intelligence Test. It has been used frequently in special education in the assessment of learning disabilities and consists of ten subtests and two supplementary subtests. Examination of the current third edition WISC III, (1992) is limited in its testing of phonemic knowledge and auditory discrimination.

The Wechsler Intelligence Scales are standardized tests, meaning that as part of the test design, they were administered to a large representative sample of the target population, and norms were determined from the results. The scales have mean, or average, standard score of 100 and a standard deviation of 15.

Further to this, none of the subtests deal with the production of isolated phonemes. The Arithmetic subtest requires children to read six problems aloud and work out the answers, if the children have difficulties the tester reads it for them. In addition in the subtest of symbol search, the child is required to read the words 'yes' and 'no' which assumes their capacity to read and pronounce words. The

Wechsler tests including the earlier version, the Wechsler Pre-school and Primary Scale of Intelligence - Revised (1989) are not specific language tests, but are more tests of intelligence, and relate to verbal capacity or language and cognition in general.

3.13 Tests revised for the selection of the tools needed for this thesis

Although several investigators have attempted to determine the factorial structure and predictive validity of phonemic awareness tests, they have not included a wide variety of task types of phonemic awareness in their test batteries, nor have they determined the predictive validity of the tests on a criterion measure of the initial steps in reading acquisition. These types of tasks are not conducive to ease of use, particularly where teachers and testers have limited time available, and need to be both efficient in dealing with large numbers of children, and where the results need to be easily interpreted to enable action plans and learning/intervention programs to be designed or adapted. Therefore none of the tests identified to this point were considered appropriate for the current research purpose.

3.14 Mongard P: Test A

In previous studies I dealt with phonological responses in English by native Mandarin Chinese speakers, a test was designed after the investigation and study of Mandarin Chinese grammar. My aim in that research was to look for links between children's language backgrounds and their phonological errors in English.

I considered various possible types of testing for this and their particular advantages and disadvantages. The advantages of various tests for eliciting English phonemes may be outlined briefly as follows:

- 1) Picture descriptions,
- 2) Reading aloud from a printed text,
- 3) Repeating words and sentences spoken by me, and
- 4) Conversation method.

1) Picture description: The students were shown a picture with various items on a well-known traffic theme ("Danger on the road"), with easily identifiable items.

A large truck approaching a corner of a main road, two boys on bicycles on the wrong side of the road trying to pass the truck, a man and his girl friend from the opposite direction coming around the corner on a motorbike but looking up at an aircraft about to land. All this sets the stage for a head-on collision. I asked each student to describe the picture orally.

The advantages of this test were that the visual material presented was not encoded in words. No auditory or reading comprehension (decoding) was required which could complicate responses if the student was deficient in those areas.

The disadvantages were that the range of phonemes used in the responses was not a fair sample of all English phonemes, but rather phonemes determined by the student's responses to the limited picture items and their relation to the dangerous traffic scene. Students may have biased the responses by actively avoiding phonemes or phoneme groups, which he or she found difficult to pronounce.

Apart from this it was most unlikely that a student would spontaneously give an adequate and standard sample of English phonemes. It was found in practice that different students would choose different phonemes so that performances of students could not be compared.

3.14.1 Mongard Test B

Reading aloud from a printed text. I compiled a printed text of 12 short sentences each comprising 4-8 words. This text contained all the vowels and consonants of the English alphabet, and most of the single vowels and single consonant phonemes, plus a modest sample of diphthongs and consonant combinations. Some phonemes occurred more than once (Tyrer, P. 1993).

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The advantages of this test were that I could control the phonemes to be used by the students and could choose a representative sample of English phonemes. The same test could be used on a number of different students whose responses could then be compared in relation to the same phonemes. Standardizing of the test could also be possible if sufficient numbers of students were studied.

I found that the test could be rapidly and easily administered, compared with other tests tried, the students more readily cooperated in this test and more easily gave it their attention (compared to the other tests tried). These were important practical considerations.

The disadvantages were that the visual test material was encoded in printed words and so any difficulty in reading comprehension might potentially interfere, full reading comprehension is not essential to make the visual-phonetic transformations of reading aloud. The subject would mainly need to have accurate visual perception of the forms of letters and have knowledge of basic phonetic rules. (For example, I can read Italian and Portuguese text aloud at considerable speed with fair account, but with limited comprehension).

3) Repeating words and sentences spoken to me: The test would involve me reading aloud from the printed text (used in 2 above) a representative sample of English phonemes in reasonably short sentences (of 3 - 4 words, well within the student's memory span). I found it easy to speak at a constant rate of about two syllables per second, which was a rate readily, accepted by the student and I had practised doing this (using a stopwatch). The student would then repeat the words after me. As with the student reading aloud from a printed text, the advantages of this test were that I could control the phonemes to be used by the student.

The stimulus for the same phonemes would be given to each student and individual performances could be compared. The disadvantages were that the test material would be encoded in spoken words so that lack of auditory comprehension could potentially interfere.

The main disadvantage of this test was that recent memory of my pronunciation could help the student pronounce the phonemes correctly. This method would not be as exacting as the student reading aloud from a standard printed text. It should be noted that auditory comprehension of the tester's words is not essential in this test. One can repeat words without knowing their meanings.

4) The conversational method: By asking questions orally, I tried to guide responses, which would demonstrate the student's use of phonemes. In theory this might be the most valid test for studying the student's spontaneous utterance of English phonemes. I tried to vary the questions appropriately but I found it too difficult and could not elicit a good sample of English phonemes from student. The test material (my spoken words) was encoded in words that the student might not fully understand, but needed to understand for appropriate responses. Further, the method elicited very different phonemes in different student so that individual performances could not be compared.

Based on the above, it seemed that reading aloud from a standard printed text gave the best chances of eliciting a standard sample of English phonemes from native Mandarin Chinese speakers. In this type of test I could more conveniently control the phonemes to be tested in these students.

These earlier studies on Mandarin speakers paved the way for an understanding of the problems faced by students from Taiwan, who are the students for the next project for my Master Thesis. The earlier studies showed the value of reading aloud from a printed text to examine the capacity of ESL learners to pronounce English phonemes and gave me experience in the construction and trial of a simple test for this purpose.

3.14.2 Mongard Test C

With the cooperation of Bond University English Language Institute Students from Taiwan (III, pre-intermediate), I used reading aloud of the printed text of 12 short English sentences (see Test A, Appendix 1), which had been successfully used in the pilot studies described above.

I also decided to construct a detailed and comprehensive printed test in order to try to elicit systematically and in a more standardized way a much larger sample of English phonemes and phoneme combinations and diphthongs. With the cooperation of the same Bond University students from Taiwan, I aimed to get data that could be looked at statistically.

Constructed an extensive though not exhaustive test of English phonemes and phoneme combinations in order to examine the capacities of the students from Taiwan to pronounce English consonant phonemes (singly and in clusters) at the beginnings and ends of words, in the interior of words, and consonant clusters bridging word boundaries. I also tested vowels and diphthongs. The outline of the test is as follows:

- 1) **Single phonemes from consonants:** Where possible in English, two examples of every consonant phoneme were chosen at the beginning of a word and two examples at the end. 92 items
- 2) **Two phonemes from consonants:** 22 examples at the beginning of a word and 22 examples at the end. Often a 2-phoneme consonant combination could be used at the beginning of a word but not at the end (e.g. "br" as in 'break'), or at the end of a word but not the beginning (eg. "nch" as in "lunch"). 44 items.
- 3) **Three phonemes from consonants:** 6 Examples at the beginning of a word and 6 examples at the end. Usually a 3-phoneme combination used at the beginning of a word could not be used at the end (eg. "spl" as in "splendid"), or a combination could be used at the end of a word but not the beginning (eg. "cts" as in "facts"). 12 items.

- 4) **Two and three phonemes from consonants:** Examples in the interior of the words. 12 items.
- 5) **Three to six phonemes from consonants:** Examples crossing word boundaries (eg. "nd str" as in "end stroke"). 12 items as phrases of 3 or 4 words.
- 6) **Phonemes from vowels and diphthongs:** Where possible in English, two examples of every phoneme were used. These phonemes were contained in the above list of subtexts 1-5 of Test B described above. 48 items.

Total number of items in Test B: 220

A number of phonemes occurred in this text more frequently than specified above for inclusion in the tables. In these cases, the phonemes or phoneme combinations to be included in the data for analysis in the tables were determined and marked (on my copy only of the test) before the test was applied. The students tested did not know this (to avoid student bias). A list of the phonemes marked for inclusion in the data to be analysed is shown in Appendix 3.

As it was desired to test the students phonemes production, complicated as little as possible by any reading difficulty, I used the simplest possible letter combinations for a given phoneme e.g. "ff" as in "cuff" rather than "gh" as in "rough" for the phoneme /f/.

Test A comprised 12 short sentences, each of 4-8 words. For Test B, I used one word in each test item rather than whole sentences (except in Part 5 of the test where phrases of 3 or 4 words were used). This kept Test B as simple and as short as possible while still allowing a thorough test of the phonemes.

Randomization of the items: In constructing Test B, I started at the beginning of the alphabet, with 2 words beginning with consonant phonemes /b/, then two words ending with "b" and so on through the alphabet. Such grouping of phonemes might affect the student's responses and I randomized the items in each Subtest 1-5 of Test B, using Tables of Random Numbers. This broke up the

previous somewhat ordered grouping and left only occasional random association of similar phonemes.

As the phonemes for vowels and diphthongs (Subtest 6) were drawn from Subtests 1-5 there was no need to randomize these phonemes further.

I administered Test A and Test B to each student individually and was present for the whole test, to ensure constant conditions: that the student was tranquil, undisturbed in quiet surroundings, uninterrupted, relaxed and reassured as much as possible, with the microphone held at an appropriate distance.

For each student, the (easier) pilot Test A took about 5 minutes to administer first. This familiarized the student with the procedure and encouraged confidence. The more difficult Test B and C (administered some days later) took about 15 minutes. These were important practical points. Long tests produce fatigue and consequent varying student concentration and other unwanted effects, such as lack of cooperation (Mongard, P. 1994).

3.14.3 Illinois Test of Psycholinguistic Capacity

The Bateman (1965) designed the Illinois Test of Psycholinguistic Capacity (ITPA). It is known as ITPA test and has been widely used in diagnosing children's learning difficulties. This test consists of nine sub-tests, of which four relate to auditory stimuli in which the child needs to recognise the phonemes combined in syllables and words, the children are also tested on the semantic values of the words. The test is time consuming and the tester needs specialised training.




3.14.4 Test of Auditory Analysis Skills

Rosner (1971) developed the Test of Auditory Analysis Skills. In this test the child must analyse words such as 'snowflakes' into its respective syllables and phonemes. This author provided evidence of the importance of phonemic analysis in reading, and found strong correlations between the Test of Auditory Analysis Skills and reading scores in children's from kindergarten to year 6. This test proved to be very time consuming for my study.

3.14.5 Lindamood Auditory Conceptualization Test (LAC)

Charles and Pat Lindamood (1979) whose occupations were linguist and speech therapist respectively designed the Lindamood Auditory Conceptualization Test (LAC). The LAC Test measures the child's capacity to distinguish phonemes through the use of coloured blocks. A pre-check is given to make sure the child understands some of the simple concepts used in the test, and the child is presented with a sequence of three different subtests. In the first two, the task is to identify the 'sameness/difference' of individual phonemes and their correct number and sequence. The task of the student is to show s/he understands whether or not the sounds s/he just heard are the same or different, and how many sounds there are. There is no particular relationship between any particular sound and any specific coloured block. The sounds are presented orally to the child in a strict and orderly fashion. There are no word clues and the examiners must take care to pronounce the phonemes in as clear and isolated a manner as possible.

Table 3-6 Sound Patterns

Sound pattern	Block Pattern
/b/ /b/ /b/	 Same three sounds repeated – same three colors
/b/ /m/	 Two different sounds – two different colors
/s/ /s/ /sh/	 Same two sounds (colors) followed by a different sound (color)

Sound pattern

/d/ /j/ /d/

Block Pattern



First sound (color), followed by a different sound (color), followed by the same sound (color) as the first

The LAC measures the 'auditory discrimination' at the phoneme level. In the last part of the LAC test the children must do something much more complex they must be able to show they can manipulate the phonemes in all the ways listed in the earlier task (Lewkowicz, 1980). The student must be able to first hear the differences in the various combinations of phonemes that are presented, and show what they hear by manipulating the blocks appropriately (adding, subtracting or altering order of coloured blocks).

Another interesting feature of the test is the scoring. The test is not 'normed' in the traditional sense, although validity and reliability scores are given in the manual. Instead, cut-off scores are presented for different grade levels, which are to be interpreted as minimum competency scores. The LAC is able to identify a central problem in phonemic processing and by extension, reading. It also has predictive value regarding any child under-performing in reading and spelling. The tester must get specialised training by the Lindamood Association in America, which I attended for several weeks.

3.15 Research based tests of phonological knowledge and phonetic processing

Lundberg, Wall and Olofsson (1980) used a battery of tests on Swedish children aged 6 to 7 years, which focused on assessing children's phonological knowledge, phonetic processing and metalinguistic skills. This battery was highly representative of the research area and included tests developed by others, which were modified by these researchers. These tests required the children to carry out the following skills: (a) blending syllables and blending phonemes, both with

concrete representation, (b) blending syllables and blending phonemes, presented orally only, (c) segmenting syllables and segmenting phonemes, concretely represented, (d) identifying the location of a given sound in a word, (e) capacity to reverse phonemes and (f) rhyme production. Many tasks such as these have been designed and used to test phonemic awareness. Examples of the different approaches and the task type, these tasks are limited to matching, recognition or production, phoneme segmentation, phoneme counting, blending, deletion, substitution and reversal. There is a limited focus on pronunciation and production.

3.15.1 Tasks used in the different test to assess phonemic awareness

Although several investigators have attempted to determine the factorial structure and predictive validity of phonemic awareness tests, they have not included a wide variety of task types of phonemic awareness in their test batteries, nor have they determined the predictive validity of the tests on a criterion measure of the initial steps in reading acquisition. These types of tasks are not conducive to ease of use, particularly where teachers and testers have limited time available, and need to be both efficient in dealing with large numbers of children's, and where the results need to be easily interpreted to enable action plans and learning/intervention programs to be designed or adapted. Therefore none of the tests identified to this point were considered appropriate for the current research purpose. The Task is shown in the following table I designed.

Table 3-7 Validity of the Tests

Task	Example	Studies
Sound-to-word matching	Is there a /f/ in calf?	Marsh & Mineo (1977); McNeill & Stone (1965); Skjelford (1976); Wallach, Wallach, Dozier & Kaplan (1977)
Word-word matching	Do pen and pipe begin the same?	Bradley & Bryant, 1978; Stuart- Hamilton, 1984; Wallach & Wallach 1976
Recognition or production of rhyme	Does sun rhyme with run?	Calfee, Chapman, & Venezky, 1972; Doehring, Trites, Patel & Fiedorowicz, 1981
Isolation of a sound	What is the first sound in rose?	Wallach & Wallach, 1976; Williams 1980
Phoneme segmentation	What sounds do you hear in the word hot?	Fox & Routh, 1975; Goldstein, 1976; Helfgott, 1974; Skjelfjord, 1976; Williams, 1980
Phoneme counting	How many sounds do you hear in the word cake?	Backman, 1989; Lieberman, Shankweiler, Fischer, & Carter, 1974; Mann, 1986; Tunmer & Nesdale, 1985; Yopp, 1985; Yopp & Singer, 1984; Zifcak, 1977
Phoneme blending	Combine these sounds: /c/-/a/-/t/.	Chall, Roswell, & Blumenthal, 1963; Fox & Routh, 1976; Goldstein, 1974; Helfgott, 1974

Task	Example	Studies
Phoneme deletion	What word would be left if /t/ were taken away from the middle of stand?	Bruce, 1964; Calfee, Chapman, & Venezky, 1972; Doehring, Trites, Patel, & Fiedorowicz, 1981; Morais, Cary, Alegria, & Bertelson, 1979; Read, Yun-Fei, Hong-Yin, & Bao-Qing, 1986; Rosner, 1975
Specifying deleted Phoneme	What sound do you hear in meat that is missing in eat?	Stanovich, Cunningham, & Cramer (1984)
Phoneme reversal	Say os with first sound last and the last sound first.	Alegria, Pignot, & Morais (1982)
Invented spellings	Write the word monster	Morris, 1983; Read, 1978; Zifcak, 1977

3.15.2 Auditory Discrimination Test

The purpose of the Auditory Discrimination Test (Wepman, 1973) was to determine a child's capacity to recognize the fine differences that exist between the phonemes used in English speech (Wepman, 1973). After reading a pair of words to the child, s/he was asked to listen and to indicate whether the words were the same or different. Word pairs were selected on the basis of the following criteria firstly; each word pair was matched for familiarity by selecting words that were as close as possible in frequency of use, based on the Thorndike-Lorge Teacher's Word Book of 30,000 Words (1944). Secondly, matches were made within phonetic categories; that is, articulatory stops were matched only with other articulatory stops. Thirdly, matches were equated for length. Vowel comparisons were based on (a) the part of the tongue raised, (b) the position of the lips, and (c) the height of the tongue. Each pair was contrasted on the basis of a single discriminating feature.

The test took approximately fifteen minutes to administer. It consisted of 40 word pairs, 30 pairs of different words and 10 pairs of the same words. The 'same' items were included as a check for understanding instructions and for paying attention. Each subject's score was based only on the total number correct of the 'different' items. The scores ranged from 0 to 30. This is an interesting test but not suitable for the aim of my research.

3.15.3 Phoneme Blending Test

The purpose of the Phoneme Blending Test (Roswell-Chall, 1959) was to determine each child's capacity to blend isolated sounds into words. The test contained three parts, comprising 10 items each, with the parts progressively more difficult. The first part consisted of two-phoneme words that had been segmented into two component parts (e.g. a-t). The second part contained three- to four-phoneme that had been segmented into two parts (e.g. st-ep, f-at). The third and most difficult part consisted of three- to four-phoneme words segmented into three parts (e.g., c-a-t, d-e-sk).

Each child was given three sample items prior to administration of the test. The child was asked to “tell what word we would have if these sounds were put together”. The component sounds of each word were spoken at approximately half-second intervals. After each segmented word, the child was asked to speak the word he or she heard when the sounds were blended. The child’s score was based on the total number of correct responses (maximum = 30). The test took approximately 5 to 10 minutes to administer. This test was not suitable for the purpose of my research.

3.15.4 Phoneme Counting Test

The Phoneme Counting Test (Lieberman et al., 1974) was developed to assess children’s capacity to count the number of phonemes in an utterance. The test consisted of 42 randomly assorted items of one, two, or three-segment utterances. Under game like conditions, each child was asked to listen to an utterance and indicate the number of sounds in the utterance by tapping with a pencil on a table. All of the two and three phoneme utterances were real words. Each child was first given a series of demonstration utterances, with the following instructions:

We are going to play a listening and tapping game today. I’m going to say some words and sounds and tap them after I say them. Listen, so you’ll see how to play the game.

At this point the following examples were given as training: lul (one tap); boo (two taps); boot (three taps). Each child was then asked to repeat the demonstration triad. Once the child responded correctly to this triad, he or she was given three more triads as training: lael, as, had; lol, toe, tall; and lil, ma, cut.

Upon completion of training the following instructions were given:

Now we are ready to play the real game. I’ll say a word or sound, but I won’t tap it because you know how to play the game yourself. So, you say the word after me and then tap it. After each word, be sure to put your pencil down so I’ll know you’ve finished tapping.

Each correct response was followed by confirmation. The instructor corrected any incorrect responses and demonstrated the correct response. Each child's score consisted of the number of correct responses by the child, with a possible range of 0 to 42 correct. The test took between 5 and 10 minutes to administer. Again this test was not suitable for my research.

3.15.5 Phoneme Deletion Test

The Phoneme Deletion Test (Bruce, 1964) was used to determine children's capacity to delete phonemes from words. The test consisted of 30 words (26 monosyllables, 3 disyllables, and 1 disyllable), and took approximately 10 minutes to administer. The words were drawn from the first 500 items in Burroughs (1957) vocabulary count for children aged five to six-and-a-half, to ensure the words were in the children's vocabulary. Each child was asked what word would remain if a certain 'sound' were removed from a stimulus word. The sound and its position in the word were given in the following format: "What word would be left if /t/ were taken away from the middle of stand? The target sound, its position, and the word varied depending on the stimulus item.

Of the test items, 21 yielded words in the first 500 of Burroughs' count once the appropriate sound was deleted. The other 9 test words yielded words in the second 500 of Burroughs' count. The position of the phoneme to be deleted was equally divided between the beginning, middle, and ending of the test words, and the various positions were randomly ordered in the test list.

Although Bruce (1964) did not provide any words for training, he suggested that children be given a number of examples prior to the test. The following words were used here as examples: cat (remove the /k/), bright (remove the /r/) and cried (remove the /d/). Children experiencing difficulty with the demonstration items were given further examples, using their names and the names of their teachers or friends (e.g. Johnny with the /j/). This is an interesting test, but again not suitable for my research.

3.15.6 Test of Auditory Analysis Skills

Rosner's (1975) Test of Auditory Analysis Skills also assessed phoneme deletion capacity. It included both syllable and phoneme segmentation items, and took only a few minutes to administer. It began with simple syllable elisions from compound words such as *sunshine*, and progressed to more difficult items, such as deleting a syllable from a multisyllabic word, and deleting a phoneme from the beginning, ending, or middle of a word. There were 15 items on this test: 2 training items and 13 test items. The subjects were given similar instructions for each item, following this model: "Say *sunshine*". The child repeated the word. "Now say *sunshine* but don't say *shine*". The subject's score was the number of items correct, with a possible range of 0 to 13. This test was not suitable for the aim of my research.

3.15.7 Rhyming Test

The Rhyming Test (Yopp, 1995) involved presenting the child with twenty word pairs and asking them to indicate whether or not the word pairs were rhymes. Initially, the child was asked whether s/he knew what a rhyme was. Then the concept was clarified for the child as 'words that sound the same at the end'. Several examples were given, including *cat/hat*, *man/ran*, *sandals/candles*, and the child's own name with an appropriate rhyme. Counterexamples were also given, such as *run/green*, and the child was reminded that these words did not rhyme because *run* ended with *un*, whereas *green* ended with *een*. The test procedure was to read each pair of words, and the child was required to respond with either 'yes' or 'no'. Scores had a possible range from 0 to 20 correct, while the administration time was approximately 2 minutes. Although the words were drawn from Thorndike and Lorge's (1963) list of word frequencies, the constraint of using rhyming words allowed the choice to be made from only 75% of the words. As I was not testing rhyming, this test was not suitable.

3.15.8 Word Analysis and Synthesis Skill (WASS)

The Word Analysis and Synthesis Skill (WASS) Test (Goldstein, 1974) focused on phoneme analysis or segmentation. It consisted of subtests, which were developed

to assess the child's capacity to analyse words into phonemes/ sounds. In this test the tester pronounced a word in normal speech and the child was required to respond by saying the word in a segmented way. A total of 16 words were used to measure phoneme segmentation capacity. These words were also selected on the basis of children's familiarity with them. Eight words each comprised two phonemes, and the remaining eight words comprised three phonemes. Pictures of each word were provided, as well as checkers to be manipulated with each sound. Children were given the following preliminary instructions:

Today we are going to play a different picture game. It is called "What's the name of the secret picture?" Your job is to guess the name of the picture I am holding in my hand. I will give you some help. I will say the name of the picture in a funny way. I will break the name into parts. When you say the parts together, you will know the name of the secret picture. OK?

