School of Psychology and Speech Pathology
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The Relationship Between Otitis Media and Literacy Outcomes of Urban Indigenous Australian School Children

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Declaration

To the best of my knowledge and belief this thesis contains no material previously published by any other person except where due acknowledgment has been made.

This thesis contains no material which has been accepted for the award of any other degree or diploma in any university.

Signature: .....

Date: 24/03/15

Abstract

This quantitative study examined data from 97 pre-primary, year one and year two students attending one of four schools in Perth, Western Australia. Of these, 57 students identified as Indigenous Australian. The research aimed to document the relationship between literacy outcomes and the presence of otitis media (OM) in the early school years in Indigenous Australian children, a relationship widely discussed but not confirmed in literature to date. OM, highly prevalent in Indigenous Australian children, is often accompanied by mild fluctuating hearing loss (HL) which has been found to be associated with literacy acquisition in studies of non-Indigenous children. The spelling, reading, phonological awareness skills and letter knowledge of all children were assessed using a culturally modified version of the Queensland University Inventory of Literacy (Dodd & Holm, 1996). Generalised Linear Mixed Model analysis was used to compare the literacy outcomes of Indigenous children with their non-Indigenous peers and the Indigenous peers with and without OM and subsequent HL. Non-Indigenous participants performed significantly better on all outcome measures than the Indigenous participants. There was no significant difference on the outcome measures between the groups of Indigenous children who had single or recurring episodes of OM, nor between the groups with both OM and HL and those with normal ear health. Indigenous students were provided with a literacy intervention based on the Gillon Phonological Awareness Program (Gillon, 2008). Of these, 38 students were involved in follow-up assessments. The participants demonstrated overall significant improvement on all outcome measures. This significant improvement remained for phonological awareness outcomes when accounting for normal classroom maturation and

continued at a follow-up assessment in the year following the intervention. Participants with and without OM and HL did not show any significant differences in pre and post intervention assessments. This study is the first of its size to explore OM and HL in metropolitan Indigenous Australian children. Despite a number of policies and programs relying on the premise that a relationship exists, all Indigenous children performed poorly on literacy outcomes regardless of their ear health status. The study concludes that the impact of OM in early pre-school years on language development is still a possibility and that a targeted phonological awareness program for all Indigenous students would be beneficial.

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Chapter One: Introduction

This research is for the community who works together to promote positive health and educational development in children: educators, caregivers, health workers, speech pathologists and audiologists. Of particular importance are the personnel who work with Indigenous Australian children. They will likely be well aware of the existence of middle ear health problems in this population, and the daily struggle that these children experience with speech, hearing, educational, behavioural and language difficulties.

1.1 Background

A long history of research on, and more recently with and by, Indigenous Australians has focused on middle ear health problems and the reasons for and solutions to these difficulties (Humphery, 2001). Nevertheless, Indigenous Australian children continue to experience disproportionate negative health outcomes with subsequent speculation on the links between health and education. While health and education have traditionally been addressed independently, an association has developed amongst education and health professionals whereby education is viewed as a strong predictor of health outcomes within Indigenous Australian populations (V. Johnston, 2009; Lyons & Janca, 2012; Zubrick et al., 2006). Similar views have been postulated by these groups whereby the reverse may be true; poor health may predict poor educational outcomes (Dodson, Hunter, & McKay, 2012; Mellor & Corrigan, 2004; Zubrick et al., 2006). This association is the focus of this dissertation where the relationship between middle ear conditions and literacy outcomes in Indigenous Australian children is explored.

Middle ear conditions, including otitis media (OM), have been recognised as possible contributors to poor educational outcomes (Gravel & Wallace, 1998; Roberts, 2002; Sonnenschein, 2004; C. Williams & Jacobs, 2009). There is, however, a major challenge to this recognition. International and Australian research has focused on many aspects of education such as book reading (Vernon-Feagans, Hurley, & Yont, 2002), speech (Shriberg et al., 2000), vocabulary (Roberts, Rosenfeld, & Zeisel, 2004), standardised measures of expressive and receptive language (Casby, 2001), school attendance (Otto, 2010) and literacy skills such as phonological awareness, reading and spelling (Winskel, 2010) with respect to the presence of OM. This literature does not reach a consensus on whether middle ear conditions impact negatively on these outcomes. Additionally, research focusing on school age literacy in Indigenous Australian children with high rates of OM is very scarce (Aithal, Yonovitz, & Aithal, 2008; Walker & Wigglesworth, 2001; C. Williams & Jacobs, 2009).