Two blending examples were given, d-o-g and ow-l. As the tester spoke each word a checker was placed into a checker-sized square within a row of four squares on an index card (13cm x 21cm), beginning with the leftmost square. After placing the appropriate number of checkers in the squares, all the sounds were repeated in a segmented way, while pointing to each checker, and the child was asked *What word do you get when you say d-o-g together?* This procedure was repeated for the example owl. The child was then given the first test picture card and said, *here's a picture of (test word). What is it?* You say (test word) funny just like I've been doing. Use the checkers'. If the child did not respond in about 10 seconds, the tester said, *Say a part of the word (test word) and put a checker in the square.* If the child's response was incorrect, the tester removed the checkers and said, *Let's do this one together.* All correct responses were praised, and all incorrect responses were corrected. Test pictures were given to each child in random order. The number of correct responses given, including both the oral segmentation and the use of the checkers, determined a child's score. Scores had a possible range of 0 to 16. The test took approximately 5 minutes to administer. This test was also not suitable for my research.

3.15.9 Phoneme Segmentation

The Yopp Test (1995) also tested phoneme segmentation. Like the Goldstein (1974) segmentation test, its purpose was to measure a child's capacity to articulate the sounds of a word separately, in order. The word list for this test was based upon both word familiarity and feature analysis. All words except one occurred on Thorndike and Lorge's (1963) list as most frequently occurring (i.e. at least 100 occurrences per million). The exception was the word zoo, which was included to meet the feature analysis criteria described below. This test also took into account the classification of speech sounds as classified by linguists (Ladefoged, 1982). For instance, consonants are classified according to both manner and place of articulation and vowel sounds are classified according to the height of the tongue and the tongue's location in the mouth. Words occurring on the Yopp-Singer list were selected based on an analysis of their component sounds. All commonly occurring places and manners of articulation of English-language consonants were represented on the list. Likewise, all heights and locations of English vowels were represented on the list.

Directions for administration of the test were as follows:

Today we're going to play a different word game. I'm going to say a word, and I want you to break the word apart. You are going to tell me each sound in the word in order. For example, if I say old, you will say o-l-d. Let's try a few words together.

Three more examples were given. These included ride, go, and man. Then the child was given the test proper. Feedback was given to the child as he or she progressed through the list. If the child responded correctly, the tester nodded, or said, "That's right". If the child gave an incorrect response, he or she was corrected. Only words that the children responded to accurately on their own were scored as correct. Scores had a possible range of from 0 to 22 correct. The test took approximately 5 to 10 minutes to administer.

3.15.10 Sound Isolation Test

The Sound Isolation Test was a modified version of the Yopp's test noted earlier. In this test children were asked to identify the starting sounds of spoken words. The stimulus words used for identification of beginning sounds came directly from Wallach & Wallach (1976). Words used for identification of final and middle sounds were selected on the basis of word frequency, with at least 40 occurrences per million (Thorndike & Lorge, 1963). Only five words in each category were included, in keeping with the Wallach & Wallach.

Directions to each child also came from the Wallach & Wallach as follows:

I'm going to say a word, and you tell me what sound the word starts with. Let's try one for practice: Jack. What sound does Jack start with?

The tester indicated whether each response was correct or incorrect, and gave or repeated the correct response, "Jack starts with the sound /j/". This same procedure was followed for all the words on the list. The child's score was the number of correct responses, with a possible score range of 0 to 15.

3.15.11 Word-to-Word Matching Test

The Word-to-Word Matching test was also based on Yopp (1995) and Wallach & Wallach (1976). Its purpose was to determine the child's capacity to match the sounds at the beginning of two words, and the sounds in the final and middle position. The words used for matching final and middle sounds were also varied in frequency. Children were given the following instructions:

I'm going to say two words, and you tell me if they start with the same sound. Let's try some for practice. Big, baby – do they start with the same sound? (After waiting for the child's response, the tester indicated if the child was right, or corrected the child if his or her answer was wrong). Big and baby start with the same sound. They start with /b/.

After the practice items for beginning sound matching were completed, the first 8 test items were given to the child. This part of the test was followed by instructions We Speak With Our Ears (2012)

for matching final sounds in word pairs, using rain/pin and shirt/pet as examples. Once the 8 items in this section of the test were completed, instruction and examples were given for matching middle sounds in word pairs, using hop/big and bite/ride as practice pairs. The maximum possible score was 24. The test took less than 5 minutes to administer.

Table 3-8 shows the means, standard deviations, and reliability scores for some of the above tests. The reliability of each test was determined using Cronbach's alpha. Seven of the tests had high internal consistency, with $\alpha > .83$. The Roswell-Chall (1959) phoneme-blending test showed the greatest reliability ($\alpha = .96$), followed closely by the Yopp-Singer phoneme segmentation test ($\alpha = .95$). Two tests showed moderate to high reliability: Rosner's (1975) phoneme deletion test ($\alpha = .78$) and the Yopp rhyme test ($\alpha = .76$). The Yopp modification of Wallach's (1976) word-to-word matching test had the lowest reliability ($\alpha = .58$) for this sample. Table 3-8 shows the relative difficulty of these from least difficult to most difficult and Table 3-9 shows the Interco relations of these tests of phonemic awareness.

Table 3-8 Means, standard deviations, and reliability scores for phonemic awareness tests

Test	Max Score	Mean	SD	α
Auditory discrimination (Wepman, 1973)	30	20.47	6.94	.85
Phoneme blending (Roswell-Chall, 1959)	30	19.47	9.39	.96
Phoneme counting (Lieberman et al. 1974)	42	23.80	7.65	.83
Phoneme deletion (Bruce, 1964)	30	7.89	6.70	.92
Phoneme deletion (Rosner, 1975)	13	5.96	2.99	.78
Rhyme	20	14.23	3.76	.76

Test	Max Score	Mean	SD	α
(Yopp)				
Phoneme segmentation	16	8.53	4.71	.88
(Goldstein, 1974)				
Phoneme segmentation	22	11.78	7.66	.95
(Yopp-Singer)				
Sound isolation	15	8.77	3.74	.84
(Yopp modification)				
Word-to-word matching	24	15.12	3.04	.58
(Yopp modification)				

Table 3-9 Relative difficulties of tests of phonemic awareness from least to most difficult

Test	Converted M
Rhyme (Yopp)	.714
Auditory discrimination (Wepman, 1973)	.699
Phoneme blending (Roswell-Chall, 1959)	.652
Word-to-word matching (Yopp modification)	.631
Sound isolation (Yopp modification)	.589
Phoneme counting (Lieberman et al, 1974)	.584
Phoneme segmentation (Yopp-Singer)	.535
Phoneme segmentation (Goldstein, 1974)	.530
Phoneme deletion (Rosner 1975)	.463
Phoneme deletion (Bruce, 1964)	.265

Table 3-10 Intercorrelations of tests of phonemic awareness

Test	1	2	3	4	5	6	7	8	9	10
Auditory discrimination	-	.31	.25	.26	.16	.11	.29	.33	.24	.20
Phoneme blending		-	.72	.51	.56	.50	.79	.79	.64	.47
Phoneme counting			-	.52	.56	.44	.72	.75	.77	.50
Phoneme deletion (Bruce)				-	.65	.38	.57	.55	.56	.48
Phoneme deletion (Rosner)					-	.42	.56	.62	.55	.56
Rhyme						-	.44	.55	.42	.56
Phoneme segmentation (Goldstein)							-	.82	.74	.58
Phoneme segmentation (Yopp-Singer)								-	.80	.58
Sound isolation									-	.55
Word-to-word matching										-

3.16 Conclusion

Examination of these tests, as outlined in this chapter, shows that no single task as used for testing phonological knowledge has the scope required for investigating children's phonological development in keeping with the aim of the research conducted for this thesis. An alternative, more holistic approach would seem to be pertinent, such as adapting the International Phonetic Alphabet (IPA) to test phonological development through testing the whole list of isolated phonemes presented. A further advantage in taking this approach was the potential to collect data to advise on whether all or some phonemes are necessary to predict reading success.

The testing of isolated phonemes is justified on the grounds that, if a child cannot utter phonemes, s/he obviously cannot articulate them into syllables and words. An exploratory hypothesis suggests that one would expect some correlation between the capacities to pronounce phonemes and to articulate them into syllables and words. On this basis it is also argued that the St. Lucia Graded Word Reading Test (GWRT) would be very useful in gauging children's reading capacity and capacity to articulate whole words, and to assess the degree of correlation between pronunciation of all the phonemes underpinning the English language and the capacity to articulate whole English words. Other advantages of the St. Lucia Graded Word Reading Test include the fact that it was standardised in the Brisbane metropolitan area, where this research has been conducted, and is still in current use; it is also convenient and easy to administer in the classroom, and takes about 10 minutes for each child to complete. I resolved to create a test which isolated phonemes based on the IPA, and to utilise the GWRT to assess children's phonological development for the purpose of the research for this thesis.

Chapter four outlines the methodology for the research and shows how, on the basis of the above discussions, the IPA and the St. Lucia Graded Word Reading Test were applied to investigate the way phonological skills impact on reading capacity for children's in the early years of schooling through preschool to adolescence and identify which phonemes children of various ages find difficult to master, in keeping with the research aim of this thesis.

Chapter 4

METHODOLOGY

4.1 Introduction

Chapter 4 outlines the methodology for the research, and shows how the International Phonetic Alphabet (IPA) and the St. Lucia Graded Word Reading Test (GWRT) were applied to investigate the way that phonological skills impact on reading capacity for children's in the early years of schooling through Pre-school to adolescence and identify which phonemes children of various ages found difficult to master with the aim of finding a suitable testing tool for teachers to use in the classroom in order to find out whether children have difficulty with reading, in keeping with the research aim of this thesis.

The testing of isolated phonemes is justified on the grounds that, if a child cannot utter phonemes, s/he obviously cannot articulate them into syllables and words. An exploratory hypothesis suggests that one would expect some correlation between the capacities to pronounce phonemes and to articulate them into syllables and words. On this basis it is also argued that the St. Lucia Graded Word Reading Test (GWRT) would be very useful in gauging children's reading capacity and capacity to articulate whole words, and to assess the degree of correlation between pronunciation of all the phonemes underpinning the English language and the capacity to articulate whole English words. Other advantages of the GWRT included the fact that it was standardised in the Brisbane metropolitan area, where this research was conducted. I resolved to create a test which isolated phonemes based on the IPA, and to utilise the GWRT to assess children's phonological development for the purpose of the research for this thesis.

4.2 Research paradigm

There is a great diversity of research paradigms. These paradigms can be divided into three categories: 1) Modernism (Positivism/Post-positivism), Post-modernism (Interpretivism/Constructivism), 2) Criticalism and Representationalism and 3)

Post-post-modernism (Integralism). These paradigms have their own methods, focus, and quality standards that guide researchers to address the issues regarding designs, tools, validity criteria and the interpretation of data (Yin, 2003).

These paradigms did not all originate from educational researchers but they came from other areas or disciplines such as naturalistic science, social and political science, literatures and philosophy. Experimentation should be ontologically realist, but also Epistemologically Fallible, critical, and hence Post positivist, and it should pursue publicly specified methods that try both to verify causal relationships and to falsify them through the judicious use of experimental designs, statistical analyses, and a critically appraised common sense that is heavily dependent on past knowledge in a particular substantive area (Campbell & Stanley, 1963).

Epistemology is defined as a branch of philosophy that investigates the origin, nature, methods and limits of human knowledge. Ontology is a branch of metaphysics that studies the nature of existence or being as such. Some definitions for a paradigm in the research literature include:

- An example or pattern of small, self contained, simplified examples that we use to illustrate procedures, processes, and theoretical points (Webster Dictionary).
- A paradigm is a worldview, a general perspective, and a way of breaking down the complexity of the real world. (Niglas, 2001).

“An integrated cluster of substantive concepts, variables and problems with corresponding methodological approaches and tools,” said by Thomas Kuhn, who is known for the term ‘paradigm’.

How does a researcher like me select a research paradigm and the corresponding methodology? Some questions can be raised such as, what is the nature of the social phenomena being investigated? What are the bases of knowledge corresponding to the social reality? And how knowledge can be acquired and disseminated? What is the relationship between individuals and their environments? Is there a social phenomenon objective in nature or created by the

human mind?" Based on this information it is possible to identify whether the research questions pertain to positivism, anti-positivism, and critical theory, and choose the appropriate methodology for the research.

The research approach can be quantitative, qualitative, and critical and action-orientated. Quantitative research methods can include surveys and longitudinal, cross-sectional, correlational, and quasi-experimental and ex-post facto research. For qualitative research the approach can include biographical, phenomenological, ethnographic and case study. The critical and action-oriented approach can be conducted through ideology critique and action research (Baptise, 2000).

4.2.1 Selecting a research paradigm

A researcher can select a research paradigm and the corresponding methodology by asking the following questions:

- 1) What is the nature of the social phenomena being investigated?
- 2) Is the social phenomenon objective in nature or created by the human mind?
- 3) What are the bases of knowledge corresponding to the social reality, and how can knowledge be acquired and disseminated?
- 4) What is the relationship of an individual with his/her environment?

From these questions the researcher can identify if the research questions belong to positivism, anti-positivism, or critical theory.

The positivist paradigm is essential to systematise the knowledge generation process with the help of quantification, which enhance precision in the description of parameters and the discernment of the relationship among them. The physical and social reality is independent of those who observe it and the observation of this reality is unbiased; it constitutes scientific knowledge. Behavioural researchers in education and psychology exemplify an approach to scientific inquiry that is grounded in positivism (Yin, 2003).

Positivist inquiry focuses on the determination of the general trends of defined populations. The features of the social environment retain a high degree of constancy across time and space. The first thing is to define the population of interest, and to select a representative sample of the population. The researcher generalises the findings obtained from studying the sample to the larger population using the statistical techniques to determine the likelihood that sample findings are likely to apply to the population.

The use of mathematics to represent and analyse features of social reality is consistent with positivist epistemology. A particular feature can be isolated and conceptualised as a variable, and the variables can be represented as numerical scales. Deductive analysis identifies underlying themes and patterns prior to data collection and searching through the data for instances of them and using hypothesis testing.

Post-positivism is the social reality constructed by the individuals who participate in the research, different individuals construct it differently. This view of social reality is in some ways similar to the constructivist movement in cognitive psychology, which posits that individuals gradually build their own understanding of the world through experience and maturation.

Quantitative research is a formal, objective, systematic process in which numerical data are utilised to obtain information about the world (Burns & Grove, 1991).

Quantitative research is inclined to be deductive; in other words, it tests theory. It uses data that are structured in the form of numbers, or that can be immediately transported into numbers. I had to explore all possible designs in the choice of a particular one for my study. For the research for this study a correlation-experimental research method was required (Niglas, 2001).

4.2.2 Designing a methodology

It is commonly held that quantitative research and experimental and quasi-experimental research follows a positivist philosophy. By positivist it is meant that the world is directly knowable. On the basis of the ontological, epistemological,

and ethical points of view I have suggested a methodology, which is Correlation Experiment. The steps I took to develop this methodology are as follows:

Theorising: I employed theory to develop a conceptual framework about the topic of interest (See Chapter 2).

Agenda Setting: I drew on this framework to define a research problem, which I phrased as a design problem: how can I find out the reading capacity for children's in the early years of schooling through Pre-school to adolescence and identify which phonemes children of various ages find difficult to master, in keeping with the research aim of this thesis?

Designing: I developed an initial solution concept applying the design cycle. The design cycle consists of four steps: (1) specifying the intended application domain that consists of the class of problems the solution concept needs to address and the class of contexts to which it should be applicable; (2) listing the requirements for the solution concept (functional requirements, operational requirements, limitations, and limiting conditions); (3) designing a draft solution concept; and (4) evaluating the draft against the application domain and requirements. The next step is to test this solution concept in the practice stream and to apply progressive refinement to the design (Collins et al., 2004).

The testing phase of the study started with step four. A methodology research with action research testing can be a useful way to create knowledge that is both relevant and rigorous. Research combined with action research testing can produce knowledge that is relevant for both practice and theory. These solution concepts have been tested in real life situations and are "reality proof". The theoretical contribution of a Correlation Experiment based research may lie in the identification of important variables and relationships and the further specification of the validity domain of causal relations.

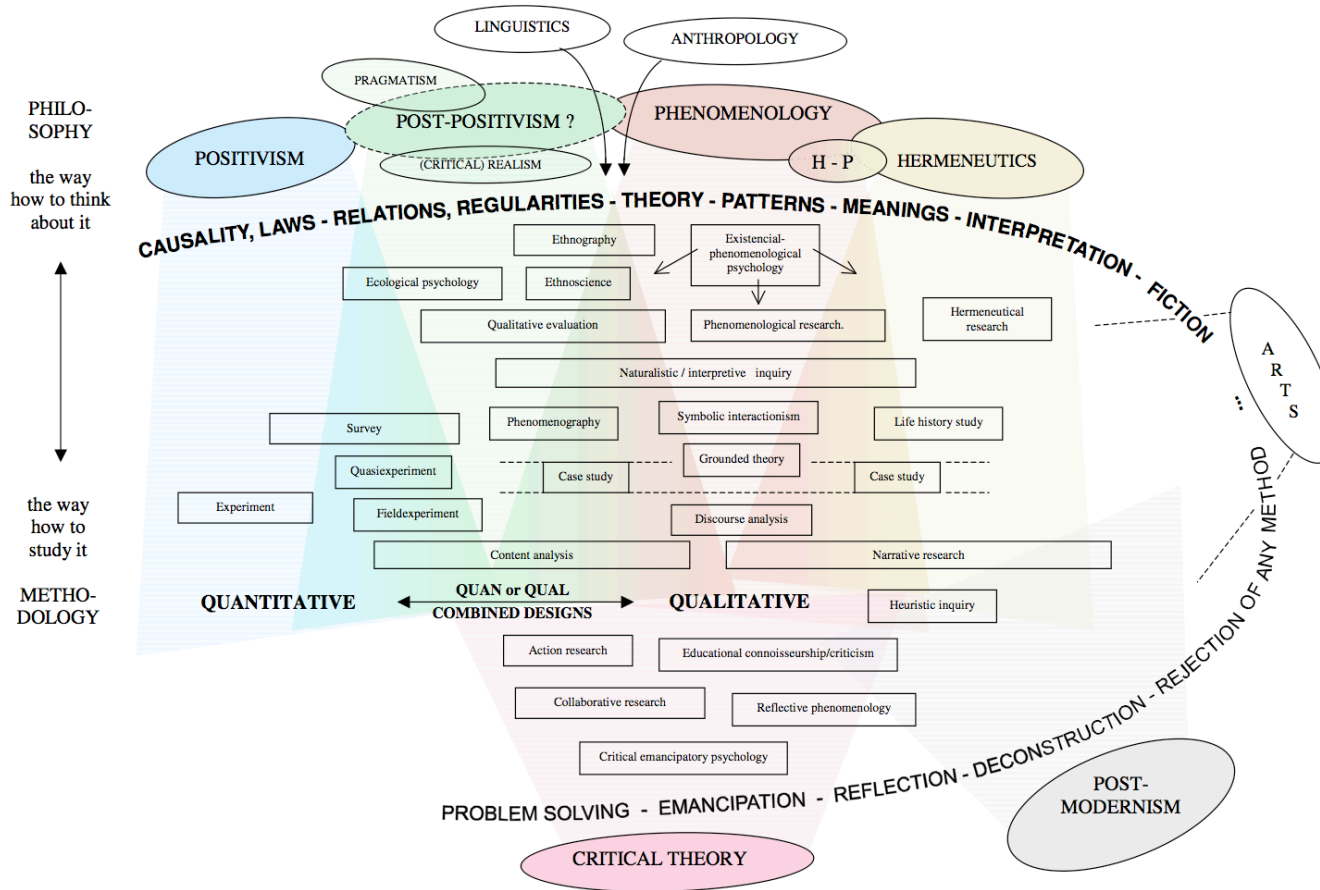


Figure 4-1 Relationship between philosophy and methodology in social and educational research (adapted from Niglas, 2001a, 2001b)

4.3 Correlation-Experimental research design

A Correlation Experiment is a particular type of experiment or study in which one has little or no control over the allocation of treatment or other factors being studied. The key difference in this approach is the lack of random assignment; another factor is that often involved in this experimentation method is the use of time series analysis, both interrupted and non-interrupted. It also refers to a type of research design that shares many similarities with the traditional experimental design or randomised controlled trial, but specifically lacks the element of random assignment (Niglas, 2001).

Correlation-Experimental design treats a given situation as an experiment even though it is not so by design; the independent variable may not be randomised or matched, or there may be no control group. The significant element of the quasi-experiment is the measure of the dependent variable, which allows for comparison. Some data are quite straightforward, but other measures, such as level of self-confidence in writing capacity or increase in creativity or in reading, are inescapably subjective. In such cases Correlation-experimentation often involves a number of strategies to compare subjectivity, such as rating data, testing, surveying, and content analysis.

Rating essentially is developing a rating scale to evaluate data. In testing, experimenters and Correlation - Experimenters ANOVA (Analysis of Variance) and ANCOVA (Analysis of Co-Variance) are used to test differences between control and experimental groups, as well as different correlations between groups (Niglas, 2001). For research one must have a hypothesis for a causal relationship. A control group and a treatment group must be developed. To eliminate confounding variables that might mess up the experiment and prevent the causal relationship, one must have a larger group with a carefully sorted constituency, preferably randomised, in order to minimise the interference of accidental differences.

4.4 Overview of the experiment

My research focused on a sample of 898 children (Pre-school through to Grade 8) from schools in the metropolitan area of Brisbane (Queensland, Australia). Data were collected about children’s capacity to pronounce phonemes and read and say words aloud. Demographic data were also collected to identify and group children’s responses according to age, grade of schooling, and language background. A total of four data collection instruments were used:

- A survey questionnaire, which collected demographic data and contained questions to create a ‘test friendly’ context (Appendix 1).
- The International Phonetic Alphabet (IPA) adapted to test phonemes (Appendix 2).
- The St. Lucia Graded Word Reading Test table of norms (Appendix 3).
- The Picture Word Reading Test (for non-readers/Pre-school children) and (Appendix 4).

A breakdown of the experiment is shown in Table 4-1.

Table 4-1 Overview of the experiment

Pre-school	English Speaking Background		Non-English Speaking Background	
	Picture Word Reading Test	IPA	Picture Word Reading Test	IPA

School children Grades 1 - 8	ESB		NESB	
	St Lucia GWR Test	IPA	St Lucia GWR Test	IPA

4.4.1 Schools

A total of 18 schools, 12 primary and six secondary, was randomly selected from all state schools in the Brisbane metropolitan area (from a list provided by the Queensland Department of Education) using a table of random numbers. Approval to approach schools and seek their cooperation in the research was obtained from the same Department (Education Queensland). The Pre-school sample was also selected at random from Pre-schools attached to the selected primary schools. The childcare centres were randomly selected from those listed in the relevant section of the local telephone book.

4.4.2 Children

The sample of children, which totalled 898, was selected from the class rolls at each grade level at each school and centre using a table of random numbers. Three males and three females were selected from each class group in each grade level and Pre-school group. Written permission to participate in the research was obtained from each child's parents or guardian. Three children were dropped from the sample because of hearing impairment. The sample breakdown in terms of grade levels and language backgrounds is shown in Table 4-2.

Table 4-2 Sample breakdown of numbers of children's by grade level and language background

Grade Level	Number of Classes	English Speaking Background		Non-English Speaking Background		Total
		Male	Femal	Male	Femal	
Pre-school		110	100	31	45	286
Grade 1 (G1)	10	25	28	6	5	64
Grade 2 (G2)	14	41	40	3	5	89
Grade 3 (G3)	13	35	35	5	7	82
Grade 4 (G4)	11	26	30	9	6	71
Grade 5 (G5)	9	21	26	4	3	54
Grade 6 (G6)	10	25	31	6	2	64
Grade 7 (G7)	9	23	25	7	1	56

Grade 8 (G8)	22	61	64	6	1	132
		367	379	77	75	898

Because the sample was of a totally random selection, it was not possible to select children's according to language background in advance since this information was not available to the researcher. It was known, that many school communities in the metropolitan area included non-English speaking background families.

4.4.3 Survey questionnaire

The survey questionnaire had two purposes. Firstly, it was developed to collect demographic data from each child to allow categorisation for analysis in accordance with age, grade level and language background. Secondly, it was designed to create a supportive environment for the administration of the GWRT and the IPA test.

Children's parents or guardians completed the survey questionnaire for the Pre-school sample. But for children's in Grades 1 to Grade 8, I administered this questionnaire in the format of an informal, focused, individualised interview. Initially I spoke to the child for a few minutes to build rapport by using greetings and explaining to the child what would be happening and why it was important to have the child's co-operation. I then introduced myself to the child and elicited the child's demographic details and other information and recorded it as specified on the survey questionnaire. These data were then entered into an Excel sheet with coding for the variables of age, grade level and language background.

4.4.4 The IPA

The IPA was adapted for use as a test to test the children's capacity to pronounce the 52 phonemes that underpin spoken English, as referred to in the literature review. A small pilot study was conducted initially to work out the best way to proceed with the testing, which consisted of a recording of these phonemes presented on an audiocassette tape to ensure consistency of administration to all children in the sample. Five tapes were created with each tape presenting the

phonemes in a different, randomly sequenced order. The tapes were used in sequential order during testing such that the first child received tape one, the second child tape two, the sixth child tape one and the seventh child tape two to control for possible ordering effects.

The testing was conducted in a quiet room where there was little likelihood of distractions such as was usual in a withdrawal room, staff room or office. I would first build some rapport with the child before explaining the procedure of the test; then I gave an example of how it would be done. As I played each sound the child was required to repeat that sound after the taped version such as 'b' as in bat 'b', 'ch' as in chin 'ch' and so on until the 52 phonemes were tested. I raised his/her hand to signal that the next phoneme would be released from the tape. This acted as a cue for the child to pay attention and listen carefully. This provided consistency in the phonemes produced for the purposes of listening and reproduction. Trial of the instrument with younger children showed a need to be less formal in the administrative procedure. To accommodate potential talkative responses from these younger children – e.g., when required to say "E" for EGG a child may naturally respond with "I had an egg for breakfast" or "I don't like eggs" – I allowed the child to have a further two opportunities to respond. If the child failed to respond the tester moved to the next item.

The child's response was scored as either one point for pronouncing the phoneme correctly or zero for incorrect pronunciation or no response. Scores were recorded on a form specially designed for the task. This resulted in a score out of 52 for each child. It was not practicable to record the children's responses on audiotape in view of the large numbers tested and the fact that the one tester who helped me participated in a training procedure to ensure issues of validity and reliability were adequately addressed. The criterion for correctness was that the particular phoneme was pronounced so that it could be recognised by the tester as being the phoneme sought, and specifically different from any of the other 51 phonemes.

The fact that all children listened to the same recording of the phonemes set the standard for reproduction for both the child and the tester. The testing was done in

the following way: I would press the tape recorder with the left hand and raise the right hand simultaneously and then say, "When I raise my hand say 'b' as in 'bat – b'", etc. If the child mispronounced the sound or there was no response the child would get a nought. If the child was able to pronounce the sound she/he scored one.

4.4.5 The Picture Word Reading Test

The Picture Word Reading Test was used as an instrument for all Pre-school children and consisted of 25 pictures, which was presented separately one picture per flashcard to each child, testing only the child's capacity to say words aloud. The pictures had previously been used as a teaching tool with children from Pre-school and under who could not read.

As I displayed each picture in turn to the child he/she identified it by pronouncing the word. After introducing the word I would say to the child, for instance, in the case of the egg "Say EGG". The child was then required to repeat/pronounce the same word in response. The pictures of the test were presented in the same order for each child. The child's response was scored as either one point for repeating/pronouncing the word correctly or no score for incorrect pronunciation or no response. I then recorded the child's responses on a separate score sheet by placing a tick against those words which were pronounced correctly. This resulted in each child being allocated a score out of 25. The criteria for correct pronunciation were developed from the recording of a good speaker of English. Given that many native English speakers would pronounce differently, the person chosen was one who had a clear, educated voice and who was representative of English speech, as the children were most likely to be exposed to this in the Brisbane metropolitan area in the educational context.

The procedure for testing these younger children included extra time to establish rapport. I aimed at making the testing an enjoyable experience for the child to ensure the best response. Testing did not start until the child seemed relaxed enough to give maximum co-operative effort. Once rapport was established, the picture test was administered. I initially talked about the pictures to be presented

to establish their relevance to the child's own 'real' life experience – e.g., "Have you got a cat at home?" This assisted in maximising the authenticity of the test for this younger age group who have low threshold levels for test anxiety and concentration. For reasons of validity and reliability the testing timeframe for these children was limited to a maximum of 15 minutes at any one time. I resumed testing after a short break depending on the particular circumstances.

4.4.6 The St. Lucia Graded Word Reading Test (GWRT)

The St Lucia Graded Word Reading Test GWRT was administered to all children in grades 1 – 8 to test the children's capacity to read and pronounce words. This related their performance to their reading age norm and allowed comparison against chronological age.

The test format required the child to read aloud from horizontal lists of words, which gradually increased in difficulty. Sufficient time was allowed for the child to attempt each word without prolonging the test unnecessarily. The following instructions were given to the child: "I want you to see how many of these words you can read [present word list]. Some of them are fairly easy but others are a little harder. Now begin here [point to the first word or starting point] like this [run your finger along the first line of words to be read]".

When the child reached a point of difficulty and had trouble reading a word, he/she had three chances to get it right without any help. If the child could not correctly read (say and pronounce) the word, then he/she was required to move to the next word. The child was encouraged to attempt each word until 10 consecutive words were failed. Any word, which was read with an understandable pronunciation, was allowed as correct. Stress on the wrong parts of a word, was not acceptable. No prompting or teaching was allowed during the administration of the test.

Each word read correctly was marked on the tester's record with a plus (+) sign. If not correct, the child's response was clearly recorded with a (x) sign above the corresponding word on the tester's record. Words not attempted were marked with a minus (-). Calculating the number of words the child was able to read until

the ceiling of 10 incorrect words was reached scored the test. The reading age for each child was identified by matching the particular test score with the reading age in the table of norms.

4.4.7 The training of a tester

The writer of this thesis conducted most of the testing. Another tester was employed to complete the testing in the planned timeframe since it was important to complete the testing in all schools during a common time of the year convenient for schools. This tester was a trained teacher. The tester attended two 45-minute training sessions over a two-week period outside school time. The training sessions provided an explanation of the purpose of the research and the rationale for testing and included modelling of the various procedures for the administration of the various data collection instruments. It also contained training on how to build rapport with the child, ensuring the sensitive collection of demographic details and recording and scoring information. Particular attention was paid to training the tester who would be dealing with the younger children to ensure she would be able to gain and sustain young children's attention through creating a warm, supportive environment. For many of the sessions I was available to be involved in the testing which gave an opportunity to make sure that the tester was able to perform correctly.

4.4.8 Data analysis

Pearson product-moment correlations were calculated to determine whether significant correlations existed between children's performance on the reading test (PWRT or GWRT) and the variables of grade, language background, and gender and NESB children's performance on the reading test (PWRT or GWRT) and the IPA. The item analysis of the IPA was also performed with the idea of constructing a shorter version based on the order of difficulties in relation to children's capacity to pronounce isolated phonemes, which could possibly be used for teachers in the classroom to find out whether children have difficulty with reading.

4.5 Ethics of the study

The term ethics and morals tend to be used interchangeably. Morals refer to an unwritten set of values that provide a frame of reference that we use to help our decision-making and regulate our behaviour. Ethics generally refer to a written code of value principles that we use in particular contexts. Research ethics are the principles that we use to make decisions about what is acceptable practice in any research project. Research participants have moral and legal rights and it is important that as researchers we do not violate these rights. A code of research ethics is required to ensure that there are agreed standards of acceptable behaviour for researchers, which protect participants' moral and legal rights (Maunthner & Birch, 2002).

Ethics codes also ensure that there is good scientific practice in research. It is essential that the public should be able to trust the results of research programs as these findings may impact on their lives.

Research studies have to comply with legal requirements and this includes the data protection legislation and appropriate screening of researchers working with vulnerable groups of people. Research is required to comply with the commonly agreed international standards for good practice in research, these can be categorised as beneficence which means to do positive good, non-maleficence to do no harm, informed consent, confidentiality and anonymity. What did this mean for my research project? I had to bear in mind that my responsibility was to protect the rights and dignity of all research participants and in this case the participants were vulnerable partly on account of being children under the age of sixteen.

With vulnerable participants I need to consider where I will interact with them. To undertake research with vulnerable populations that requires the researcher to be on one's own with the individual in a private interview room or the like, then I would need to undergo Criminal Records Bureau screening (Blue card) in Queensland. There were several other factors related to research ethics that I had to consider when I designed my research project, such as consent, protection of

participants, debriefing, confidentiality, observational research, the avoidance of deception, withdrawal from the research, and data storage.

As a researcher I must also consider my own safety when undertaking research, to ensure that I do not take unnecessary risks, ensuring that I have a clear procedure in place to be put into action.

4.6 Trial study testing the designed testing instruments

To investigate further the tests used for this research, a pilot test was conducted with six children who were randomly selected. These children were tested with the same testing tools as the main research study of this thesis. The six children were tested six to eight months later to see if there was a difference in their scores. The test proved to be a good tool to find out the progress of these children. I then selected another sample of 84 children who were participating in a language program at my clinic in order to enhance their reading capacity through a phonologically based treatment program and did the same testing as with the six children. I selected a sample that had been diagnosed with learning difficulties.

The children were tested on the same instruments as the core sample both before and after the program treatment.

- A survey questionnaire, which collected demographic data and contained questions to create a 'test friendly' context (Appendix 1).
- The International Phonetic Alphabet (IPA) adapted to test phonemes (Appendix 2).
- The St. Lucia Graded Word Reading Test table of norms (Appendix 3).
- The Picture Word Reading Test (for non-readers/Pre-school children) and (Appendix 4).

This allowed some investigation of whether their capacity to pronounce phonemes improved as their progress in reading improved or not over time, and also of the children and the specific nature of the sample (children recognised as requiring help with language and reading). At the same time, the study sample could be matched on the variables of age, grade, language background (all the children were

from English speaking backgrounds), gender, and the production of phonemes (IPA) correlated with saying and reading words aloud (St Lucia Graded Word Reading Test). The study was conducted with children from a clinic in the metropolitan area of Brisbane, using the tools tested in my thesis. It was conducted to find out the usefulness of the test designed for this research, by testing children from schools in the same area, the metropolitan area of Brisbane.

Included are the results of the pilot test and a discussion of the results from six children, selected at random from children attending a clinic for learning difficulties. They were tested with the IPA and the St. Lucia Graded Word Reading Test. These tests give teachers results for a child's reading process as teachers need to understand the role of phonemic knowledge and the concept of auditory discrimination, otherwise they are blindly teaching traditional phonics and wonder why such children do not learn to read. The comparison of the pre-test and post-test with six to eight months between them showed that children were able to improve their reading by working with programs that were focusing on the sound system of language, with phonemes as the smallest unit of language.

After this pilot test was completed, a further trial study of 84 children was conducted with the short version of the IPA. This was done before and after intensive treatment with programs that were tailored for each child's needs. The assessment and subsequent intervention programs were conducted with individuals who had speech, spelling, or reading problems. It was found that age, gender, language background, and socio-economic factors did not appear to relate directly to these problems. Such problems could not be traced to a specific teaching approach. Six month later the children were assessed with the same testing tools to compare their improvement. The results showed that all children had improved with these special programs.

The research showed that the IPA could be used effectively to find out a child's capacity to pronounce phonemes and that The St. Lucia Graded Word Reading Test would generate the reading age of the child. This could be effectively used in a teaching situation to test children's phonological awareness and their reading age,

as the first point of call, so teachers can take action as quickly as possible to help the children if they are not coping with their school work. Teachers, psychologists and doctors referred children to the clinic who were considered to be behind their class peers. The assessment and subsequent intervention programs were conducted with children who had speech, spelling, or reading difficulties and behavioural problems. It was found that age, gender, language background and socio-economic factors did not appear to relate directly to learning difficulties nor could such problems be traced to a specific teaching approach.

Tyrer (2001) found that auditory conceptualisation was to be one of the critical factors for children with reading difficulties and this was revealed from sending the children for hearing and auditory processing testing. Furthermore, from experience with so many children with learning and behavioural difficulties, it was discovered that most individuals with language or literacy disorders were able to make gross judgements of sameness or difference with respect to spoken syllable or word pairs, but they could not make precise judgement as to how and where two syllables or words differed.

4.7 The testing procedures

Initially the data were collected from 6 children; this was the pilot test (test 1). Following this was the test (test 2) involving 84 children. The first and second test participants were all children referred to the clinic with reading difficulties. The children were tested with the International Phonetic Alphabet (IPA) and the St. Lucia Graded Word Reading Test (GWRT) on the first occasion, and with the short version of the IPA between 6 and 8 months apart to find out what progress they had made with the pronunciation of phonemes as a result of the treatment programs.

All the children from the pilot test (test 1), and the 84 children (test 2) were tested initially by a specialist with the Wechsler Intelligence Scale for Children. They went for a check-up by their family doctor, attended a behavioural optometrist for eye testing and the auditory processing clinic for hearing testing, and then received the IPA, and the ST. Lucia Word Reading Test. Other testing was done on writing and

spelling samples. The testing was also conducted on adolescents and pre-adolescents and this had to be done differently from the early childhood children. The short questionnaire was a way of building rapport to engage the child with the testing.

An informal evaluation was first conducted, as this can be one of the most productive encounters between the examiner and the child. It is during this interview that the examiner can follow up on tentative hypotheses developed from reading the referral and the developmental health history, or from discussing the child with the parent. It is often productive first to interview the parent/s and the child together so that the child is able to know with certainty some of the perceptions of the parent/s before being interviewed separately.

4.8 Example of a report for a child

This is an example of a report given for a child in the clinic. When this child first came, the following developmental and medical history was obtained, the child's medical history revealing some significant findings:

The mother reported a normal prenatal period and the child's birth and delivery were both uneventful, the child consistently lost weight for the first six weeks until his feeding schedule was stabilised. The child also suffered from five ear infections during the first year of its life. Motor development appeared essentially within normal limits, but language development was quite delayed. Early attempts to speak were almost unintelligible, and a single word vocabulary was not recognisable until two and a half years to three years of age. At just over three years of age the child could barely combine words into single sentences and the child's speech was still unclear.

Classroom observation and a report by the teacher suggested that this child was poorly motivated, inattentive, and an active student who performs inconsistently. The child frequently requests repetition of directions and gives up easily on most tasks. The child's performance on the WISC-R placed the child in the average range of intellectual functioning. Nonetheless the child's usually poor performance on

tasks involving verbal responses suggests a weakness in the capacity to process language.

On the St. Lucia Graded Word Reading Test the child showed to be reading at nine years and two months compared with the child's biological age of 13 years and four months – that is, four years and two months behind the child's reading capacity. The IPA showed the child to have correctly performed 80.65% of the sounds, which correlates with the St. Lucia Graded Word Reading Test indicating the child's poor performance in reading words aloud.

In reading aloud the child omitted letters or syllables (for example, "fishman" for "fisherman", "safe" for "safely"); changed letters or syllables (for example, "sitonan" for "situation", "discent" for "diseased"); substituted one word for another (for example, "raced" for "rescued", "kidnapped" for "cleaned"); made insertions not in the text (for example, "T-shirt" for "shirt", "disposonal" for "disposal"); and made inversions (for example, "no" for "on", "bluging" for "bulging"). The child's writing was similarly but more severely affected. It was apparent that this child had a significant deficit in auditory perception, analysis, short-term memory, and conceptualisation. The child's expressive language abilities were poor and he also had great difficulty with reading, spelling, and computing arithmetic problems.

The child demonstrated extreme difficulty associating appropriate sounds with the symbols, applying phonetic principles and blending to spell words common to the child's receptive and speaking vocabulary. The child had normal hearing but despite this had difficulty with tasks involving auditory discrimination, auditory memory, acoustic sequencing, and auditory verbal comprehension. With visual spatial perception, the child was able to recognise visual spatial forms to reproduce drawing, to solve visual spatial problems, and to utilise visual memory.

This child was diagnosed as experiencing significant reading difficulties characteristic of children with auditory linguistic learning difficulties. The child had average intelligence; auditory linguistic skills appeared to be severely depressed when compared with visual spatial abilities. The child was assessed as being able to

benefit from a highly structured environment with clearly defined expectations and consistent positive reinforcement. Counselling was likely to be useful in shaping attention and concentration skills and enhancing self-esteem and motivation. The child's environment should be without distractions and if possible, a quiet place, free of competing background noise, should be provided. In the classroom, the child should be seated close to the teacher.

It was recommended that the child should have learning and behavioural therapy for receptive and expressive language skills, as well as to provide support in the auditory processing areas. Teaching memory techniques such as association, visual imagery, and recognition of critical elements might enhance auditory memory and listening skills. Furthermore this child would benefit from intensive remedial instruction from a learning disability specialist in a self-contained setting. A sequenced linguistic approach to reading with frequent repetition and controlled vocabulary should be used. The child should be able to utilise the conceptual capacity to understand the structure of language despite the child's auditory difficulties.

4.9 Results of the pilot testing

As it was a smaller size group on the second occasion of the testing, compared to the number tested of 898 children in the first testing. The six children were tested six to eight months apart. They were tested with the same tools, and the dates of the actual testing have not been given for ethical reasons. These children followed the same procedure as mentioned for the report of the child in Section 7.3 of this chapter.

4.9.1 Pilot test of 6 children: Test number 1

Table 4-3 Pilot test of 6 children, test 1

	Number	Gender	Hand	Age	GWRT	IPA
	1	M	R	10.04	7.02	0.63
	2	M	R	8.11	6.08	0.50
	3	F	R	7.03	6.07	0.20
	4	F	R	9.07	7.06	0.51
	5	M	L	9.05	5.03	0.42
	6	F	R	9.04	7.02	0.60

M= Male; Left hand

F= Female; Right hand

As shown in the table for test 1, the six children performed poorly in the IPA, which is the phoneme-testing instrument. For the GWRT test the children were behind their reading age as follows:

- Child 1 was 3 years behind. (Male)
- Child 2 was 2 years and 3 months behind. (Male)
- Child 3 was 9 months behind; this child was only 7 years old and 3 months in biological age. (Female)
- Child 4 was 2 years and 3 months behind. (Female)
- Child 5 was 4 years and 2 months behind. (Male)
- Child 6 was 2 years and 2 months behind. (Female)

These children were also found to have behavioural problems, only one of the children was found to be left handed, and all attended the clinic three times a week with a learning behavioural specialist. They were tested six to eight months later.

4.9.2 Pilot test of six children: Test number 2

Table 4-4 Pilot test of 6 children, test 2

	Number	Gender	Hand	Age	GWRT	IPA
	1	M	R	10.10	8.07	1.00
	2	M	R	9.05	7.11	1.00
	3	F	R	7.09	8.04	1.00
	4	F	R	10.01	9.00	1.00
	4	M	L	9.11	7.03	1.00
	6	F	R	9.10	8.09	1.00

= Male; Left hand

= Female; Right hand

The results for the second test showed that all the children could pronounce the phonemes of the IPA after intensive help; the reading age was found to have increased as follows:

- Child 1 gained 1 year and 5 months.
- Child 2 gained 1 year and 3 months.
- Child 3 gained 2 years and 7 months.
- Child 4 gained 1 year and 9 months.
- Child 5 gained 2 years.
- Child 6 gained 1 year and 7 months.

Some of the children did better than others and this was due to their motivation and the seriousness of their behavioural issues and family problems.

4.10 Results of the testing of the 84 children

The initial testing was conducted over a few months as it was a large sample, and the children had to see different specialists for such things as hearing tests, IQ tests, medical check-ups, neurological tests, and others as mentioned in Section 7.3 of this chapter. It was found that 57 boys and 27 girls had learning difficulties. It was

also found that 12 of the group were left-handed, 24 had high average intelligence, and 5 were teenagers. All the children had problems with pronouncing phonemes, and were lagging behind with their reading. These were children assessed as having learning difficulties and behavioural and psychological problems, referred by doctors, psychologists, teachers and schools. They were all tested with the short version of IPA, a very useful diagnostic testing tool.

Testing after six to eight months with the short version of the IPA proved to be very useful as a diagnostic tool. It showed that all the children had increased their level of pronunciation of the phonemes, some less so than others depending on their motivation to work and their behavioural problems. Some children found it more difficult as they were older and had very low self-esteem and they needed to spend more time working with the programs designed. Some of these children attended the clinic for up to three years. One child was seven years old when he came to the clinic and he left at thirteen. This is the reason to start helping children at a very young age if they are tested as having learning difficulties.

The children's teacher reported that the children were more focused, attentive and happy and the children were also making friends and were behaving appropriately most of the time in the classroom. The parents reported that the children stopped having nightmares, were cooperative, and were not so angry. By using the IPA I was able to find out children's capacity to pronounce phonemes. This was a very successful testing tool and I was able to use it with ease for young and older children, it is a diagnostic test that I would recommend to teachers and schools to use as the first point of call in finding out if children have difficulties pronouncing phonemes. Marie Clay's diagnostic test could then be employed after the initial testing, as it is more complicated. Alternatively, special education teachers could follow up with Marie Clay's reading recovery test. The IPA is the easiest testing tool for the teacher to make an initial diagnosis for the child to have further testing and help.

The trial of the test explained how the short version of the IPA test was conducted in a real world condition, first with six children in a pilot test (Test 1) and then (after

intensive treatment with programs that were tailored for each child's needs) for a larger sample with 84 children (Test 2) from a clinic in the metropolitan area of Brisbane, using the tools that were tested in this thesis initially with 898 children. The findings from this part of the study have been reported in this chapter for the purpose of finding out the usefulness of the test designed for this research. The research showed that teachers could effectively use these tests in the schools to test children's phonological awareness and their reading age as a first investigation of children with reading difficulties.