1.1.1 What is otitis media?

In the literature review and discussion chapters, OM, unless otherwise specified, encompasses related conditions including acute OM (AOM), OM with effusion (OME), chronic OM with effusion and chronic suppurative OM (CSOM). AOM is an infection of the middle ear. However, symptoms and presentation of the disease vary. OME is characterised by fluid collecting in the middle ear, but there are often no outward indicators of the infection such as redness or fever, particularly in Indigenous Australian children (Coates, Morris, Leach, & Couzos, 2002). If the amount of fluid increases and the ear drum is ruptured, releasing fluid into the outer ear, then the disease becomes classified as OM with perforation. If the initial

infection persists for over two weeks the disease is called chronic OM. CSOM is when the discharge persists (Zubrick et al., 2004).

Within the current study, OM refers to a type b tympanogram that reflects either fluid in the middle ear that causes the tympanic membrane to have neutral or negative pressure (Walker & Wigglesworth, 2001; C. Williams, 2003) or a perforated tympanic membrane.

1.1.2 How is hearing and language impacted?

Hearing loss (HL) is the inability to hear at expected levels. It is expected that with normal hearing, people can hear sounds at thresholds between 0dB and 25dB (Kolb & Whishaw, 2014). The World Health Organisation classifies HL in grades of severity, identifying a hearing level between 26dB and 40dB as a slight or mild impairment, hearing levels between 41dB and 60dB as a moderate impairment and hearing levels greater than 60dB as severe to profound impairment (World Health Organization, 2014). It has been well established that more severe cases of HL, particularly sensorineural loss from birth, have a debilitating effect on language development and learning (Moeller, 2000). However, the HL associated with OM is typically mild to moderate and far from constant throughout childhood. Rather, it fluctuates both in severity and in its association with OM, often occurring during or after an episode (Zumach, Chenault, Anteunis, & Gerrits, 2010). It is this form of HL that is addressed in this study due to the lack of evidence of the impact on language learning. The participants of the current study are identified with HL if they have a hearing level of greater than 25dB indicating mild loss, although the recurrence of HL throughout the study period is also considered. While the effect of this mild fluctuating HL on language development has been the subject of an extended period

of research (Nittrouer & Burton, 2005; Roberts, 2002) with researchers concluding that consistent mild sensorineural HL does affect learning in primary school years (Wake & Poulakis, 2004), very little literature has focused on episodes of the disease in the early school years and how the child's exposure to literacy is affected.

1.1.3 Who does this research involve?

This current study was conducted in metropolitan Perth, Western Australia and focused on the Aboriginal and Torres Strait Islander participants and their non-Aboriginal peers from four primary schools. Perth is Noongar country and was traditionally occupied by the Whadjuk Noongar people. The researcher acknowledges the history and influence of the Whadjuk elders and their families who have had and still have a significant influence in the lives of their children. Aboriginal and Islander Education Officers (AIEO) at each of the schools reported on the cultural language groups of their students. Whilst most participants in the study identified as Noongar, a number had relocated from various regions of Australia and identified with a different Aboriginal or Torres Strait Islander cultural language group. Much of the literature discussed below has been completed within different cultural language regions. This research uses the term Indigenous Australian to encapsulate this diversity.

1.2 Purpose and Significance

The current study provides a significant addition to the pool of literature addressing Indigenous education, providing a body of data within the context of the early primary years which expands upon current limited knowledge of the role that OM plays in the poor literacy outcomes of Indigenous Australian children. Prior literature indicates that this is an inadequately understood relationship but

particularly significant given the high rates of OM in this population (Coates, Morris, Leach, & Couzos, 2002; Gunasekera, Morris, McIntyre, & Craig, 2009).