The short version of the International Phonetic Alphabet (IPA) is a test that can be easily administered by teachers in the classroom. The children were tested 6 to 8 months after the first testing to assess their improvement and all the children eventually had much higher level of reading skills. The IPA proved to be a successful testing tool, thereby making us aware that these children had difficulty with pronouncing phonemes that could nevertheless be addressed. 21st century classroom teachers need the diagnostic tools of assessment to identify auditory dysfunction and also the pedagogical skills to respond effectively.

4.11 Conclusion

Chapter 4 explains the methodology and its rationale in relation to the review of phonetic testing using the International Phonetic Alphabet (IPA), and the importance for the children's testing in this thesis. The comparison between the IPA and the St Lucia Graded Word Reading Test was used to assess the phonological difficulties and determine the reading age of each child.

As children under the age of 6 years were tested, I used an appropriate test such as The Picture Word Reading Test, which is specifically designed for children under 6 years old. A survey questionnaire was also designed to create a relaxed and friendly environment while collecting demographic data. This survey included questions from the child's background such as hours per day spent reading and watching television, whether the child lived with one or both parents, their ethnic background, and whether they could speak other languages besides English. The results were related to age related scores for the IPA, the St Lucia Graded Word

Reading test, The Picture Word Reading Test, and gender differences for all the above, including ethnic differences and family background.

Chapter 5 presents the results of the analyses performed on the data collected from the children's population which was administered with the International Phonetic Alphabet (IPA.), the St Lucia Graded Word Reading Test (GWRT), The Picture Word Reading Test (PWRT), and the questionnaire detailed in Chapter 4. Statistical analyses were performed on the responses obtained from the administration of the IPA and the PWRT to Pre-school (Ps) children, and on the responses obtained from the administration of the IPA as well as the testing with the GWRT with children in Grade 1 (G1) through to Grade 8 (G8).

Chapter 5

RESULTS AND DATA ANALYSIS

The results found on children's comparative performance on the IPA and the GWRT

5.1 Introduction

In this chapter I present the results of the analyses performed on the data collected from the children's population for this study who were administered the International Phonetic Alphabet (IPA), the St. Lucia Graded Word Reading Test (GWRT), the Picture Word Reading Test (PWRT), and the accompanying questionnaire, detailed in Chapter 4. These results are intended to address the research questions of this thesis. This study investigates the assessment of children's capacity to pronounce isolated phonemes and their capacity to read or say words aloud in the English language: implications for learning to read, given the importance of auditory processing skills for reading.

5.2 Research questions

- 1) How do phonological skills correlate with reading words aloud of children in Pre-school to Grade 8?
- 2) Which phonemes do children of Pre-school to Grade 8 find difficult to master?
- 3) In what ways can a practical assessment tool be developed for classroom teachers to test children's phonemic knowledge and awareness?
- 4) What differences can be found between children from ESB (English Speaking Background) and NESB (Non-English Speaking Background) in their development of phonemic competence in English, and their capacity to pronounce isolated phonemes and to read words aloud?

Statistical analyses were performed on the responses obtained from the administration of the IPA and the PWRT to Pre-school (Ps) children, and on the responses obtained from the administration of the IPA. The testing results with the GWRT applied to children in Grade 1 (G1) through to Grade 8 (G8) children. Each of

these groups was further divided into children from an English Speaking Background (ESB) and children from a Non-English Speaking Background (NESB) and then broken down by gender.

Pearson product-moment correlations were calculated to determine whether significant correlations existed between children's performance on the reading test (PWRT or GWRT) and the variables of grade, language background, and gender. Analysis of variance (ANOVA) tests were performed on these variables to test for significant differences between ESB and NESB children's performance on the reading test (PWRT or GWRT) and the IPA. The item analysis of the IPA was also performed with the idea of constructing a shorter version based on the order of difficulties in relation to children's capacity to pronounce isolated phonemes, which could possibly be used for teachers in the classroom to find out if children's have difficulty with reading.

The research hypotheses (please see the next section of this chapter) were tested to determine whether the degree of association between ESB (English speaking background) and NESB (non-English speaking background (please refer to Chapter 4) children's capacity to pronounce whole English words could be predicted based on the phonemes of the IPA and the whole words analysis of the GWRT. The IPA and PWRT also show strong correlation for both ESB and NESB children. In Pre-school and grade 1 it was found that girls perform better than boys.

I proceeded to do a statistical analysis which I performed on the responses obtained from the administration of the IPA and the PWRT from Pre-school (Ps) children, and on the responses I obtained from the administration of the IPA and the GWRT from children in Grade 1 (G1) through to Grade 8 (G8) children. Each of these groups was further divided into children from an English Speaking Background (ESB) and children from a Non-English Speaking Background (NESB) and then broken down by gender. Table 5-1 shows the number of children in each group and sub-group.

Table 5-1 Number of children tested broken down by their school grade and language background

Language Background & Gender		Number of children									Total
		Pre- school (P)	Grade 1 (G1)	Grade 2 (G2)	Grade 3 (G3)	Grade 4 (G4)	Grade 5 (G5)	Grade 6 (G6)	Grade 7 (G7)	Grade 8 (G8)	
ESB	M	110	25	41	35	26	21	25	23	61	367
	F	100	28	40	35	30	26	31	25	64	379
NESB	M	31	6	3	5	9	4	6	7	6	77
	F	45	5	5	7	6	3	2	1	1	75
Total		286	64	89	82	71	54	64	56	132	898

Pearson product-moment correlations were calculated to determine whether significant correlations existed between children's performance on the reading test (PWRT or GWRT) and the variables of grade, language background, and gender.

5.3 Hypothesis

A total of 13 hypotheses were formulated, and alpha levels were set at 0.05. These hypotheses were formulated with respect to the assessment of children's capacity to pronounce isolated phonemes and their capacity to read or say words aloud in English language: implications to learning to read, and between group comparisons across the different grade levels and broken down based on the variable of language background. Hypotheses involving within group (Grade level) comparisons were generated to test for similarity and other hypotheses were generated for within group comparisons of children's capacity to articulate the phonemes of the IPA.

The hypotheses that were involved within groups (Grade level) where the tests were based on the children's capacity to articulate the phonemes of the IPA are shown in Table 5-2.

Hypotheses involving between groups (Grade level) tests based on children's capacity to pronounce whole English words based on the GWRT are shown in Table 5-3. Hypotheses involving within groups (Grade level) tests based on children's capacity to pronounce whole English words based on the GWRT are shown in Table 5-4.

The hypotheses involved in the degree of association between children's capacity to articulate the phonemes of the IPA and the children's capacity to pronounce whole English words based on the GWRT are shown in Table 5-5.

The hypotheses involved in the degree of association between ESB (English Speaking Background) children's capacity to articulate the phonemes of the IPA and their capacity to pronounce whole English words based on the GWRT, and the degree of association between NESB (Non English Speaking Background) children's capacity to articulate the phonemes of the IPA and the children's

capacity to pronounce whole English words based on the GWRT, are shown in Table 5-6.

The hypotheses involved in the degree of association between Pre-school children’s capacity to articulate phonemes of the IPA and their capacity to pronounce whole English words based on the GWRT are shown in Table 5-7. The hypotheses involved in the degree of association between Pre-school ESB (English Speaking Background) children’s capacity to articulate phonemes of the IPA and their capacity to pronounce whole English words based on the PWRT, and the degree of association between Pre-school NESB (Non English Speaking Background) children’s capacity to articulate phonemes of the IPA and their capacity to pronounce whole English words based on the GWRT, are shown in Table 5-8.

Where testing involved subsets or grades, relevant hypotheses were suffixed with a “period” and the designation of the subset or grade under examination – e.g., $H_0\text{IPA.g1}$ (for IPA language background tests on Subset 1) and $H_0\text{IPA.GWRT.g1}$ (for correlation tests between IPA. and GWRT performance for Grade 1 children).

Table 5-2 A list of hypotheses between groups involving tests of children’s capacity to articulate isolated phonemes

Test	Hypothesis Notation	Hypotheses Involving the International Phonetic Alphabet (null & alternative)
1	$H_0\text{IPA Grade}$	There is no significant difference between grades in children’s performance scores on the IPA.
	$H_A\text{IPA Grade}$	There is a significant difference between grades in children’s performance scores on the IPA.
2	$H_0\text{IPA Grade between ESB \& IPA}$	There is no significant difference between grades in ESB children’s performance scores on the IPA.
	$H_A\text{IPA Grade between ESB \& IPA}$	There is a significant difference between grades in ESB children’s performance scores on the IPA.

Test	Hypothesis Notation	Hypotheses Involving the International Phonetic Alphabet (null & alternative)
3	H ₀ IPA Grade between NESB & IPA	There is no significant difference between grades in NESB children's performance scores on the IPA.
	H _A IPA Grade between NESB & IPA.	There is a significant difference between grades in NESB children's performance scores on the IPA.

Table 5-3 List of hypotheses within groups involving tests of children's capacity to articulate isolated phonemes

Test	Hypothesis Notation	Hypotheses Involving the International Phonetic Alphabet (null & alternative)
4	H ₀ IPA Grade between ESB & NESB	There is no significant difference within grades in ESB and NESB children's performance scores on the IPA.
	H _A IPA Grade between ESB & NESB	There is a significant difference within grades in ESB and NESB children's performance scores on the IPA.
5	H ₀ IPA Grade between boys & girls	There is no significant gender (M vs. F) difference within grades in children's performance scores on the IPA.
	H _A IPA Grade between boys & girls	There is a significant gender (M vs. F) difference within grades in children's performance scores on the IPA.

Table 5-4 List of hypotheses between groups involving tests of children's capacity to pronounce whole English words

Test	Hypothesis Notation	Hypotheses Involving the St. Lucia Graded Word Reading Test (GWRT) (null & alternative)
6	H ₀ GWRT Grade scores on GWRT	There is no significant difference between grades in children's performance scores on the GWRT.

Test	Hypothesis Notation	Hypotheses Involving the St. Lucia Graded Word Reading Test (GWRT) (null & alternative)
	H_A GWRT Grade scores on GWRT	There is a significant difference between grades in children's performance scores on the GWRT.
7	H_0 GWRT Grade between ESB & GWRT	There is no significant difference between grades in ESB children's performance scores on the GWRT.
	H_A GWRT Grade between ESB & GWRT	There is a significant difference between grades in ESB children's performance scores on the GWRT.
8	H_0 GWRT Grade between NESB & GWRT	There is no significant difference between grades in NESB children's performance scores on the GWRT.
	H_A GWRT Grade between NESB & GWRT	There is a significant difference between grades in NESB children's performance scores on the GWRT.

Table 5-5 List of hypotheses within groups involving tests of children's capacity to pronounce whole English words

Test	Hypothesis Notation	Hypotheses Involving the International Phonetic Alphabet (null & alternative)
9	H_0 GWRT Grade ESB & NESB on GWRT	There is no significant difference within grades in ESB and NESB children's performance scores on the GWRT.
	H_A GWRT Grade ESB & NESB on GWRT	There is a significant difference within grades in ESB and NESB children's performance scores on the GWRT.
10	H_0 GWRT Grade boys & girls on GWRT	There is no significant gender (M vs. F) difference within grades in children's performance scores on the GWRT.
	H_A GWRT Grade boys & girls on GWRT	There is a significant gender (M vs. F) difference within grades in children's performance scores on the GWRT.

Table 5-6 List of hypotheses involving tests of children’s capacity to articulate isolated phonemes with children’s capacity to pronounce whole English words

Test	Hypothesis Notation	Hypotheses Involving the IPA and the St. Lucia Graded Word Reading Test (GWRT) (null & alternative)
11	H ₀ IPA Grade correlations between IPA & GWRT	There is no significant correlation between children’s scores on the IPA and children’s scores on the GWRT.
	H _A IPA Grade correlations between IPA & GWRT	There is a significant correlation between children’s scores on the IPA and children’s scores on the GWRT.

Table 5-7 List of hypotheses involving tests of ESB children’s capacity to articulate isolated phonemes with ESB children’s capacity to pronounce whole English words

Test	Hypothesis Notation	Hypotheses Involving the IPA and the St. Lucia Graded Word Reading Test (GWRT) (null & alternative)
11a	H ₀ IPAGWRT. ESB	There is no significant correlation between ESB children scores on the IPA and ESB children’s scores on the GWRT.
	H _A IPAGWRT. ESB	There is a significant correlation between ESB children scores on the IPA and ESB children’s scores on the GWRT.

Table 5-8 List of hypotheses involving tests of NESB children’s capacity to articulate isolated phonemes with NESB children’s capacity to pronounce whole English words

Test	Hypothesis Notation	Hypotheses Involving the St. Lucia Graded Word Reading Test (GWRT) (null & alternative)
12	H ₀ IPA GWRT. NESB	There is no significant correlation between NESB children scores on the IPA and NESB children’s scores on the GWRT.
	H _A IPA GWRT. NESB	There is a significant correlation between NESB children scores on the IPA and NESB children’s scores on the GWRT.

Table 5-9 List of hypotheses involving tests of Pre-school children's capacity to articulate isolated phonemes with Pre-school children's capacity to pronounce whole English words

Test	Hypothesis Notation	Hypotheses Involving the Picture Word Reading Test (PWRT) (null & alternative)
13	H ₀ IPA Pre-school PWRT	There is no significant correlation between Pre-school children's scores on the IPA and Pre-school children's scores on the PWRT.
	H _A IPA Pre-school PWRT	There is a significant correlation between Pre-school children's scores on the IPA and Pre-school children scores on the PWRT.

Table 5-10 List of hypotheses involving tests of Pre-school ESB children's capacity to articulate isolated phonemes with Pre-school ESB children's capacity to pronounce whole English words

Test	Hypothesis Notation	Hypotheses Involving the Picture Word Reading Test (PWRT) (null & alternative)
12a	H ₀ IPA. PWRT.ESB	There is no significant correlation between Pre-school ESB children's scores on the IPA and Pre-school ESB children's scores on the PWRT.
	H _A IPA.PWRT.ESB	There is a significant correlation between Pre-school ESB children's scores on the IPA and Pre-school ESB children's scores on the PWRT.

Table 5-11 List of hypotheses involving comparative tests of Pre-school NESB children's capacity to articulate isolated phonemes with Pre-school NESB children's capacity to pronounce whole English words

Test	Hypothesis Notation	Hypotheses Involving the Picture Word Reading Test (PWRT) (null & alternative)
12b	H ₀ IPA.PWRT. NESB	There is no significant correlation between Pre-school NESB children's scores on the IPA and Pre-school NESB children's scores on the PWRT.
	H _A IPA.PWRT. NESB	There is a significant correlation between Pre-school NESB children's scores on the IPA and Pre-school NESB children's scores on the PWRT.

5.4 Results

5.4.1 Reliability analysis of the International Phonetic Alphabet

The items of the International Phonetic Alphabet (IPA) were submitted to reliability analysis using SPSS. Cronbach's alpha, a measure of a scale's internal consistency based on the average inter-item correlations of all split-half tests, was calculated for the 52 items of the IPA. Cronbach's alpha was reported at $\alpha = .83$, indicating that the scale was highly reliable. The standardised item alpha for the 52 items was reported at $\alpha = .84$.

5.4.2 Between and within group comparisons (Pre-school and Grades 1 to 8)

This section reported the results of analyses carried out on the IPA. This was administered to Pre-school (Ps), and Grade 1 (G1) to Grade 8 (G8) children and the GWRT was administered to G1 to G8 children. Mean scores for children based on their grade level were compared and reported for these two instruments. Based on the outcome of these analyses, the subjects were then split according to their reported native language, and mean scores based on language background were compared and reported for the IPA and the GWRT. Further analyses were then conducted based on children's gender within the language background groups.

5.4.3 Tests involving the IPA and grade level

Mean scores and standard deviations for Ps' and G1 to G8 children's performance on the IPA are shown on Table 5-12. Examination of the means shows an upward trend in children's mean scores on the IPA from Ps through to G6, followed by a downward trend in children's mean scores on the IPA for G7 and G8.

Table 5-12 Descriptive statistics for children's performance scores on the IPA by grade (Ps and G1–G8)

Grade	N	Mean	Standard Deviation
Ps	286	45.2448	6.8648
G1	64	46.9844	5.2387

Grade	N	Mean	Standard Deviation
G2	89	49.0337	3.9064
G3	82	49.5000	3.6047
G4	71	49.9155	3.1747
G5	54	50.2778	2.8906
G6	64	50.8594	2.8333
G7	56	50.3393	2.9000
G8	132	49.0682	3.6049

5.4.4 Testing the differences between the grades in the pronunciation of isolated phonemes

To test the null hypothesis (H_0 IPA_g) that there is no significant difference between Grades in children's performance scores on the IPA, an analysis of variance (ANOVA) was performed followed by post-hoc group comparisons using Tukey's HSD test. Results are shown in Table 5.13. Since $p < 0.5$, we are able to say that the null hypothesis (H_0 IPA_g) is rejected at the 5 per cent significance level.

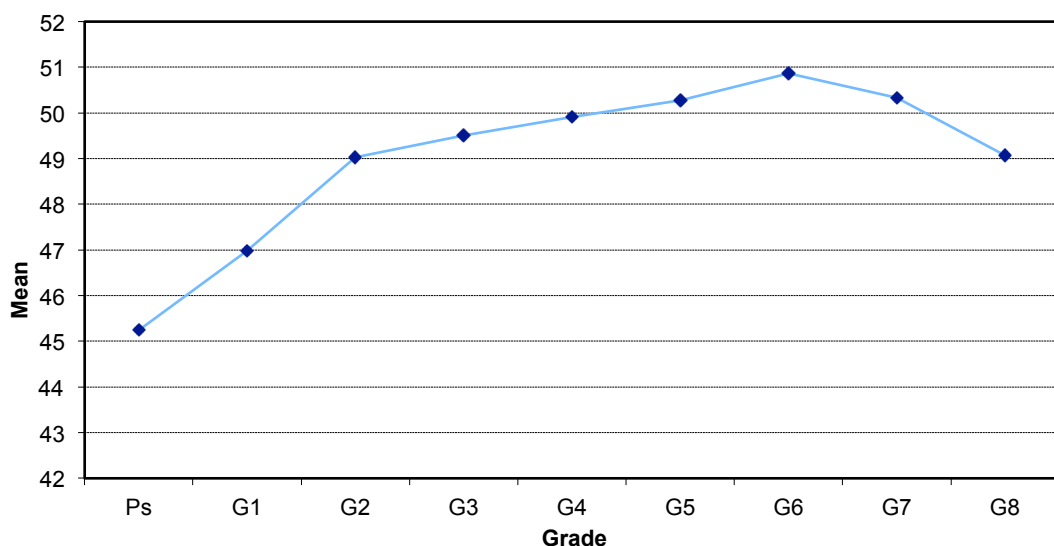


Figure 5-1 Descriptive statistics for children's performance scores on the IPA by grade (Ps and G1-G8)

Table 5-13 Summary table for children’s performance on the IPA by grade (Ps and G1–G8)

Source	SS	Def.	MS	F	P
Between groups	4031.317	8	503.915	20.959	.000***
Within groups	21374.251	889	24.043		
Total	25405.568	897			

Note: *** $p < .001$

The post-hoc comparisons using Tukey’s HSD, identified three homogeneous subsets at the 5 per cent significance level. As group sizes were unequal, the subsets were calculated using a harmonic mean sample size = 77.444. Means for groups in the homogeneous subsets are shown in Table 5-14

Table 5-14.

Table 5-14 Means for identified homogeneous subsets for children’s performance on the IPA

Grade	N	Subset for $\alpha = .05$		
		1	2	3
Ps	286	45.2448		
G1	64	46.9844	46.9844	
G2	89		49.0337	49.0337
G8	132		49.0682	49.0682
G3	82			49.5000
G4	71			49.9155
G5	54			50.2778
G6	64			50.8594
G7	56			50.3393
Sig. Level		.400	.168	.332

5.4.5 Tests involving the IPA and grade level

The data were pooled according to the identified homogeneous subsets in order to analyse whether significant differences existed on the children’s performance scores on the IPA based on language background for ESB and NESB children

separately. Although the subsets overlapped, subset 1 (Ps and G1) and subset 3 (G2–G8) shared no common groups (see Table 5-15), and therefore between groups comparisons were carried out between ESB and NESB data. Table 5-15 shows mean scores and standard deviations for ESB and NESB children’s performance on the IPA for the two subsets.

Table 5-15 Descriptive statistics for ESB and NESB children’s performance scores on the IPA by subset (1 and 3)

Language	Subset	N	Mean	Standard Deviation
ESB	(1) Ps and G1	263	45.6920	6.9552
	(3) G2–G8	483	49.8965	3.1190
NESB	(1) Ps and G1	87	45.1724	5.5263
	(3) G2–G8	65	48.2000	4.9787

An ANOVA was performed to test the null hypothesis (H_0 IPA.gesb) that there was no significant difference between Ps and G1 ESB children’s performance on the IPA and G2–G8 ESB children’s’ performance on the IPA. Results of the analysis of variance are shown in Table 5-16. Since $p < 0.5$, the null hypothesis (H_0 IPA.gesb) was rejected. Examination of the means in Table 5-16 above indicates that G2–G8 ESB children’s performance on the IPA was significantly better than that of ESB children’s in Ps and G1.

Table 5-16 ANOVA summary table for ESB children’s performance on the IPA by subset (1 and 3)

Source	SS	Df.	MS	F	P
Between groups	3010.132	1	3010.132	128.984	.000***
Within groups	17362.877	744	23.337		
Total	20373.009	745			

Note: *** $p < .00$

An ANOVA was next performed to test the null hypothesis (H_0 IPAgnesb) that there was no significant difference between Ps and G1 NESB children’s performance scores on the IPA and G2–G8 NESB Children’s performance on the IPA. Results of

the analysis of variance are shown in Table 5-17. As the p-value = 0.001, I was able to reject the null hypothesis (H_0 IPA.gnesb) at the 5 per cent significance level. Examination of the means in Table 5-17 above indicates that G2–G8 NESB children performed significantly better on the IPA than did NESB children in Ps and G1.

Table 5-17 ANOVA summary table for NESB children’s performance on the IPA by subset (1 and 3)

Source	SS	Df.	MS	F	P
Between groups	341.022	1	341.022	12.142	.001**
Within groups	4212.814	150	28.085		
Total	4553.836	151			

Note: ** $p < .0$

The within group comparisons were conducted next to decide whether there were significant language background differences in performance scores on the IPA within each of the identified subsets. Separate ANOVAs were performed to test the null hypotheses (H_0 IPA.glb.s1) for Ps and G1 children, and (H_0 IPA.glb.s3) for G2–G8 children, that there was no significant difference within grades in ESB and NESB children’s performance scores on the IPA. The means and standard deviations for ESB and NESB children’s performance on the IPA in each subset are shown in Table 5-18.

Table 5-18 Descriptive statistics for ESB and NESB children’s performance scores on the IPA by subset (1 and 3)

Subset	Language	N	Mean	Standard Deviation
(1) Ps and G1	ESB	263	45.6920	6.9552
	NESB	87	45.1724	5.5263
(3) G2–G8	ESB	483	49.8965	3.1190
	NESB	65	48.2000	4.9787

Results of the analysis of variance for Ps and G1 children are shown in Table 5-19. As the p-value = 0.527, I was unable to reject the null hypothesis (H_0 IPA.lb.s1) at the

5 per cent significance level. This indicated that language background played no significant part in performance on the IPA for Ps and G1 children.

Table 5-19 ANOVA summary table for children’s performance on the IPA based on language background by grade (Ps and G1)

Source	SS	Df	MS	F	P
Between groups	17.650	1	17.650	.401	.527
Within groups	15300.467	348	43.967		
Total	15318.117	349			

Results of the analysis of variance for G2–G8 children are shown in Table 5-20. As the p-value = 0.000, I was able to reject the null hypothesis (H_0 IPA_{b.s3}) at the 5 per cent significance level. Examination of the means in Table 5-20 above indicates that ESB children in G2–G8 performed significantly better on the IPA than did G2–G8 NESB children.

Table 5-20 ANOVA summary table for children’s performance on the IPA based on language background by grade (G2–G8)

Source	SS	Df	MS	F	P
Between groups	164.884	1	164.884	14.346	.000***
Within groups	6275.224	546	11.493		
Total	6440.108	547			

Note: *** p < .001

The within group comparisons were conducted next to determine whether there were significant gender differences in performance scores on the IPA. As no significant language differences were found for subset 1 (Ps and G1), an ANOVA was performed on this group to test the null hypothesis (H_0 IPA_{gmf.s1}) that there was no significant gender difference between Ps and G1 children’s performance on the IPA. Means and standard deviations for male and female children’s performance on the IPA for Ps and G1 children are shown in Table 5-21.

Table 5-21 Descriptive statistics for children performance scores on the IPA based on gender by grade (Ps and G1)

Grade	Gender	N	Mean	Standard Deviation
Ps and G1	Male	172	44.3895	7.9497
	Female	178	46.6966	4.7809

Results of the analysis of variance are shown in Table 5-22. As the p-value = 0.001, I was able to reject the null hypothesis (H_0 IPA gmf.s1) at the 5 per cent significance level. Examination of the means in Table 5-21 above indicates that overall, for Ps and G1, female children tended to perform significantly better on the IPA than did male children.

Table 5-22 ANOVA summary table for children's performance on the IPA based on gender by grade (Ps and G1)

Source	SS	Df	MS	F	P
Between groups	465.598	1	465.598	10.909	.001**
Within groups	14852.519	348	42.680		
Total	15318.117	349			

Note: ** $p < .01$

5.5 Tests involving the GWRT and grade level

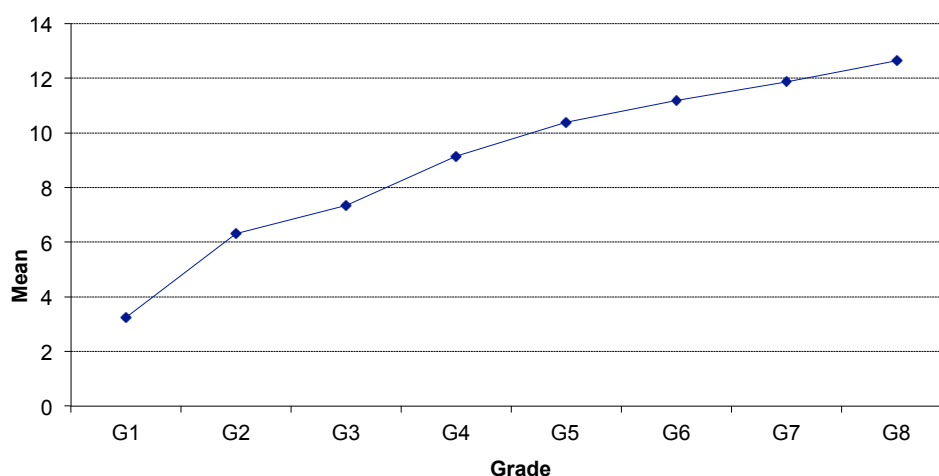
The GWRT is a measure of a child's capacity to articulate correctly whole English words from a list of words ranked in order of their difficulty of pronunciation. The raw score on this test represents the total number of correct responses made by each child from a possible total score of 100. This interim score is then converted to the children's reading age, which is a measure of the children's capacity to pronounce correctly English words ranked in order of difficulty.

Mean of the reading age scores and standard deviations for G1–G8 children's performance on the GWRT is shown Table 5-23. Examination of the means shows a consistent upward trend in children's' mean reading age from G1 through to G8.

Table 5-23 Descriptive statistics for children’s performance scores on the GWRT by grade (G1–G8)

Grade	N	Mean	Standard Deviation
G1	64	3.2414	2.9652
G2	89	6.3085	1.8674
G3	82	7.3355	1.8886
G4	71	9.1480	1.9697
G5	54	10.3804	2.1427
G6	64	11.1784	2.0551
G7	56	11.8561	2.3401
G8	132	12.6277	1.8914

Table 5-24 Descriptive statistics for children’s performance scores on the GWRT by grade (G1–G8)



5.6 Testing the differences between the grades in the pronunciation of whole English words

To test the null hypothesis (H_0 GWRTg) that there is no significant difference between grades in children’s performance scores on the GWRT, an analysis of variance was performed followed by post-hoc group comparisons using Tukey’s HSD test. Results are shown in Table 5-25. As the p-value = 0.000, I was able to reject the null hypothesis (H_0 GWRTg) at the 5 per cent significance level. This indicates that significant differences exist between grades in children’s performance on the GWRT.

Table 5-25 ANOVA summary table for children's performance on the GWRT by grade (G1–G8)

Source	SS	Df	MS	F	P
Between groups	5573.353	7	796.193	178.081	.000***
Within groups	2700.460	604	4.471		
Total	8273.813	611			

Note: *** $p < .001$

Using the Tukey's HSD identified six homogeneous subsets at the 5 per cent significance level tested the post-hoc comparison. As group sizes were unequal, the subsets were calculated using a harmonic mean sample size = 70.974. Means for groups in the homogeneous subsets are shown in Table 5-26.

Table 5-26 Means for identified homogeneous subsets for children's performance on the GWRT

Group	N	Subset for $\alpha = .05$					
		1	2	3	4	5	6
G1	64	3.2414					
G2	89		6.3085				
G3	82		7.3355				
G4	71			9.1480			
G5	54				10.3804		
G6	64				11.1784	11.1784	
G7	56					11.8561	11.8561
G8	132						12.6277
Sig. Level		1.000	.074	1.000	.323	.545	.368

5.7 Testing the differences between language backgrounds in the pronunciation of isolated phonemes

The data were pooled according to the identified homogeneous subsets in order to analyse whether significant differences existed on the children performance scores on the GWRT based on language background for ESB children and NESB children separately. Although three of the subsets overlapped, subset 1 (G1), subset 2 (G2–

G3), subset 3 (G4), subset 4 (G5–G6), and subset 6 (G7–G8) shared no common groups (Table 5-25) and therefore between group comparisons were carried out on these five subsets. Table 5-27 shows mean scores and standard deviations for ESB and NESB children’s performance on the GWRT for the five subsets.

Table 5-27 Descriptive statistics for children’s performance scores on the GWRT based on language (ESB and NESB) by subset (1, 2, 3, 4, and 6)

Language	Subset	N	Mean	Standard Deviation
ESB	(1) G1	53	3.3908	2.9820
	(2) G2 and G3	151	6.7608	1.8856
	(3) G4	56	9.2616	1.8789
	(4) G5 and G6	103	10.8713	2.2026
	(6) G7 and G8	173	12.3888	2.0221
NESB	(1) G1	11	2.5218	2.9091
	(2) G2 and G3	20	7.1045	2.3547
	(3) G4	15	8.7240	2.2987
	(4) G5 and G6	15	10.4147	1.4760
	(6) G7 and G8	15	12.5027	2.5316

An ANOVA was performed to test the null hypothesis (H_0 GWRTgesb) that there was no significant difference between grades in ESB children’s performance on the GWRT. Results of the analysis of variance are shown in: Table 5-27. As the p-value = 0.000, I was able to reject the null hypothesis (H_0 IPA.gesb) at the 5 per cent significance level. Post-hoc comparisons using Tukey’s HSD confirmed that the five identified homogeneous subsets were indeed discrete.

Table 5-28 indicates that ESB children in Grades 7 and 8 performed significantly better on the GWRT than did ESB children in Grades 5 and 6, who themselves performed significantly better than did ESB children in Grade 4. Similarly, ESB children in Grade 4 performed significantly better on the GWRT than did ESB children in Grades 2 and 3, who performed significantly better on the GWRT than did ESB children in Grade 1.

Table 5-28 ANOVA summary table for ESB children’s performance on the GWRT by subset (1, 2, 3, 4, and 6)

Source	SS	Df	MS	F	P
Between groups	4729.186	4	1182.296	262.891	.000***
Within groups	2388.062	531	4.497		
Total	7117.248	535			

Note: *** $p < .001$

An ANOVA was next performed to test the null hypothesis (H_0 GWRTgnESB) that there was no significant difference between NESB children’s performance scores on the GWRT. Results of the analysis of variance are shown in Table 5-29. As the p -value = 0.000, I was able to reject the null hypothesis (H_0 GWRTgnesb) at the 5 per cent significance level.

Table 5-29 ANOVA summary table for NESB children’s performance on the GWRT by subset (1, 2, 3, 4, and 6)

Source	SS	df	MS	F	P
Between groups	728.104	4	182.026	33.640	.000***
Within groups	384.182	71	5.411		
Total	112.286	75			

Note: *** $p < .001$

Post-hoc comparisons using Tukey’s HSD indicated that only four homogeneous subsets existed with significant differences between them. Means for these subsets are shown in Table 5-30 below.

Table 5-30 Means for identified homogeneous subsets for NESB children’s performance on the GWR

Grade	N	Subset for $\alpha = .05$			
		1	2	3	4
G1	11	2.5218			
G2 – G3	20		7.1045		
G4	15		8.7240	8.7240	
G5 – G6	15			10.4147	10.4147
G7 – G8	15				12.5027

Sig. Level	1.000	.335	.292	.119
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Examination of the means indicates that NESB children’s performance on the GWRT was more complicated than that of ESB children.

- NESB children in Grades 5, 6, 7, and 8 performed significantly better on the GWRT than did other NESB children, children in Grades 5 and 6 performed only as well as children in Grade 2 and 3. Secondly, NESB children in Grades 4, 5, and 6 performed significantly better on the GWRT than did NESB children in lower grades.
- Children in Grade 4 performed equally well on the GWRT, as did children in Grades 2 and 3.
- NESB children in Grades 2, 3, and 4 performed significantly better on the GWRT than did NESB children in the lowest grade 1, so NESB children in Grade 1 performed significantly worse on the GWRT than did any other NESB children.

The within group comparisons were conducted next to determine whether there were significant language background differences in performance scores on the GWRT. Based on the results of the post-hoc group comparisons shown in Table 5-25, separate ANOVAs were performed to test the null hypothesis (H_0 GWRTglb) for G1, G2–G3, G4, G5–G6, and G7–G8 children, which indicated that there was no significant difference within these groups in either ESB or NESB children’s performance scores on the GWRT. Means and standard deviations for ESB and NESB children’s performance on the GWRT in each subset are shown in Table 5-26 above.

No significant differences were found between Grade 1 ESB and NESB children’s performance on the GWRT, indicating that language background played no significant part in performance on the GWRT for children in any of the identified homogeneous subsets. Results of the analyses of variances for G1 children’s are shown in Table 5-31. As the p-value = 0.381, I was unable to reject the null hypothesis (H_0 GWRTglb.s1) at the 5 per cent significance level.

Table 5-31 ANOVA summary table for children's performance on the GWRT based on language background by grade (G₁)

Source	SS	Df	MS	F	P
Between groups	6.878	1	6.878	.780	.381
Within groups	547.027	62	8.823		
Total	553.905	63			

Results of the analysis of variance for G₂ – G₃ children are shown in Table 5-32. As the p-value = 0.459, I was unable to reject the null hypothesis (H_0 GWRTglb.s₂) at the 5 per cent significance level.

Table 5-32 ANOVA summary table for children's performance on the GWRT based on language background by grade (G₂–G₃)

Source	SS	Df	MS	F	P
Between groups	2.086	1	2.086	.552	.459
Within groups	638.692	169	3.779		
Total	640.778	170			

Results of the analysis of variance for G₄ children are shown in Table 5-33. As the p-value = 0.352, I was unable to reject the null hypothesis (H_0 GWRTglb.s₃) at the 5 per cent significance level.

Table 5-33 ANOVA summary table for children's performance on the GWRT based on language background by grade (G₄)

Source	SS	Df	MS	F	P
Between groups	3.419	1	3.419	.880	.352
Within groups	268.148	69	3.886		
Total	271.567	70			

Results of the analysis of variance for G₅ and G₆ children are shown in Table 5-34. As the p-value = 0.439, I was unable to reject the null hypothesis (H_0 GWRTglb.s₄) at the 5 per cent significance level.

Table 5-34 ANOVA summary table for children’s performance on the GWRT based on language background by grade (G5–G6)

Source	SS	Df	MS	F	P
Between groups	2.730	1	2.730	.603	.439
Within groups	525.333	116	4.529		
Total	528.062	117			

Results of the analysis of variance for G7 and G8 children are shown in Table 5-35. As the p-value = 0.838, it was not possible to reject the null hypothesis (H_0 GWRTglb.s6) at the 5 per cent significance level.

Table 5-35 ANOVA summary table for children’s performance on the GWRT based on language background by grade (G7–G8)

Source	SS	Df	MS	F	P
Between groups	.179	1	.179	.042	.838
Within groups	793.044	186	4.264		
Total	793.223	187			

Within group comparisons were conducted next to determine whether there were significant gender differences in performance scores on the GWRT. As no significant language differences were found for subset 1 (G1), subset 2 (G2–G3), subset 3 (G4), subset 4 (G5–G6), and subset 6 (G7–G8), separate ANOVAs were performed on each of these groups. Means and standard deviations for male and female children’s performance on the GWRT are shown in Table 5-36.

Table 5-36 Descriptive statistics for children’s performance scores on the IPA based on gender by grade

Grade	Gender	N	Mean	Standard Deviation
G1	Male	31	3.4777	3.1315
	Female	33	3.0194	2.8304
G2 – G3	Male	84	7.1174	1.8592
	Female	87	6.4955	1.9806

Grade	Gender	N	Mean	Standard Deviation
G4	Male	35	9.0063	2.1169
	Female	36	9.2858	1.8347
G5 – G6	Male	56	10.9475	2.1222
	Female	62	10.6919	2.1365
G7 – G8	Male	97	12.5881	2.0324
	Female	91	12.1951	2.0802

Results of the analysis of variance for grade 1 children are shown in Table 5-37. As the p-value = .541, it was not possible to reject the null hypothesis (H_0 GWRTgmf.s1) at the 5 per cent significance level. This would indicate that there was no significant gender difference in G1 children’s performance on the GWRT.

Table 5-37 ANOVA summary table for children’s performance on the GWRT based on gender by grade (G1)

Source	SS	Df	MS	F	P
Between groups	3.358	1	3.358	.378	.541
Within groups	550.547	62	8.880		
Total	553.905	63			

Results of the analysis of variance for G2 and G3 children are shown in Table 5-38. As the p-value = .036, I was able to reject the null hypothesis (H_0 GWRTgmf.s2) at the 5 per cent significance level. Examination of the means in Table 5-37 above indicates that for G2 and G3 male children tended to perform better on the GWRT than did female children.

Table 5-38 ANOVA summary table for children’s performance on the GWRT based on gender by grade (G2–G3)

Source	SS	Df	MS	F	P
Between groups	16.527	1	16.527	4.474	.036*
Within groups	624.251	169	3.694		
Total	640.778	170			

Note: * $p < .05$

Results of the analysis of variance for G₄ children are shown in Table 5-39. As the p-value = .554, I was unable to reject the null hypothesis (H_0 GWRTgmf.s₃) at the 5 per cent significance level. This would indicate that there is no significant gender difference in G₄ children's performance on the GWRT.

Table 5-39 ANOVA summary table for children's performance on the GWRT based on gender by grade (G₄)

Source	SS	Df	MS	F	P
Between groups	1.387	1	1.387	.354	.554
Within groups	270.180	69	3.916		
Total	271.567	70			

Results of the analysis of variance for G₅ and G₆ children are shown in Table 5-40. As the p-value = .516, it was not possible to reject the null hypothesis (H_0 GWRTgmf.s₄) at the 5 per cent significance level. This would indicate that there was no significant gender difference in G₅ and G₆ children's performance on the GWRT.

Table 5-40 ANOVA summary table for children's performance on the GWRT based on gender by grade (G₅-G₆)

Source	SS	Df	MS	F	P
Between groups	1.922	1	1.922	.424	.516
Within groups	526.141	116	4.536		
Total	528.062	117			

Results of the analysis of variance for G₇ and G₈ children are shown in Table 5-41. As the p-value = .192, I was unable to reject the null hypothesis (H_0 GWRTgmf.s₆) at the 5 per cent significance level. This would indicate that there was no significant gender difference in G₇ and G₈ children's performance on the GWRT.

Table 5-41 ANOVA summary table for children’s performance on the GWRT based on gender by grade (G7–G8)

Source	SS	Df	MS	F	P
Between groups	7.255	1	7.255	1.717	.192
Within groups	785.968	186	4.226		
Total	793.223	187			

5.8 Hypotheses rejected and not rejected

Table 5-42 and Table 5-43 provide summary information on whether the 28 hypotheses were rejected or not rejected. A total of 17 out of 28 was rejected.

The list of hypotheses for the research is presented in the following tables; alpha levels were set at 0.05.

Table 5-42 Lists of hypotheses (IPA)

TEST	HYPOTHESIS NOTATION	HYPOTHESES INVOLVING THE INTERNATIONAL PHONETIC ALPHABET	OUTCOME
1	H ₀ IPA g	There is no significant difference between grades in children’s performance scores on the IPA.	Rejected
2	H ₀ IPAg _{esb}	There is no significant difference between grades in ESB children’s performance scores on the IPA.	Rejected
3	H ₀ IPAg _{nesb}	There is no significant difference between grades in NESB children’s performance scores on the IPA.	Rejected
4	H ₀ IPAg _{lb.s1}	There is no significant difference within grades (Ps and G ₁) in ESB and NESB children’s performance scores on the IPA.	Not rejected

TEST	HYPOTHESIS NOTATION	HYPOTHESES INVOLVING THE INTERNATIONAL PHONETIC ALPHABET	OUTCOME
4a	H ₀ IPAglb.s3	There is no significant difference within grades (G2-G8) in ESB and NESB children's performance scores on the IPA.	Rejected
5	H ₀ IPA.gmf.s1	There is no significant gender (M vs. F) difference within grades (Ps and G1) in children's performance scores on the IPA.	Rejected

Table 5-43 Lists of hypotheses (GWRT)

TEST	HYPOTHESIS NOTATION	HYPOTHESES INVOLVING THE ST LUCIA GRADED WORD READING TEST (GWRT)	OUTCOME
6	H ₀ GWRTG	There is no significant difference between grades in children's performance scores on the GWRT.	Rejected
7	H ₀ GWRTGesb	There is no significant difference between grades in ESB children's performance scores on the GWRT.	Rejected
8	H ₀ GWRTGnesb	There is no significant difference between grades in NESB children's performance scores on the GWRT.	Rejected
9	H ₀ GWRTGlb.s1	There is no significant difference within grades (G1) in ESB and NESB children's performance scores on the GWRT.	Not rejected

TEST	HYPOTHESIS NOTATION	HYPOTHESES INVOLVING THE ST LUCIA GRADED WORD READING TEST (GWRT)	OUTCOME
9a	H ₀ GWRTGlb.s2	There is no significant difference within grades (G ₂ -G ₃) in ESB and NESB children's performance scores on the GWRT.	Not rejected
9b	H ₀ GWRTGlb.s3	There is no significant difference within grades (G ₄) in ESB and NESB children's performance scores on the GWRT.	Not rejected
9c	H ₀ GWRTGlb.s4	There is no significant difference within grades (G ₅ -G ₆) in ESB and NESB children's performance scores on the GWRT.	Not rejected
9d	H ₀ GWRTGlb.s6	There is no significant difference within grades (G ₇ -G ₈) in ESB and NESB children's performance scores on the GWRT.	Not rejected
10	H ₀ GWRTGmf.s1	There is no significant gender (M vs. F) difference within grades (G ₁) in children's performance scores on the GWRT.	Not rejected
10a	H ₀ GWRTGmf.s2	There is no significant gender (M vs. F) difference within grades (G ₂ -G ₃) in children's performance scores on the GWRT.	Rejected
10b	H ₀ GWRTGmf.s3	There is no significant gender (M vs. F) difference within grades (G ₄) in children's performance scores on the GWRT.	Not rejected

TEST	HYPOTHESIS NOTATION	HYPOTHESES INVOLVING THE ST LUCIA GRADED WORD READING TEST (GWRT)	OUTCOME
10c	H ₀ GWRTGmf.s4	There is no significant gender (M vs. F) difference within grades (G5-G6) in children's performance scores on the GWRT.	Not rejected
10d	H ₀ GWRTGmf.s6	There is no significant gender (M vs. F) difference within grades (G7-G8) in children's performance scores on the GWRT.	Not rejected

Table 5-44 Lists of hypotheses (IPA and GWRT)

TEST	HYPOTHESIS NOTATION	HYPOTHESES INVOLVING THE INTERNATIONAL PHONETIC ALPHABET (IPA) AND THE ST LUCIA GRADED WORD READING TEST (GWRT)	OUTCOME
11(1)	H ₀ IPA.GWRT.Grade1	There is no significant correlation between G1 children's scores on the IPA and the GWRT.	Rejected (<i>r</i> = .2481)
11(1a)	H ₀ IPA.GWRT ESB.Grade 1	There is no significant correlation between G1 ESB children's scores on the IPA and the GWRT.	Not rejected
11(1b)	H ₀ IPA.GWRT NESB.G rade1	There are no signifying children's scores on the IPA and the GWRT.	Rejected (<i>r</i> = .6879)
11(2)	H ₀ IPA.GWRT.G 2-G8	There is no significant correlation between G2-G8 children's scores on the IPA and the GWRT.	Rejected (<i>r</i> = .3171)
11(2a)	H ₀ IPA.GWRT ESB.G2-G8	There is no significant correlation between G2-G8 ESB children's scores on the IPA and the GWRT.	Rejected (<i>r</i> = .3019)

TEST	HYPOTHESIS NOTATION	HYPOTHESES INVOLVING THE INTERNATIONAL PHONETIC ALPHABET (IPA) AND THE ST LUCIA GRADED WORD READING TEST (GWRT)	OUTCOME
11(2b)	H ₀ IPA.GWRT NESB.G2 G8	There is no significant correlation between G2–G8 NESB children’s scores on the IPA and the GWRT.	Rejected

Table 5-45 Lists of hypotheses (IPA and PWRT)

TEST	HYPOTHESIS NOTATION	HYPOTHESES INVOLVING THE INTERNATIONAL PHONETIC ALPHABET (IPA) AND THE PICTURE READING TEST (PWRT)	OUTCOME
12	H ₀ IPA.PWRT	There is no significant correlation between Pre-school children’s scores on the IPA and the PWRT.	Rejected (<i>r</i> = .8190)
12a	H ₀ IPA.PWRTesb	There is no significant correlation between Pre-school ESB children’s scores on the IPA and the PWRT.	Rejected (<i>r</i> = .8330)
12b	H ₀ IPA.PWRTnesb	There is no significant correlation between Pre-school NESB children’s scores on the IPA and the PWRT.	Rejected (<i>r</i> = .7575)

5.9 Tests involving the PWRT and the IPA (Pre-school)

These tests examined the association between the Pre-school children’s capacity to pronounce isolated phonemes and to articulate whole English words.