The target age range of this study is of particular significance as only one prior study has been conducted that focused specifically on the impact of OM during the school years (Walker & Wigglesworth, 2001). Motivated by the absence of evidence and the discouraging statistics documenting the significantly poor performance of Indigenous Australian children on measures of literacy (Centre for Community Child Health, 2009; Curriculum Corporation, 2000; Godfrey & Galloway, 2004), this study endeavours to fulfil two purposes.

First, this study documents a large and statistically rigorous analysis of the relationship between OM and HL over an 18 month period and the subsequent outcomes of a targeted intervention program using a culturally adapted assessment of literacy and pre-literacy skills. This is presented with the intent to provide solid evidence in support, or otherwise, of the negative consequences of OM on literacy outcomes and therefore contribute to the discussion on the need for OM screening and intervention programs and literacy awareness and intervention programs within primary schools with Indigenous Australian attendance.

A reciprocal benefit was purposed for this study contributing to an improved educational experience for the participants in gratitude for their community knowledge (AIATSIS, 2011). Formative years of school are critical for child development. It is in these years that students build self-esteem and confidence socially, culturally and academically (Lyons & Janca, 2012), and use this confidence to learn academic skills, such as literacy. Including the intervention in the study plan was important for providing the participants of this study with some immediate

benefit. The long term outcomes are also expected to be beneficial as the improvements shown following the intervention are likely to have positive repercussions throughout primary school and beyond. Most importantly, the intervention lends itself to a strength based approach to enhance Indigenous Australian academic outcomes by introducing an accessible and successful program exposing children to explicit instruction in phonological awareness.

1.3 Overview of the thesis

An overview of the thesis according to chapters is set out below.

1.3.1 Chapter two: Appraisal of existing knowledge.

This chapter, divided into four subsections, provides an outline of literature relating to the fields of influence. First, a discussion of language development leading to the skills required for successful educational outcomes highlights the importance of the language environment in the development of language awareness and processing and provides a summary of skills specific to literacy outcomes. The second and third fields of knowledge present the prevalence of OM, the risk factors associated with the disease and the concomitant HL. The final section discusses the relationship between OM and HL in relation to language and literacy outcomes. This section has a particular focus on the contradictory nature of the pertinent studies and the scarcity of data relevant to Indigenous Australian children.

Each of the sections is written with a funnel structure, first focusing on the international context then moving to the studies and knowledge most relevant to the population of the current study. The analysis of the strengths and inadequacies of these studies, particularly as they pertain to literacy intervention and HL, underpins the research questions outlined at the end of the chapter.

1.3.2 Chapter three: Research process.

The current study required quantitative correlation analysis. Collection of the appropriate data needed to be rigorous as well as culturally appropriate. This process, including ethics approval, ear health and hearing assessments, literacy assessment, recruitment and nature of participants and the intervention is described in chapter three.

1.3.3 Chapter four: Results.

The results are explained in chapter four, beginning with an initial analysis involving observation of the data surrounding the participant characteristics; gender, year group and school. The results of the initial literacy assessment are presented with a description of how the participants, as a cohort, performed in each outcome. Following this, data addressing each of the research questions are provided. As each research question is addressed, group comparisons are made for each of the four literacy outcomes supported by, where relevant, a table highlighting any statistical significance.

1.3.4 Chapter five and six: Assessment and intervention interpretations and discussion.

These two chapters address the results of the study and how they support current and relevant literature. Previous assessment and intervention studies are examined as a way of placing the current study into context. Each research question is addressed followed by discussion on possible reasons for the responses.

1.3.5 Chapter seven: Conclusions.

In chapter seven, the research questions and outcomes are revisited and discussed with respect to the implications for health and education providers. The limitations of the study as well as suggestions for further research are also presented.

Chapter Two: Appraisal of Existing Knowledge

2.1 Language and Literacy

In the early schools years, students require a complex set of skills to achieve academic success. Reading alone draws on numerous components of knowledge including phonemic awareness, decoding skills, construction of meaning, vocabulary, spelling and writing (Foorman & Torgesen, 2001). Numeracy requires an integrated network of understanding, strategies and application skills (Thompson, 2010, pp. 33-34) and significant instruction (Siraj-Blatchford, Taggart, Sammons, Melhuish, & Sylva, 2013), much of which also relies on the ability to read and write. Beyond these more concrete skills, social and emotional competence has proven to be a foundation for school success (Webster-Stratton & Reid, 2004). This complex interaction of factors creates a real challenge for researchers and educators alike when working with early school literacy skills within an international education context.