Pearson product-moment correlations were calculated between Ps children’s performance on the PWRT and the IPA in order to test the null hypothesis (H₀IPA.PWRT) that there was no significant correlation between the Ps children’s capacity to pronounce isolated phonemes and their capacity to articulate whole English words. A strong positive correlation (*r* = .8190, *p* < .001) between the Ps children’s performance on the PWRT and the IPA was found. As the *p*-value < .05, I

was able to reject the null hypothesis (H_0 IPA.PWRT) at the 5 per cent significance level. These results indicated that, as the Ps children's capacity to pronounce isolated phonemes increased, so too did their capacity to articulate whole English words.

The Ps children's group was then split based on language background and Pearson product-moment correlations were calculated between Ps ESB children's performance on the PWRT and the IPA to test the null hypothesis (H_0 IPA.PWRTesb) that there was no significant correlation between Ps ESB children's capacity to pronounce isolated phonemes and their capacity to articulate whole English words based on language background. A strong positive correlation of ($r = .8330$, $p < .001$) was found between the Ps ESB children's performance on the PWRT and the IPA. As the p-value $< .05$, I was unable to reject the null hypothesis (H_0 IPAGWRTesb.g1) at the 5 per cent significance level. This result indicated that, as the Ps children's capacity to pronounce isolated phonemes increased, so too did their capacity to articulate whole English words.

Finally, Pearson product-moment correlations were calculated between Ps NESB children's performance on the PWRT and the IPA to test the null hypothesis (H_0 IPA.PWRTnesb) that there was no significant correlation between Ps NESB children's capacity to pronounce isolated phonemes and their capacity to articulate whole English words based on language background. A strong positive correlation ($r = .7575$, $p < .001$) between the Ps NESB children's performance on the GWRT and the IPA was found. As the p-value $< .05$, I was able to reject the null hypothesis (H_0 IPA.PWRTnesb) at the 5 per cent significance level. This result indicated that, as the Ps NESB children's capacity to pronounce isolated phonemes increased, so too did their capacity to articulate whole English words.

5.10 The tests involving the GWRT and the IPA

These tests examined the association between children's capacity to pronounce isolated phonemes and to articulate whole English words based on Grade.

5.10.1 Grade 1 (children)

Pearson product-moment correlations were calculated between G1 children's performance on the GWRT and the IPA in order to test the hypothesis (H_0 IPA.GWRT.g1) that there was no significant correlation between G1 children's capacity to pronounce isolated phonemes and their capacity to articulate whole English words. A weak positive correlation ($r = .2481$, $p < .05$) between the G1 children's performance on the GWRT and the IPA was found. As the p-value $< .05$, I was able to reject the null hypothesis (H_0 IPA.GWRT.g1) at the 5 per cent significance level. This result indicated that, as the G1 children's capacity to pronounce isolated phonemes increased, so too did their capacity to articulate whole English words.

The G1 children's group was then split based on language background to determine whether children's native language was associated with the articulation of phonemes and the pronunciation of whole English words. For G1 ESB children, Pearson product-moment correlations were calculated between their performance on the GWRT and the IPA to test the hypothesis (H_0 IPA.GWRTesb.g1) that there was no significant correlation between G1 ESB children's capacity to pronounce isolated phonemes and their capacity to articulate whole English words based on language background. A very weak positive correlation ($r = .0665$, $p > .05$) between the G1 ESB children's performance on the GWRT and the IPA was found. As the p-value $> .05$, I was unable to reject the null hypothesis (H_0 IPA.GWRTesb.g1) at the 5 per cent significance level. This result indicated that G1 ESB children's capacity to pronounce isolated phonemes and their capacity to articulate whole English words were not significantly associated.

Similarly, Pearson product-moment correlations were calculated between G1 NESB children's performance on the GWRT and the IPA to test the null hypothesis (H_0 IPA.GWRTnesb.g1) that there was no significant correlation between G1 NESB children's capacity to pronounce isolated phonemes and their capacity to articulate whole English words based on language background. A moderately strong positive correlation ($r = .6879$, $p < .05$) between the G1 NESB children's performance on the

GWRT and the IPA was found. As the p -value $< .05$, I was able to reject the null hypothesis (H_0 IPA.GWRTnesb.g1) at the 5 per cent significance level. This result indicated that, as the G1 NESB children's capacity to pronounce isolated phonemes increased, so too did their capacity to articulate whole English words.

5.10.2 Grades 2–8 Children

Because of the differences in the level of responses between Pre-school and Grade 1 groups and Grades 2 to 8, it was preferable to do an analysis by grouping them in this way. The Pearson product-moment correlations were calculated between G2–G8 children's performance on the GWRT and the IPA in order to test the null hypothesis (H_0 IPA.GWRT.g2-g8) that there was no significant correlation between the G2–G8 children's capacity to pronounce isolated phonemes and their capacity to articulate whole English words. A weak positive correlation was found ($r = .3171$, $p < .01$) between the G2–G8 children's performance on the GWRT and the IPA was found. As the p -value $< .05$, I was able to reject the null hypothesis (H_0 IPA.GWRT.g2-g8) at the 5 per cent significance level. This result indicated that, as the G2 – G8 children's capacity to pronounce isolated phonemes increased, so too did their capacity to articulate whole English words.

The G2–G8 children's group was then also split based on language background and once again Pearson product-moment correlations were calculated between G2–G8 ESB children's performance on the GWRT and the IPA to test the null hypothesis (H_0 IPA.GWRTesb.g2-g8) that there was no significant correlation between G2–G8 ESB children's capacity to pronounce isolated phonemes and their capacity to articulate whole English words based on language background. A weak positive correlation ($r = .3019$, $p < .01$) between the G2–G8 ESB children's performance on the GWRT and the IPA was found. As the p -value $< .05$, I was able to reject the null hypothesis (H_0 IPA.GWRTesb.g2-g8) at the 5 per cent significance level. This result indicated that, as the G2–G8 children's capacity to pronounce isolated phonemes increased, so too did their capacity to articulate whole English words.

Finally, Pearson product-moment correlations were calculated between G2–G8 NESB children's performance on the GWRT and the IPA to test the hypothesis

(H_0 IPAGWRTnesb.g2-g8) that there was no significant correlation between G2–G8 NESB children’s capacity to pronounce isolated phonemes and their capacity to articulate whole English words based on language background. A moderate positive correlation ($r = .4054$, $p < .01$) between the G2 – G8 NESB children’s performance on the GWRT and the IPA was found. As the p-value $< .05$, I was able to reject the null hypothesis (H_0 IPA.GWRTnesb.g2-g8) at the 5 per cent significance level. This result indicated that, as the G2 – G8 NESB children’s capacity to pronounce isolated phonemes increased, so too did their capacity to articulate whole English words.

5.11 Item analysis

This section reports the results of the item analysis carried out on the IPA test in order to construct a shortened version of the test. This short version of the IPA contained the most statistically appropriate selection of items for the testing of Pre-school and school-aged children in order to determine their capacity to articulate whole English words. The selection of items was based on three indices: (i) item difficulty, (ii) item-total correlations, and (iii) item discrimination.

5.11.1 Calculation of the item selection indices

Item difficulty was defined as the proportion of subjects who answered each item correctly. Its values ranged from 0.0 to 1.0. Taking the number of subjects who answered correctly and dividing this by the number of subjects tested calculated item difficulty. An item is considered appropriate if it is neither too easy (high item difficulty) nor too difficult (low item difficulty). These were considered appropriate items for a short version of the IPA, which should have a calculated item difficulty larger than 0.1 and smaller than 0.9.

Item-total correlation (r) was defined as the correlation between scores on an item and scores on the total test. This index indicated that each item cohered appropriately with the other items in the short version of the test. The appropriate items for a short version of the IPA should have item-total correlations greater than 0.4.

Item discrimination (d) was an index for calculating how efficiently an item discriminated between subjects who obtained high scores and subjects who obtained low scores on the entire IPA. Appropriate items for a short version of the IPA should have item discrimination values that are high and positive. Item discrimination (d) is calculated using the following equation:

$$D = \frac{(U - L)}{(N * 0.2)}$$

Where:

U is the number of subjects in the upper range of the total test scores who answered the item correctly (the top 25%).

L is the number of subjects in the lower range of the total test scores who answered the item correctly (the bottom 25%).

N is the total number of subjects in the upper or lower range group.

As the scores for the item selection indices for choosing appropriate items for a short version of the IPA based on children’s responses were not consistent across grade and language status, a “phoneme x grade” frequency matrix was created (see Table 5-46). If a phoneme met the above item selection criteria for any grade and language group, it was entered in the frequency matrix. The frequency for each phoneme that children had difficulty pronouncing was then calculated. The “difficulty” frequencies were then summed across all grades to give the total number of errors in pronunciation made by the children. If at least one error in pronunciation in any grade for either language group were identified, then that phoneme was selected for the short form of the IPA.

Table 5-46 Frequency matrix for incorrectly pronounced phonemes across grades and language groups (correctly pronounced phonemes omitted)

Phoneme	G2	G3	G4	G5	G6	G7	G8	Total
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Phoneme	G2	G3	G4	G5	G6	G7	G8	Total
CH_IN						✓		1
D_OG	✓						✓	2
TH_EN				✓		✓		2
H_AT						✓		1
L_OT	✓							1
A_GO				✓			✓	2
B_AH_				✓				1
F_AR_E	✓							1
F_AR_						✓		1
F_EAR_				✓				1
F_U_R			✓					1
TAK_ER_						✓	✓	2
SI_NG_						✓		1
FI_NG_ER	✓							1
S_IP	✓					✓		2
TH_IN				✓				1
V_AN						✓		1
W_IN				✓				1
Y_ET				✓				1
Z_IP				✓				1
VI_SI_ON				✓				1
B_I_T				✓		✓		2
F_IR_E				✓		✓		2
B_OI_L				✓				1
P_OOR_				✓		✓		2
P_OR_T	✓	✓						2
BR_OW_	✓	✓	✓	✓	✓	✓	✓	7
S_OUR_		✓				✓	✓	3
D_U_E	✓							1
D_U_G			✓	✓			✓	3
P_UR_E	✓	✓		✓				3

On the basis of this process, a scale comprising 31 items from the original 52-item set of the IPA was constructed. The selected items are shown in Table 5-47 and are arranged in order of difficulty, such that the majority of children from Pre-school to Grade 8 should be able to pronounce with relative ease phonemes such as tʃ (Chin), h (Hat), and l (Lot), and find the higher order phonemes such as ʌ (dug), juː (214row), and aʊ (214row) more difficult to pronounce. The use of a short version of the IPA could considerably decrease the time taken to assess participants' capacity to pronounce phonemes correctly, while maintaining the discrimination required to predict accurately the participants' capacity to articulate whole English words.

5.12 Reliability analysis of the short version of the International Phonetic Alphabet

The items of the short version of the IPA were submitted to a reliability analysis using SPSS. Cronbach's alpha for the 31 items of the IPA was reported at $\alpha = .7678$, indicating that the scale was highly reliable. The standardised item alpha for the 31 items was reported at $\alpha = .7740$.

Table 5-47 Phonemes sorted in order of difficulty based on the indices of item difficulty, item-total correlation, and item discrimination, 31 phonemes

Order	Error Frequency	Phoneme	Example
1	1	CH_	Chin
2	1	H_	Hat
3	1	L_	Lot
4	1	_AH_	Bah
5	1	_AR_	Fare
6	1	_AR_	Far
7	1	_EAR_	Fear
8	1	_U_	Fur
9	1	_NG_	Sing
10	1	_NG_	Finger
11	1	TH_	Thin
12	1	V_	Van

Order	Error Frequency	Phoneme	Example
13	1	W_	Win
14	1	Y_	Yet
15	1	Z_	Zip
16	1	_SI_	Vision
17	1	_OI_	Boil
18	1	_U_	Due
19	2	D_	Dog
20	2	TH_	Then
21	2	A_	Ago
22	2	_ER_	Taker
23	2	S_	Sip
24	2	_I_	Bit
25	2	_IR_	Fire
26	2	_OOR_	Poor
27	2	_OR_	Port
28	3	_OUR_	Sour
29	3	_U_	Dug
30	3	_UR_	Pure
31	7	_OW_	Brow

Table 5-48 Phonemes, item-total correlation, and item discrimination for testing adolescents

Order	Error Frequency	Phoneme	Example	Order	Error Frequency	Phoneme	Example
1	1	CH_	Chin	17	1	_OI_	Boil
2	1	H_	Hat	18	1	_U_	Due
3	1	L_	Lot	19	2	D_	Dog
4	1	_AH_	Bah	20	2	TH_	Then
5	1	_AR_	Fare	21	2	A_	Ago
6	1	_AR_	Far	22	2	_ER_	Taker
7	1	_EAR_	Fear	23	2	S_	Sip
8	1	_U_	Fur	24	2	_I_	Bit

Order	Error Frequency	Phoneme	Example	Order	Error Frequency	Phoneme	Example
9	1	_NG_	Sing	25	2	_IR_	Fire
10	1	_NG_	Finger	26	2	_OOR_	Poor
11	1	TH_	Thin	27	2	_OR_	Port
12	1	V_	Van	28	3	_OUR_	Sour
13	1	W_	Win	29	3	_U_	Dug
14	1	Y_	Yet	30	3	_UR_	Pure
15	1	Z_	Zip	31	7	_OW_	Brow
16	1	_SI_	Vision				

5.13 Conclusion

In Chapter 5, I have presented the results of the statistical analyses performed on the data collected from the children's population which was administered with the International Phonetic Alphabet, the St. Lucia Graded Word Reading Test, The Picture Word Reading Test, and the questionnaire detailed in Chapter 4. Analysis was also conducted on responses from The Picture Word Reading Test for Pre-school children, and also the responses obtained from these children from the administration of the International Phonetic Alphabet. Analysis was applied to the testing with the St. Lucia Graded Word Reading Test with children in Grade 1 through to Grade 8 children. Each of these groups was further divided into children from an English Speaking Background and children from a Non-English Speaking Background and then broken down by gender.

Pearson product-moment correlations were calculated to determine whether significant correlations existed between children's' performance on The Picture Word Reading Test, and The St. Lucia Graded Word Reading Test, in relation to the variables of grade, language background, and gender. Tests were performed on these variables to test for significant differences between ESB and NESB children's' performance on: The Picture Word Reading Test, The St. Lucia Graded Word Reading Test and the International Phonetic Alphabet Test. The item analysis of the International Phonetic Alphabet Test was also performed with the idea of

constructing a shorter version based on the order of difficulties in relation to children's capacity to pronounce isolated phonemes, which could possibly be used for teachers in the classroom to find out if children have difficulty with reading. In Chapter 6, the results of the hypotheses are discussed and the research questions are answered.

Chapter 6

DISCUSSION

6.1 Introduction

Chapter 6 discusses the results of the statistical analysis which I performed on the responses obtained from the administration of the IPA and the PWRT from Pre-school (Ps) children, and on the responses I obtained from the administration of the IPA and the GWRT from children in Grade 1 (G1) through to Grade 8 (G8) children. Each of these groups were further divided into children from an English Speaking Background (ESB) and children from a Non-English Speaking Background (NESB) and then broken down by gender. The data was collected from testing with the International Phonetic Alphabet, the St. Lucia Graded Word Reading Test the Picture Word Reading Test, and the questionnaire detailed in Chapter 4.

In the discussion of the data analysis, the following research questions have been answered:

- 1) How do phonological skills correlate with reading words aloud of children in Pre-school to Grade 8?
- 2) Which phonemes do children of Pre-school to Grade 8 find difficult to master?
- 3) In what ways can a practical assessment tool be developed for classroom teachers to test children's phonemic knowledge and awareness?
- 4) What differences can be found between children from ESB (English Speaking Background) and NESB (Non-English Speaking Background) in their development of phonemic competence in English, and their capacity to pronounce isolated phonemes and to read words aloud?

Research hypotheses noted how children were tested to determine whether the degree of association between ESB (English speaking background) and NESB (non-English speaking background) children's capacity to pronounce whole English

words could be predicted based on the phonemes of the IPA and the whole words analysis of the GWRT. The IPA and the PWRT also showed strong correlation for both ESB and NESB children for Pre-school and Grade 1, it was found that girls performed better than boys.

6.2 An analysis of the statistical data

The following are subdivision questions

- a) Is there a correlation between children's capacity to pronounce isolated phonemes of the IPA and their capacity to pronounce and read whole English words?
- b) To what degree is the capacity to pronounce isolated phonemes and the capacity to pronounce English words related to children's age and grade?
- c) Does a child's capacity to pronounce isolated phonemes of the IPA and their capacity to say and read words aloud differ in children of English speaking background (ESB) and non-English speaking background (NESB)?
- d) To what degree is the capacity to pronounce isolated phonemes and the capacity to pronounce English words related to children's age and grade?

Is there a significant correlation between? The following are subdivision questions:

- a) All children's age and their capacity to articulate and read whole English words?
- b) ESB children's age and their capacity to articulate and read whole English words?
- c) NESB children's age and their capacity to articulate and read whole English words?
- d) All children's age and their capacity to pronounce the isolated phonemes of the IPA?
- e) ESB children's age and their capacity to pronounce the isolated phonemes of the IPA? NESB children's age and their capacity to pronounce the isolated phonemes of the IPA? All children's capacity to pronounce the isolated phonemes of the IPA and their capacity to articulate whole English words?

- f) ESB children's capacity to pronounce the isolated phonemes of the IPA and their capacity to pronounce whole English words?
- g) NESB children's capacity to pronounce the isolated phonemes of the IPA and their capacity to articulate whole English words?

Is there a significant difference between?

- a) ESB and NESB children's capacity to articulate whole English words?
- b) ESB children's and NESB children's capacity to pronounce the isolated phonemes of the International Phonetic Alphabet (IPA)?

6.2.1 Answers to the foregoing questions

(A) Is there a significant correlation between children's age and their capacity to articulate and read whole English words?

PRE-SCHOOL CHILDREN $r = .4837$ $p < .001$ (two tailed)

Correlation is moderate

GRADE 1 CHILDREN $r = .3770$ $p < .01$ (two tailed)

Correlation is moderate

GRADES 2-8 CHILDREN $r = .7272$ $p < .01$ (two tailed)

Correlation is moderately strong

(B) Is there a significant correlation between the age of ESB children and their capacity to articulate and read whole English words?

PRE-SCHOOL CHILDREN $r = .5226$ $p < .001$ (two tailed)

Correlation is moderately strong

GRADE 1 CHILDREN $r = .2829$ $p < .05$

Correlation is weak

GRADES 2-8 CHILDREN $r = .7326$ $p < .01$ (two tailed)

Correlation is moderately strong

(C) Is there a significant correlation between NESB children's age and their capacity to articulate whole and read English words?

PRE-SCHOOL CHILDREN $r = .2806$ $p < .05$ (two tailed)

Correlation is weak

GRADE 1 CHILDREN $r = .7675$ $p < .01$ (two tailed)

Correlation is moderately strong

GRADES 2-8 CHILDREN $r = .6760$ $P < .01$ (two tailed)

Correlation is moderately strong

(D) Is there a significant correlation between all children's age and their capacity to pronounce the isolated phonemes of the IPA?

PRE-SCHOOL CHILDREN $r = .4560$ $P < .001$ (two tailed)

Correlation is moderate

GRADE 1 CHILDREN $r = .231$

Correlation is not significant

GRADE S 2-8 CHILDREN $r = .006$

Correlation is not significant

(E) Is there a significant correlation between native ESB children's age and their capacity to pronounce the isolated phonemes of the IPA?

PRE-SCHOOL CHILDREN $r = .5123$ $p < .001$ (two tailed)

Correlation is moderate

GRADE 1 CHILDREN $r = .004$

Correlation is not significant

GRADES 2-8 CHILDREN $r = .025$

Correlation is not significant

(F) Is there a significant correlation between NESB children's age and their capacity to pronounce the isolated phonemes of the IPA?

PRE-SCHOOL CHILDREN $r = .1453$

Correlation is not significant

GRADE 1 CHILDREN $r = .683$ $p < .05$

Correlation is moderately strong

GRADES 2-8 CHILDREN $r = -.147$

Correlation is not significant

(G) Is there a significant correlation between all children's capacity to pronounce the isolated phonemes of the IPA and their capacity to articulate whole English words?

PRE-SCHOOL CHILDREN $r = .8190$ $p < .001$ (two tailed)

Correlation is very strong

GRADE 1 CHILDREN $r = .2481$ $p < .05$

Correlation is weak

GRADES 2-8 CHILDRENS $r = .3171$ $p < .01$ (two tailed)

Correlation is weak

(H) Is there a significant correlation between native ESB children's capacity to pronounce the isolated phonemes of the IPA and their capacity to articulate whole English words?

PRE-SCHOOL CHILDREN $r = .8330$ $p < .001$ (two tailed)

Correlation is very strong

GRADE 1 CHILDREN $r = .0665$

Correlation is not significant

GRADES 2-8 CHILDREN $r = .3019$ $p < .01$ (two tailed)

Correlation is weak

(I) Is there a significant correlation between NESB children's capacity to pronounce the isolated phonemes of the IPA and their capacity to articulate whole English words?

PRE-SCHOOL CHILDREN $r = .7575$ $p < .001$ (two tailed)

Correlation is strong - very strong

GRADE 1 CHILDREN $r = .6879$ $p < .05$

Correlation is strong

GRADES 2-8 CHILDREN $r = .4054$ $p < .01$ (two tailed)

Correlation is moderate

(A) Is there a significant difference between ESB children's and NESB children's capacity to articulate whole English words?

PRE-SCHOOL CHILDREN $F = 1.833$ $p = .177$

Means: ESB children 20.1048 NESB children 20.9211

Difference is not significant

GRADE 1 CHILDREN $F=.780$ $p=.381$

Means: ESB children 3.3908 NESB children 2.5218

Difference is not significant

GRADES 2-8 CHILDREN $F=1.253$ $p=.264$

Means: ESB children 9.9431 NESB children 9.4878

Difference is not significant

(B) Is there a significant difference between ESB children's and NESB children's capacity to pronounce the isolated phonemes of the International Phonetic Alphabet (IPA)?

PRE-SCHOOL CHILDREN $F=.090$ $p=.765$

Means: ESB children 45.1714 NESB children 45.4474

Difference is not significant

GRADE 1 CHILDREN $F=7.339$ $p<.01$

Means: ESB children 47.7547 NESB children 43.2727

Difference is significant

GRADES 2-8 CHILDREN $F=14.346$ $p<.01$

Means: ESB children 49.8965 NESB children 48.2000

Difference is significant

Table 6-1 Differences between Pre-school and Grade 1 to Grade 8

PRE-SCHOOL	GRADE 1	GRADES 2-8
Not significant	Not significant	Not significant

Whatever the degree of exposure to a language other than English in the NESB children, it was not enough to cause a significant difference in their articulation of whole English words compared to those ESB children in any of the groups studied.

(B) As regards to the capacity to pronounce the isolated phonemes of the IPA, there was no significant difference between the ESB children and the NESB children for the Pre-school children, there was a significant difference between the two groups for the Grade 1 and Grades 2-8 children, the ESB children having the higher mean scores.

PRE-SCHOOL	GRADE 1	GRADES 2-8
Not significant	Not significant	Not significant

With the younger Pre-school children and the smaller number of phonemes involved, there was no significant difference in the capacity to pronounce the phonemes between the ESB and the NESB children. The significant difference for the Grade 1 and Grades 2-8 children may be due to the larger number of phonemes involved, with the ESB children having the higher mean scores.

6.3 Table of correlations

Table 6-2 Correlations between age and pronouncing English words

	PRE-SCHOOL	GRADE 1	GRADES 2-8
2A All	Moderate	Moderate	Moderately strong
2B ESB	Moderately strong	Weak	Moderately strong
2C NESB	Weak	Moderately strong	Moderately strong

Table 6-3 Correlations between age and pronouncing isolated phonemes

	PRE-SCHOOL	GRADE 1	GRADES 2-8
2D All	Moderate	Not significant	Not significant
2E ESB	Moderate	Not significant	Not significant

2F NESB	Not significant	Moderately strong	Not significant
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Table 6-4 Correlations between pronouncing phonemes and pronouncing whole words

	PRE-SCHOOL	GRADE 1	GRADES 2-8
2G All	Very strong	Weak	Weak
2H ESB	Very strong	Not significant	Weak
2I NESB	Strong-very strong	Strong	Moderate

There was no significant difference in the abilities of ESB children and NESB children to articulate whole English words in any of the age groups studied. As in regards to the capacity to pronounce the isolated phonemes of the IPA, there was no significant difference between the ESB children and the NESB children for the Pre-school children, there was a significant difference between the two groups for the Grade 1 and Grades 2-8 children, the ESB children having the higher mean scores.

There was a moderate (or greater) correlation between all the children's ages and their capacity to say and read whole English words throughout the age ranges studied. For ESB children, the correlation between age and capacity to articulate whole English words was moderately strong for Pre-school children (who repeated words spoken by the tester) and Grades 2-8 children, but only a weak correlation for Grade 1 children. For NESB children, the correlation between age and capacity to articulate whole English words was weak for Pre-school children but moderately strong for Grade 1 and Grades 2-8 children. In the group of all children, there was a moderate correlation between age and capacity to pronounce isolated phonemes of the IPA for the Pre-school children, but no significant correlation for the Grade 1 and Grades 2-8 children.

In the native English-language group, there was also a moderate correlation between age and capacity to pronounce isolated phonemes of the IPA for the Pre-school children but no significant correlation for the Grade 1 and Grades 2-8

children. The similar findings would be expected as the native ESB children formed about 82% of all the children.

In the NESB children group, there was a moderately strong correlation between age and capacity to pronounce isolated phonemes of the IPA for Grade 1 children but no significant correlation for Pre-school children or for Grades 2-8 children. In the group of all children, there was a very strong correlation between the capacity to pronounce isolated phonemes of the IPA and the capacity to articulate whole English words for the Pre-school group, but there were only weak correlations for Grade 1 and Grades 2-8 children. The correlation between the capacity to pronounce isolated phonemes and the capacity to articulate whole English words was very strong for Pre-school children.

In the ESB group, there was a very strong correlation between the children's capacity to pronounce phonemes of the IPA and their capacity to articulate whole English words for Pre-school children, but only a weak correlation for Grades 2-8 children and no significant correlation for Grade 1 children. As in the very strong correlation for native English-language children supported the predictive value of the capacity to pronounce isolated phonemes in Pre-school children. The correlation was again weak in Grades 2-8 children. There was no significant correlation for Grade 1 children. In the NESB group, there was a strong to very strong correlation between the children's capacity to pronounce phonemes of the IPA and their capacity to articulate whole English words for the Pre-school children, a strong correlation for the Grade 1 children and a moderate correlation for the Grades 2-8 children.

6.4 Discussion of the results shown in these analyses

Statistical analyses were performed on the responses obtained from the administration of the IPA, the St. Lucia Graded Word Reading Test, and the Picture Word Reading Test of the Pre-school children (P), Grade 1 children (G1), and Grades 2-8 children (G2-G8). Each of the three groups was further divided into children from an English Speaking Background (ESB) and children from a Non-English Speaking Background (NESB).

Table 6-5 Number of children tested broken down by their school grade and language background

Language Background	Number of children			Total
	Pre-school (P)	Grade 1 (G1)	Grades 2–8 (G2-G8)	
ESB	210	53	483	746
NESB	76	11	65	152
Total	286	64	548	898

Pearson product-moment correlations were calculated to determine whether significant correlations existed among the various instruments administered to the children and a number of variables, including children's ages. Analysis of variance (ANOVA) tests were performed on a number of important variables to test for significant differences between means across the instruments for children in identified language groups

The items of the International Phonetic Alphabet (IPA) were submitted to a reliability analysis using SPSS. Cronbach's alpha, a measure of a scale's internal consistency based on the average inter-item correlations of all split-half tests, was calculated for the 52 items of the IPA at $\alpha = .8325$, indicating that the scale is highly reliable. The standardised item alpha for the 52 items was reported at $\alpha = .8374$.

Analyses were carried out on the various instruments administered to the Pre-school children. Mean scores for ESB children and NESB children are compared and discussed for the administered instruments. The degrees of association between the children's ages, grades and language L1 and L2 and their performance on the various tests are also discussed.

6.4.1 The Picture Word Reading Test

This test is a measure of a child's capacity to articulate correctly whole English words from pictures containing both an image of an object (e.g., an egg) and the word (e.g., "Egg") printed under the image. The score on this test represents the total number of correct responses made by each Pre-school student from a

possible total score of 25. Examination of the means and standard deviations showed general similarity between the two language groups, indicating that Pre-school children's performance did not vary greatly between ESB children and NESB children.

A t-test was used for independent samples and was performed comparing the two language groups' performance on The Picture Word Reading Test. No significant differences existed between ESB children and NESB children on performance on the Picture Reading Test, indicating that Pre-school children's native language status had no significant effect on their capacity to articulate whole English words as measured by, The Picture Reading Word Test.

Correlation between Pre-school children's ages and their capacity to articulate whole English words, and the degree of association between the children's ages and the children's performance on The Picture Word Reading Test, were calculated for all the children in the Pre-school group. Examination of these results showed a moderately significant positive correlation between age and the Pre-school children's capacity to articulate correctly whole English words for the total sample of children.

This finding indicated that, for the total sample of Pre-school children, age and capacity to articulate English words were significantly correlated. This result implied that, as the children's ages increased so did their capacity to articulate correctly whole English words as measured by The Picture Word Reading Test. The Pre-school group was then split based on native language status, and the degree of association between children's' ages and the performance on The Picture Word Reading Test for ESB children and NESB children was again calculated to test the null hypotheses (H_{02} (a) and H_{02} (b), respectively) that there were no significant correlations between the children's ages and their capacity to articulate whole English words based on native language status. Examination of these results showed a moderately significant positive correlation between age and the Pre-school children's capacity to articulate correctly whole English words for ESB children. There was also a significant correlation between age and NESB children's

capacity to articulate correctly whole English words, although the correlation was quite weak.

These results indicated that for both ESB and NESB children, as the children's ages increased so did their capacity to articulate correctly whole English words as measured by The Picture Word Reading Test. These language groups, age and capacity to articulate English words were significantly correlated. The Pre-school children were treated differently as the reading test started in Grade 1; these children had not yet started to learn to read.

6.4.2 The International Phonetic Alphabet (IPA)

This test is a measure of a child's capacity to pronounce correctly isolated phonemes. The IPA score represents the total number of correct responses made by each student from a possible score of 52. Examination of the means and standard deviations again showed general similarity between the two identified language groups. The difference found between the ESB and the NESB Pre-school languages groups with the IPA was not perceptible.

It was found that no significant differences existed between the two language groups on performance on the IPA. These results indicated that Pre-school children's native language status (ESB vs. NESB) had no significant effect on their capacity to pronounce isolated phonemes as measured by the IPA.

The degree of association between the Pre-school children's ages and the performance on the IPA was calculated between the children's ages and their capacity to pronounce isolated phonemes. The Pre-school group was then split based on native language status, and the degree of association between ESB children' and NESB children' ages on their performance on the IPA was again calculated respectively. Examination of these results showed a moderately significant positive correlation between age and the Pre-school children's capacity to pronounce correctly isolated phonemes for the total sample of children. There was a significant correlation between the Pre-school children's ages and their

capacity to pronounce isolated phonemes when language status was not considered.

6.4.3 Pre-school children's capacity to pronounce isolated phonemes and to articulate whole English words

The degree of association between the Pre-school children's performance on The Picture Word Reading Test and their performance on the IPA was calculated between the children's capacity to pronounce isolated phonemes and their capacity to articulate whole English words. The Pre-school group was then split based on native language status, and the degree of association between ESB children's and NESB children's performance on The Picture Word Reading Test and their performance on the IPA was also calculated. Examination of these results indicated very strong significant positive correlations between the children's capacity to pronounce correctly the isolated phonemes and their capacity to articulate correctly English words for the total sample of Pre-school children, as well as for ESB children and NESB children. These results indicated that, as children's capacity to pronounce correctly isolated phonemes increased, so too did their capacity to articulate correctly whole English words. Furthermore, there was a significant correlation between the children's performance on the IPA and their performance on the Picture Reading Test. Children's capacity and NESB children's capacity to pronounce the isolated phonemes of the IPA were significantly correlated with their capacity to articulate whole English words.

6.5 Grade 1 children

Analyses were carried out on the various instruments administered to Grade 1 children. Mean scores for ESB children and NESB children were compared and reported for the administered instruments. The degrees of association among the children's' ages, their language status, and their performance on the various tests are also discussed.

6.5.1 Tests involving the St. Lucia Graded Reading Test

Examination of the means and standard deviations showed some small differences, indicating that performance on the St. Lucia Graded Word Reading Test did not vary greatly between Grade 1 ESB children and NESB children.

6.5.2 Grade 1 language groups in reading aloud whole English words

ANOVA was performed comparing the two language groups' performance on the St. Lucia Graded Word Reading Test. No significant differences existed between the two identified language groups on performance on the St. Lucia Graded Word Reading Test. These results indicated that Grade 1 children's native language status had no significant effect on their capacity to read aloud whole English words as measured by the St. Lucia Graded Word Reading Test.

6.5.3 Grade 1 children's age and reading aloud whole English words

The Grade 1 group was split based on language status, and the degree of association between ESB children's and NESB children's ages and their performance on the St. Lucia Graded Word Reading Test (reading age) were calculated. Examination of these results showed a moderately significant positive correlation between age and Grade 1 children's capacity to read aloud correctly whole English words ranked in order of difficulty, for Grade 1 children, when language status was not considered. When native language status was taken into account, the correlation between age and reading age for ESB Grade 1 children was significant, although weak. For NESB children, there was a strong significant positive correlation between age and reading age. These results indicated that, as the children's ages increased, so too did their capacity to read aloud correctly whole English words as measured by the St. Lucia Graded Word Reading Test, and also that age and capacity to articulate English words ranked in order of difficulty were significantly correlated.

6.5.4 Grade 1 language groups in the pronunciation of isolated phonemes

ANOVA was performed comparing the two language groups' performance on the IPA. Examination of the means indicated that Grade 1 ESB children's capacity to pronounce isolated phonemes as measured by the IPA was significantly higher than NESB children's capacity to pronounce the isolated phonemes of the IPA.

6.5.5 Grade 1 children's ages and the pronunciation of isolated phonemes

The degree of association between the Grade 1 children's ages and their performance on the IPA was calculated and analysed. The Grade 1 group was then split based on native language status, and the degree of association between ESB children and NESB children's ages, and their performance on the IPA was calculated. Examination of these results showed a moderately significant positive correlation between age and the children's capacity to pronounce correctly isolated phonemes only for the Grade 1 NESB children. This would indicate that, for these children, the capacity to pronounce isolated phonemes is significantly associated with their ages, and that, as these children become older, their capacity to pronounce isolated phonemes increases. There was a significant correlation between these children's ages and their capacity to pronounce isolated phonemes. For the total Grade 1 children sample, and for ESB children, no significant correlations between age and the children's capacity to pronounce isolated phonemes were found.

6.5.6 Grade 1 children's capacity to pronounce isolated phonemes and to read aloud whole English words

The degree of association between the Grade 1 children's performance on the St. Lucia Graded Word Reading Test and their performance on the IPA was calculated. The Grade 1 group was then split based on native language status, and the degree of association between ESB children's and NESB children's performance on the St. Lucia Graded Word Reading Test and their performance on the IPA was calculated

based on their capacity to pronounce isolated phonemes and their capacity to read aloud whole English words based on their native language status. Examination of these results indicated that, for the total Grade 1 children group, there was a weak significant positive correlation between their capacity to pronounce correctly the isolated phonemes of the IPA and their capacity to read aloud correctly English words using the St. Lucia Graded Word Reading Test. There was a significant correlation between the Grade 1 children's performance on the IPA and their performance on the St. Lucia Graded Word Reading Test when language status was not considered.

When language status was taken into account, the results were more complicated. Results based on native language status indicated that there was a moderately strong significant positive correlation between performance on the IPA and performance on the St. Lucia Graded Word Reading Test for the Grade 1 NESB children. This would indicate that, as these children's capacity pronounces correctly isolated phonemes increased, so too did their capacity to read aloud correctly whole English words. There was a significant correlation between the Grade 1 NESB children's performance on the IPA and their performance on the St. Lucia Graded Word Reading Test. No significant correlation was found for the ESB children's performance on the IPA and St. Lucia Graded Word Reading Test. There was no significant correlation between ESB children's capacity to pronounce isolated phonemes and their capacity to read aloud whole English words as measured by the St. Lucia Graded Word Reading Test.

6.6 Grades 2-8 children

Analyses were carried out on the various instruments administered to Grades 2–8 children. Once again, mean scores for ESB children and NESB children are compared and reported for the administered instruments.

6.6.1 The St. Lucia Graded Word Reading Test

The St. Lucia Graded Word Reading Test was administered first to the Grades 2–8 children. Examination of the means and standard deviations showed only small

differences between the two language groups, indicating that performance on the St. Lucia Graded Word Reading Test did not vary greatly among Grades 2–8 ESB children and NESB children.

6.6.2 Grades 2-8 language groups tested with the St. Lucia Graded Word Reading Test

ANOVA was performed comparing the two language groups' performance on the St. Lucia Graded Word Reading Test. It was found that no significant differences existed between the two identified language groups on performance on the St. Lucia Graded Word Reading Test. These results indicated that Grade 2–8 children's native language status had no significant effect on their capacity to read aloud whole English words as measured by the St. Lucia Graded Word Reading Test.

6.6.3 Grades 2-8 children's ages and the St. Lucia Graded Word Reading Test

Children's performance on the St. Lucia Graded Word Reading Test was calculated for all the children. The Grades 2–8 groups were then split based on native language status and the degree of association between ESB children's and NESB children's ages and their performance on the St. Lucia Graded Word Reading Test. Examination of these results showed a moderate to strong significant positive correlation between age and Grades 2–8 children's capacity to read aloud correctly whole English words ranked in order of difficulty when language status was not considered. When language status was taken into account, the results also indicated a moderate to strong significant positive correlation between age and capacity to articulate correctly whole English words for both ESB and NESB children. These results indicated that, as the children's ages increased, so too did their capacity to read aloud correctly whole English words as measured by the St. Lucia Graded Word Reading Test.

6.6.4 The International Phonetic Alphabet (IPA (Grades 2-8)

Examination of the means and standard deviations showed some differences between the two identified language groups, indicating that Grades 2–8 children’s performance on the IPA may be influenced by native language status.

6.6.5 Grades 2-8 language groups and the IPA

ANOVA was performed comparing the two language groups’ performance on the IPA. It was found that significant differences existed between the two language groups on performance on the IPA. Examination of the means indicated that Grades 2–8 ESB children’s capacity to pronounce isolated phonemes as measured by the IPA was significantly higher than NESB children’s capacity to pronounce the isolated phonemes of the IPA.

6.6.6 The correlation between grades 2-8 children’s ages and the IPA

Grade 2-8 children’s ages and their performance on the IPA were calculated for all the children. The Grades 2–8 groups were split based on language status, and the degree of association between ESB children’s and NESB children’s ages and their performance on the IPA were also calculated. Examination of these results showed no significant correlations between age and the children’s capacity to pronounce correctly isolated phonemes for any group. This would indicate that Grades 2–8 children’s capacity to pronounce isolated phonemes was not significantly associated with their age, even when language status was taken into account.

6.6.7 Grades 2-8 children’s capacity to pronounce isolated phonemes and to articulate whole English words

Grades 2–8 children’s performance on the St. Lucia Graded Word Reading Test and their performance on the IPA were calculated. The Grades 2–8 groups were then split based on their native language status, and the degree of association between ESB children’s and NESB children’s performance on the St. Lucia Graded Word Reading Test and their performance on the IPA was calculated. Examination of these results indicated that, for the total Grades 2–8 groups, there was a weak to moderate significant positive correlation between their capacity to pronounce

correctly the isolated phonemes of the IPA and their capacity to articulate correctly English words using the St. Lucia Graded Word Reading Test. There was a significant correlation between the children's performance on the IPA and their performance on the St. Lucia Graded Word Reading Test when language status was not considered.

When native language status was taken into account, the results indicated a significant correlation between performance on the IPA and performance on the St. Lucia Graded Word Reading Test for the Grades 2–8 ESB children, indicating that, as these children's capacity to pronounce correctly isolated phonemes increased, so too did their capacity to articulate correctly whole English words. The ESB children's performance on the IPA was significantly correlated with their performance on the St. Lucia Graded Word Reading Test. For the NESB children, the results also indicated a significant positive correlation between performance on the IPA and the St. Lucia Graded Word Reading Test. NESB children's capacity to pronounce isolated phonemes was significantly correlated with their capacity to articulate whole English words as measured by the St. Lucia Graded Word Reading Test.

Analyses were also carried out on the total children's sample. The sample was divided into three groups (Group 1, Group 2, and Group 3) based on ages, and the mean scores of children's capacity to pronounce correctly the phonemes that make up the IPA based on their ages were compared and reported. Examination of these means indicated clear differences between Group 1 (2–5.99 years) scores on the IPA and the scores for Group 2 (6–10–9 years) and Group 3 (11–14–9 years), the mean scores of the two older age groups did not seem to vary greatly.

6.6.8 The three age groups tested with the IPA

ANOVA was performed comparing the three age groups' performance on the IPA. Significant differences existed among the three age groups on performance on the IPA. These results indicated that age had a significant effect on children's capacity to pronounce the isolated phonemes of the IPA.

Items were arranged in order of difficulty as shown in Tables 5-47 and 5-58 in chapter 5, such that the majority of children from Pre-school to Grade 8, should be able to pronounce with relative ease phonemes such as tʃ (CHin), h (Hat), and l (Lot), and find the higher order phonemes such as ʌ (dUg), ju(e)r (pURe), and au (brOW) more difficult to pronounce. The use of a short version of the IPA should considerably decrease the time taken to assess participants' capacity to pronounce phonemes correctly, while maintaining the discrimination required to predict accurately the participants' capacity to articulate whole English words.

The items of the short version of the International Phonetic Alphabet (IPA) were submitted to reliability analysis using SPSS. Cronbach's alpha for the 31 items of the IPA was reported at $\alpha = .7678$, indicating that the scale was highly reliable. The standardised item alpha for the 31 items was reported at $\alpha = .7740$.

6.7 Conclusion

In Chapter 7, Conclusion and Recommendations, this study highlights the need to recognise that the phonemic knowledge and skills underpinning learning to read apply to children in the middle years as well as in early childhood, and the importance for teachers to assess children as early as possible in the classroom if they are showing learning difficulties.

Chapter 7

CONCLUSIONS AND RECOMMENDATIONS

7.1 Introduction

This research study was born from my work in my clinic, for children with learning and behavioural difficulties. I tested close to one thousand children and collected five thousand pieces of data for statistical analysis. I wanted to explore methods of assessing children's capacity to pronounce isolated phonemes and their capacity to read or say words aloud in the English language and the implications this has for reading, with a view to design an assessment device, to be used by teachers and others in the field of education, for the purpose of finding out children's capacity to pronounce isolated phonemes and their capacity to read or say words aloud. For this reason, this study outlined children's development of phonemic knowledge, articulation of whole word and the problem of auditory conceptualisation dysfunction. For this thesis I have used the International Phonemic Alphabet (IPA) as a preliminary but comprehensive screening test of English phonemes. The phonemes have been examined in isolation.

The St. Lucia Graded Word Reading was administered to all children in Grades 1 – 8, to test the children's capacity to read and pronounce words. This related their performance to their reading age norm and allowed comparison against chronological age. The test format required the child to read aloud from a horizontal list of words, which gradually increased in difficulty. I included children who spoke a language other than English at home and this allowed the comparison of these children's performance with those of children who only English was spoken at home. The results of the research allowed me to create a short version of the IPA, which any teacher can use to discover if a child has difficulties in producing isolated phonemes in the classroom.

The question of why some children, have difficulty learning to read and say words aloud, has been the focus of a great deal of research over the past four decades,

and much has been learned about the probable and improbable causes of such difficulty. There is evidence that inadequate facility in word identification, due in most cases to more basic phonological skills deficiencies associated with phonological coding deficits, is the cause of the problem. I found through my work in my clinic that the assessment of a child's phonemic awareness knowledge is crucial to the design and development of reading programs tailored to each child's needs. This not only affects younger children, but also children through to adolescence and adulthood.

I noted the disturbingly high number of children who had progressed to adolescence lacking the requisite skills needed to meet academic expectations, such as reading, spelling, and mathematics without success in reading. I found myself holding together children that had so much trouble at school as they were unable to keep up with their peers and adolescents that cried as they told me how they were bullied because of their lack of academic skills.

7.2 Children's phonemic awareness

This research study investigated children's phonemic awareness, phonology, auditory conceptualisation, and discrimination of sounds and articulation of words. It also explored children's phonological awareness across from Pre-school to Grade 8, through the development of an assessment device designed for the use of classroom teachers. Auditory processing was defined and a contemporary model of the reading process was outlined to illustrate its importance in the overall process of learning to read, which impacts on the development of literacy skills. This study also highlighted the need to recognise that the phonemic knowledge and skills underpinning learning to read apply to children in the middle years as well as early childhood.

7.2.1 Phonological knowledge: Implications for reading

The minimal units of linguistic sounds are phonemes. When difficulty in pronouncing phonemes correctly is blocking fluent oral expression, it is clearly important to discover such difficulties early. In this way children with these

problems can be taught the requisite motor skills in articulation and cease to perpetuate habits of incorrect pronunciation. Fluent oral expression is also recognised as playing a vital part in achieving literacy. Children who have difficulty learning to read tend to be slow to grasp the concept that letters have sounds and are slow to encode those sounds.

The causality of children with learning difficulties provides strong evidence to support the focus of this research into phonological development. The teaching of reading and spelling might well include activities and tasks designed to train and improve certain phonological abilities, such as sound segmentation and sound blending, making reading and spelling easier. Teachers would be able to design more appropriate learning activities to meet children's needs better if they had knowledge of their children's' levels of phonological development and phonemic awareness.

Children's awareness of spoken language is essential for acquiring phonemic awareness with respect to their capacity to identify, compare and manipulate the smallest units of spoken words (phonemes). The important role of language in cognitive and metacognitive development is highlighted by Lindamood (2011), who noted that in first language development the majority of sounds are acquired by ages five or six except for approximately 10 % of children who experience difficulties. This also includes their incapacity to learn and store important sounds in the language (phonemes and morphemes) and to learn and understand sounds as meaningful units (words). While the minimal units of linguistic sounds are phonemes, there are technical differences within phonemes that signal differences between words and meaning. Such a difference can be seen in the pronunciation of 'cat' and 'bat' where the difference in initial phonemes reflects a difference in meaning. Children with learning difficulties have more difficulty retrieving grammar words than content words. They mispronounce words such as *what*, *for*, and *that*. Visual memory for words seems to play an insignificant role in word recognition. Awareness of this is essential to the child's capacity to apply the phonemes. Lack of motor skills in producing English language phonemes may also be an important factor hindering children from learning to speak effectively. In

addition, the impact of language disorders is important to consider in the child's development and learning reading. The impact of such disorders increases the importance of assessment tools and programs to support young children's language acquisition.

Children with learning difficulties also have a lack of coordination between sights and sound, it is a generalised disturbance of language function that interferes with the acquisition of reading skills. Caution should be used in labelling children with learning difficulties, as many children are just slow starters and with proper instruction will have no persistent reading problems. Being a learning disabled child would not be a problem in any illiterate society, in all areas except reading she or he may perform well, but reading is necessary in today's literate world. Because each child is different the teacher, through careful observation, must determine how to prepare a lesson, by finding out which is the child's strongest teaching channel, this are auditory, visual and/or kinaesthetic.

Although it is an important area of need, little research has been undertaken, particularly into phonemic knowledge and children's development in relation to decoding words through middle years of schooling. Teachers need to be aware of the literacy issues faced by adolescent readers with decoding difficulties. It seems that adolescents who are unsuccessful in reading words unfamiliar to them may also struggle with poor phonemic awareness skills. Without sufficient awareness of the sounds that make these new words, readers are unable to move to other levels of literacy and therefore this phonological skill deserves the attention of educators in middle and high schools. Adolescents with decoding difficulties need more intensive practice and instructional time to develop their reading skills, specifically decoding instruction should emphasise syllable patterns and morphology. A reading specialist most appropriately deliver this instruction to adolescent children with difficulties, if they have problems in phonemic awareness, they should be referred to a reading specialist for formal assessment of their reading skills. Adolescents with residual speech sound errors may also have weaknesses in phonological processing.

For adolescent children with decoding difficulties, the specialist should integrate phonemic awareness instruction as a support to the classroom lessons and texts that are assigned. Although there is little research on adolescents and phonemic awareness, instructing adolescents who struggle with phonemic awareness can be derived from research involving adult beginning readers. Adolescents with poor reading skills sometimes have emotional and behavioural difficulties caused by poor achievement in school. Phonological awareness needs to be included in the teaching approach for older children as well as adults. Importantly, for the present research there are few valid and reliable testing tools for the use of teachers in the classroom. So it becomes difficult for them to find out at an early stage if children have trouble with the pronunciation of sounds.

7.3 Aim of this research

The aim of the research for this thesis is the assessment of children's capacity to pronounce isolated phonemes and their capacity to read or say words aloud in the English language: implication for learning to read. To compare children's capacity to pronounce isolated phonemes and their capacity to read or say words aloud with the view of designing a short version adapted from the International Phonemic Alphabet, that can be used as a testing tool and accessible to all teachers and other educational professionals.

From the statistical analysis, an assessment tool was devised as a short test of the IPA and the items of the short version of the International Phonetic Alphabet (IPA) were submitted to reliability analysis using SPSS. Cronbach's alpha for the thirty-one items of the IPA was reported at $\alpha = .7678$, indicating that the scale is highly reliable. The standardized item alpha for the 31 items was reported at $\alpha = .7740$.

7.4 Answers to the research questions

This study investigates children's capacity to pronounce phonemes and whole words in relation to English language and literacy, given the importance of auditory processing skills in learning to read.

1) How do phonological skills correlate with reading words aloud of children in Pre-school to year eight?

It was concluded in the statistical analysis Chapter 6, that there is a correlation between saying and reading words aloud in children from grade one to grade eight. This is an important finding considering that most children can pronounce the sounds needed for the English language by the age of five to six years old. Statistical analyses were performed on the responses obtained from the administration of the IPA and the PWRT to Pre-school (Ps) children and on the responses obtained from the administration of the IPA. The testing results with the GWRT applied to children in Grade 1 (G1) through to Grade 8 (G8) children. Each of these groups was further divided into children from an English Speaking Background (ESB) and children from a Non-English Speaking Background (NESB) and then broken down by gender.

Although research has been done in this area, it seems to be more relevant to the earlier grades and not grades five to eight. It was found through the research of this thesis that there are problems in the later grades in producing phonemes and reading and saying words aloud. This study highlights the need to recognise that the phonemic knowledge and skills underpinning learning to read apply to children in the middle years as well as in early childhood, and the importance for teachers to assess children as early as possible in the classroom if they are showing learning difficulties.

2) Which phonemes do children of preschool to Grade eight find difficult to master?

Items were arranged in order of difficulty, such that the majority of children from Pre-school to Grade eight should be able to pronounce with relative ease phonemes such as tʃ (CHin), h (Hat), and l (Lot), and find the higher order phonemes such as ʌ (dUg), ju(e)r (pURe), and au (brOW) more difficult to pronounce. The use of a short version of the IPA should considerably decrease the time taken to assess participants' capacity to pronounce phonemes correctly, while

maintaining the discrimination required to predict accurately the participants' capacity to articulate whole English language words.

Grades 2 to 8 children's performance on the St Lucia Graded Word Reading Test and their performance on the IPA were calculated. The Grades two to eight groups were then split based on their native language status and the degree of association between ESB children's and NESB children's performance on the St Lucia Graded Word Reading Test and their performance on the IPA were calculated. Examination of the results indicated that, for the total grades two to eight groups there was a weak to moderate significant positive correlation between their capacity to pronounce correctly the isolated phonemes of the IPA and their capacity to articulate correctly English words using the St Lucia Graded Word Reading Test. There was a significant correlation between the children's performance on the IPA and their performance on the St Lucia Graded Word Reading Test when language status was not considered.

3) In what ways can a practical assessment tool be developed for classroom teachers to test children's phonemic knowledge and awareness?

An assessment tool was devised as a short test of the IPA and the items of the short version of the IPA were submitted to reliability analysis using SPSS. Cronbach's alpha for the 31 items of the IPA was reported at $\alpha = .7678$, indicating that the scale is highly reliable. The standardised item alpha for the 31 items was reported at $\alpha = .7740$.

The items of the International Phonetic Alphabet (IPA) were submitted to reliability analysis using SPSS. Cronbach's alpha, a measure of a scale's internal consistency based on the average inter-item correlations of all split-half tests, was calculated for the 52 items of the IPA. Cronbach's alpha was reported at $\alpha = .83$, indicating that the scale was highly reliable. The standardised item alpha for the 52 items was reported at $\alpha = .84$.

The GWRT is a measure of a child's capacity to articulate correctly whole English words from a list of words ranked in order of their difficulty of pronunciation. The

raw score on this test represents the total number of correct responses made by each child from a possible total score of 100. This interim score is then converted to the children's reading age, which is a measure of the children's capacity to pronounce correctly English words ranked in order of difficulty.

The Pearson product-moment correlations were calculated between grade two to grade eight children's performance on the GWRT and the IPA in order to test the null hypothesis (H_0 IPA.GWRT. Grade 2 to Grade 8) that there was no significant correlation between the Grade 2 to Grade 8 children's capacity to pronounce isolated phonemes and their capacity to articulate whole English words. A weak positive correlation was found ($r = .3171$, $p < .01$) between the grade two to grade eight children's performance on the GWRT and the IPA was found. As the p-value $< .05$, I was able to reject the null hypothesis (H_0 IPA.GWRTgrade two to grade eight) at the 5 per cent significance level. This result indicated that, as the grade two to grade eight children's capacity to pronounce isolated phonemes increased, so too did their capacity to articulate whole English words.

Item difficulty was defined as the proportion of subjects who answered each item correctly. Its values ranged from 0.0 to 1.0. Taking the number of subjects who answered correctly and dividing this by the number of subjects tested calculated item difficulty. An item is considered appropriate if it is neither too easy (high item difficulty) nor too difficult (low item difficulty). These were considered appropriate items for a short version of the IPA, which should have a calculated item difficulty larger than 0.1 and smaller than 0.9.

Item-total correlation (r) was defined as the correlation between scores on an item and scores on the total test. This index indicated that each item cohered appropriately with the other items in the short version of the test. The appropriate items for a short version of the IPA should have item-total correlations greater than 0.4.

4) What differences can be found between children from ESB (English Speaking Background) and NESB (Non-English Speaking Background) in their

development of phonemic competence in English, and their capacity to pronounce isolated phonemes, and reading words aloud?

There was a significant correlation between the children's performance on the IPA and their performance on the St. Lucia Graded Word Reading Test when language background was not considered. The capacity to pronounce the isolated phonemes of the IPA, it was found that there was no significant difference between the ESB children and the NESB children among the Pre-school children, there was a significant difference between the two groups for the grade one and grades two to eight children, the ESB children having the higher mean scores.

ANOVA was performed comparing the two language groups' performance on the IPA. Examination of the means indicated that grade one ESB (English speaking background) children's capacity to pronounce isolated phonemes as measured by the IPA was significantly higher than NESB (Non English speaking background) children's capacity to pronounce the isolated phonemes of the IPA. The data was pooled according to the identified homogeneous subsets in order to analyse whether significant differences existed on the children performance scores on the GWRT based on language background for ESB children and NESB children separately. Although three of the subsets overlapped, subset 1 (Grade one), subset 2 (Grade 2 to Grade 3) subset 3 (Grade 4), subset 4 (Grade 5 to 6), and subset 6 (Grade 7 to Grade 8) shared no common groups.

7.5 Overview Of The Experiment

Data was collected on children's capacity to pronounce phonemes and read and say words aloud from a sample of children from pre-school through to grade eight from schools in the metropolitan area of Brisbane Queensland, Australia. A total of four data collection instruments were used. The large sample of children was selected from the class rolls at each year level at each school and centre using a table of random numbers. Correlations were calculated to determine whether significant correlations existed between children's performance on the reading test and the variables of grade, language background, and gender. Analysis of variance

tests were performed on these variables to test for significant differences between English speaking background and non-English background children's performance.

It was concluded in the statistical analysis in Chapter 6 that there was a correlation between saying and reading words aloud by children from grade one to grade eight. It was found through the research for this thesis that there are problems in the later grades in producing phonemes and reading and saying words aloud in the schools involved in the study.

7.5.1 The trial of the test

The assessment instruments used for the research were implemented in my remedial learning clinic, where children could be assessed and undergo remedial programs. Initially a pilot test was conducted with six children and in this trial study these children had the same background characteristics such as location, socio-economic status, language background, gender, and grade level. These children were given the same test as the main sample. The work was done with children who had speech, spelling, or reading disorders.

Following this pilot test, a test was conducted with a bigger sample of children attending the clinic. There were eighty-four children who participated in this testing, all diagnosed with learning difficulties. The same methodology as the pilot test was used. The idea was to test the short IPA test in combination with the GWRT test, in order to confirm their usefulness as an easy diagnostic test for teachers to use as a first point of call to find out if children have learning difficulties. For Test 2 only the short version of the IPA was tested as the sample was big and the focus was to investigate if the IPA is a useful assessment tool.

For this reason the test designed in this thesis has been recorded on a CD, for easy use so that the teachers or professionals only have to make sure that the child can say or not say the sound correctly. It does not involve the tester having to say the sounds, making it easier for the teacher to administer as a diagnostic test for teachers in the classroom. The results of the case study showed that the IPA might be used as a testing tool in combination with the St Lucia Graded Word Reading

[aloud] Test before and after a reading intervention program to measure improvement. These testing tools can be used as assessment instruments effectively in schools.

7.6 Contributions to knowledge

The contribution to knowledge by this thesis is the results of the children's performance with regard to phonemic knowledge for the age range moving into adolescence, as well as the creation of a user-friendly diagnostic test for teachers to speed up the diagnostic process. It is well established that phonemic awareness is a prerequisite for learning to read and that children who have auditory conceptualisation difficulties will be the ones who begin the long journey of failure.

The statistical analysis showed that there is a correlation between saying and reading words aloud in children in the higher grades. The research of this thesis shows that, adolescents and adults exhibit minor to severe degrees of difficulties when pronouncing phonemes and reading words aloud. The basic problem found in these children is in processing sounds. Children's capacity to discriminate sounds will impact on their capacity not only to decode words but also to articulate words. The assessment of learners' phonemic awareness/phonemic knowledge and skill/auditory conceptualisation function would be crucial to the design and development of reading programs/support programs not only with younger children but also with children through to adolescence and adulthood. Through this study I have shown that pre-adolescents and adolescents have trouble with pronouncing phonemes and reading difficulties in a classroom. By grade four children are expected to be able to read, these older children who have learning difficulties go through school grades without appropriate help.

It was also shown in this research that, whatever the degree of exposure to a language other than English in the non-English speaking background, it was not enough to cause a significant difference in their articulation of whole English language words compared to English speaking background children in any of the groups studied.

This study has shown that children with learning difficulties are able to improve dramatically from learning with intensive suitable programs. Recent studies have shown that intensive training in a variety of cognitive and sensorimotor skills can result in changes in grey matter volume (Krafnick, Flowers, Napoliello, & Eden, 2010). These studies help to provide insights into how the eighty-four children in this research improved by participating in intensive learning programs. My experience with working with children with learning difficulties has helped me design and conduct the testing with close to one thousand children.

7.6.1 Contribution to theoretical knowledge

The conceptual framework that I have utilised for the research for this thesis is based on the capacity of a child to pronounce phonemes and say words aloud. The awareness at the level of the phoneme has particular significance for the acquisition of reading because of its role in the development of understanding of the alphabet. The underlying complexities of English vocabulary, semantics, grammar, syntax, language interference, and code switching from other languages are all relevant to speaking English. I developed the conceptual framework from a distillation of the existing literature. Similarly I applied the concept from my conceptual framework to the analysis of data. The study's contribution to theoretical knowledge is focused on explaining why the findings from the data emerged in the way that they did.

7.6.2 Contribution to methodological knowledge

The IPA Test and the St. Lucia Graded Word Reading Test were applied to investigate the way that phonological skills impact on reading capacity. The research for my thesis focused on a sample of eight hundred and ninety eight (898) children (Pre-school through to Grade 8) from schools in the metropolitan area of Brisbane (Queensland, Australia). Data was collected about children's capacity to pronounce phonemes and read and say words aloud.

Tests were designed through my research showing the methodology to implement them and how to use these tests from testing research and work in a clinic for

children with learning and behavioural difficulties. The results showed that the testing tools were a useful means to help teachers to work with children with learning difficulties.

7.7 Recommendations for further research

The phonemes have been examined first in isolation in my research and for further study could be used in constructing the more complex test of functionally grouped phonemes in articulated speech.

In this study the phonemes have been examined separately from one another. A possible elaboration of this research could include the construction of a more complex test of functionally grouped phonemes in articulated speech. It would be useful to research the possibility of a child with learning difficulties, who is learning another language at least three hours a week. Can this help with the learning of the first language? For example, in my clinic Spanish was taught to some of the children with learning difficulties. This was a very motivating psychological factor for these children as they felt they knew something their peers did not, giving them more confidence. Moreover, their English language improved, they had better reading skills.

Is learning to draw a tool useful for helping children to learn to read? It is understood that the arts are the most powerful means of strengthening the perceptual component without which, productive thinking is impossible in every field of academic study and should this be included in the curriculum through primary school? For example, in my clinic most programs included drawing, this helped the children form a more perceptual feeling for words and gave them a way of expressing their thoughts, thereby creating a powerful motivation to learn.

7.7.1 Recommendations for policy

21st century classroom teachers need diagnostic tools of assessment to identify auditory dysfunction and also the pedagogical skills to respond effectively. It is crucial to have training and professional development in this vital area for pre-service and in-service teachers. The advent of Naplan in Australia in both early

childhood and Grades 7 and Grade 9 (middle grades) will find the outcomes and the product of this research (such as the teachers' test) very useful in their goals to lift the reading performance of children in the bottom bands.

7.7.2 Recommendations for practice

It will be useful to design practical strategies for teachers and to help parents with issues of phonemic knowledge, so they can help their children. This would include the capacity to assess children's reading difficulties as soon as the child is lagging behind.

In Queensland the literacy levels of both primary and secondary school children have shown a need for concern. In my clinic I found the poor literacy performance, of mostly boys and those who have English as a second language, to be a concern for their future lives, as literacy intervention in schooling shows current programs to be limited in their capacity to assess those children who have learning difficulties.

7.8 Conclusions

Children are now growing up in an information rich environment where reading involves more than printed, hard copy texts. They need to read to access the Internet, to use mobile phones, computers and e-mail, and a multiplicity of other electronic media (Makin, Diaz, & McLachlan, 2007). Learning experiences now include information literacy skills that require children to be independent in reading much earlier. Children are more likely to find themselves in learning environments where they need to communicate with children and teachers from diverse linguistic and cultural backgrounds, reading to communicate with friends and family for everyday purposes is occurring much earlier and they are embracing modern technology.

Against the backdrop of these concerns, the research in this thesis was initiated to make a contribution to the field of education and to the lives of individuals. A sample of over eight hundred and ninety eight children (898) from the metropolitan area of Brisbane was tested, which led to designing a test that can

easily be used by teachers in classrooms to test discrimination of sounds. It was concluded in the statistical analysis that there is a significant correlation between saying and reading words aloud and phonemic awareness in children from grade one to grade eight. It has been found that one-third of the population exhibit minor to severe degrees of difficulties when reading, a percentage of this includes children, adolescence, adults, educators and other professionals. These people are affected by auditory conceptual dysfunction and reading disabilities. The pilot study (Test 2) with six children (6), and Test 2 with eighty-four children (84), with learning difficulties, was conducted using the same diagnostic tools as the main research study. The children were all diagnosed with auditory conceptual dysfunction and reading difficulties. The testing tools proved to be a useful diagnostic resource to help these children.

The lack of success in all ages to achieve literacy is a problem for a quarter of the population, but especially focusing on adolescents who lose hope of a future and who potentially become depressed, criminals, drug addicts and social dropouts. Counselling should be part of what is provided to children, adolescents or adults attending remedial education.

The final common pathway in all oral communication involves the acquisition of phonemic knowledge and the capacity to articulate whole words, as phonemes are the core of language. It is crucial for children to have the capacity to pronounce isolated phonemes and to have the capacity to read or say words aloud. We speak with our ears.

7.9 The road ahead

Looking into the future I hope to make an impact with my research at the ground level, where the information discovered can be of most use. The testing tools that I developed and proved to be relevant and rigorous are of value not only in their inherent qualities to assist in discovering if a child has phonemic problems but also because the tests are easy to administer by non-trained or semi-trained people. This means that I have the opportunity to give classroom teachers and even parents a tool that can positively influence the course of their children's lives.

After some deliberation I have decided to develop my testing tools as an application, to be made available on iPhones, iPods, and iPads across the world. I believe that this will empower teachers and parents with the tools to make the future a brighter and more positive one for children with these difficulties.

This thesis investigated children's capacity to pronounce phonemes and whole words in relation to learning to read, a skill crucial to English language acquisition and the development of English literacy. Given the importance of auditory processing skills in learning to read and noting how important it is for children to grow and develop as literate members of contemporary society for schooling and lifelong learning, this investigation of children's capacity to pronounce phonemes and whole words is considered both timely for developments in reading pedagogy and significant for the need to look at new and transformative ways of working collaboratively to raise literacy standards, a process that begins with schooling.

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APPENDICES

Appendix 1: Accompanying Questionnaire

Patricia Anne Mongard Collette Tyrer

Name of child:

Age:

Years:

Months:

Name of School:

Class:

(Circle Appropriate Responses)

Do you like watching television (TV)?

How many hours do you spend watching TV each day?

< 1 hour

1-2 hours

2-3 hours

3-4 hours

> 4 hours

Do you like reading?

How many hours do you spend reading each day?

< 1 hour

1-2 hours

2-3 hours

3-4 hours

> 4 hours

Does your mother go out to work?

Does your father go out to work?

Any comments by Tester:

Appendix 2: The International Phonetic Alphabet (IPA)

Name of School:

Class:

Date:

International Phonetic Alphabet

b as in (bat)	ng as in (sing)	
ch as in (chin)	ngg as in (finger)	
d as in (dog)	p as in (pet)	
th as in (then)	r as in (rat)	
f as in (fat)	s as in (sip)	
g as in (go)	sh as in (ship)	
t as in (tip)	th as in (thin)	
h as in (hat)	v as in (van)	
j as in (jam)	w as in (win)	
k as in (kit)	y as in (zip)	
m as in (mat)	zh as in (vision)	
n as in (net)	i as in (bit)	
a as in (fate)	ir as in (fire)	
a as in (fat)	o as in (goat)	
a as in (ago)	o as in (got)	
ah as in (bah)	oi as in (boil)	
ar as in (fare)	oo as in (boot)	

ar as in (far)		oo as in (book)	
aw as in (paw)		oor as in (poor)	
e as in (meet)		or as in (port)	
e as in (met)		ow as in (brow)	
er as in (fear)		owr as in (sour)	
er as in (fur)		u as in (due)	
er as in (taker)		u as in (dug)	
i as in (bite)		ur as in (pure)	

Tester says: When I raise my hand, say "b" as in "bat – b" etc.

Name of Subject:

Age: years months

Patricia Anne Mongard Collette Tyrer

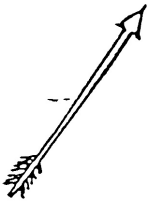


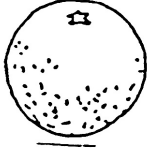





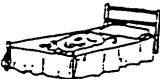














Appendix 3: The St. Lucia Graded Word Reading Test table of norms

school	little	tree	milk	book
flower	playing	Road	Bun	Summer
think	picture	Sit	Dream	Frog
something	island	sandwich	postage	downstairs
thirsty	crowd	beginning	nephew	biscuit
shepherd	saucer	canary	appeared	ceiling
angel	gradually	imagine	attractive	smoulder
knowledge	diseased	nourished	university	recent
disposal	situated	forfeit	fascinate	audience
intercede	orchestra	gnome	applaud	choir
heroic	colonel	plausible	physics	siege
systematic	soloist	campaign	slovenly	genuine
classification	prophecy	conscience	preliminary	scintillate
sabre	adamant	pivot	miscellaneous	enigma
susceptible	institution	antique	satirical	oblivion
procrastinate	pneumonia	homonym	terrestrial	rescind
belligerent	statistics	tyrannical	somnambulist	judicature
evangelical	fictitious	metamorphosis	beguile	sepulchre
ineradicable	grotesque	preferential	idiosyncrasy	bibliography

St Lucia Graded Word Reading Test

Teaching and Testing Resources Brisbane

Appendix 4: The Word Reading Test

a 	e 	l 	o 	u 
p 	h 	w 	m 	d 
f 	c 	g 	t 	d 
l 	ch 	s 	sh 	j 
v 	r 	sm 	y(ellow) 	th 