Success in early school literacy skills requires an enriched language environment throughout childhood where literacy experiences pave the way for successful language learning (Morrow, 2012). These experiences, such as exposure to adult expert speakers, provide children with the phonological repertoire, grammatical elements, vocabulary, rules of morphology and an awareness of their own output. These components are required to establish a set of strong pre-literacy skills, such as alphabet knowledge, phonological awareness, print knowledge, oral language and vocabulary (Morrow, 2012). These skills have been found to be highly predictive of reading achievement which in turn contributes to later reading performance beyond primary school (Juel, 1991). Upon entering school, students are

required to demonstrate and develop their understanding of the relationship between oral language and printed communication and will benefit from explicit attention drawn to the elements of language to form a solid foundation for literacy learning (Clay, 2001).

Literacy is integral to a child's ability to learn and succeed in school and beyond and this learning begins in infancy (Morrow, 2012). The time immediately prior to school and the first years of school are critical years for literacy development. The following section focuses on this time period, and briefly describes pre-literacy skills and the development of literacy.

2.1.1 Pre-literacy skills.

Early behaviours and skills associated with successful reading development, previously known as *readiness skills* (Roberts et al., 2000), are now described in the literature as *pre-literacy skills*. An Australia wide movement encouraging families to be involved in preparing their children for school has seen numerous publications and community initiatives supporting the development of pre-literacy skills. For example, in 2009, a national publication for community child health nurses and other professionals reported on four factors that could facilitate successful transition from pre-literacy to literacy (Centre for Community Child Health, 2009). First, oral language ability is where the child develops their vocabulary and ability to understand and generate narratives. Second, letter identification is where a child recognizes that graphemes have corresponding names. Third, they learn the conventions of print which is when the child acknowledges the reading direction of text in their language. Fourth, a literacy promoting environment is where children are exposed to the use of books and literacy activities. These factors were developed

from research on *emergent literacy*, a term used at the beginning of this century to describe pre-literacy skills (Whitehurst & Lonigan, 2001). This 2009 publication is particularly pertinent to the current study as it emphasises the challenges faced by professionals working in culturally diverse Australian communities. A policy brief immediately prior to the publication motivated interest in literacy in early childhood, identifying the importance of a strong literacy foundation for both school success as well as later outcomes such as employment, welfare dependence and social acceptance (Silverstein, Iverson, & Lozano, 2002; The Centre for Community Child Health, 2008). In 2011, the Australian Library and Information Association (ALIA) published a strategy to support caregivers and service providers in preparing children for school. They labelled these skills as *early literacy skills* (ALIA Public Libraries Advisory Committee, 2011). The ALIA framework also acknowledges the need for cultural awareness in the implementation of the strategy within a diverse Australian context. Although the term given to the set of skills needed to shape children's literacy learning and school success has varied, research to develop the skill set has continued to evolve. Pre-literacy skills learning occurs from first exposure to language, however the current discussion focuses primarily on the years immediately prior to school where students are expected to gain a more explicit consciousness of phonological awareness and letter knowledge, precursors to early reading and spelling. The following section elaborates on each skill set.

2.1.1.1 Phonological awareness

Phonological awareness is a term given for a metalinguistic skill which allows the child to manipulate phonological elements of words (Bentin, 1992). Phonological awareness progresses from knowledge of larger units, such as syllables,

to smaller units such as individual sounds at the beginning of a word (Owens, 2005). The specific ability to recognise sounds (phonemes) in words and to manipulate them is called phonemic awareness (Owens, 2004, 2005). Phonics, then, involves matching phonemes with the corresponding symbol (graphemes), as in the alphabet system (Blachman, Ball, Black, & Tangel, 1994). Researchers often use the terms phonological awareness and phonemic awareness interchangeably. Research pertaining to both is presented here, then for the remainder of the study the ability to manipulate both the larger and smaller elements of language will be referred to as phonological awareness.

Knowledge of the phoneme level is used later in development to help decode and pronounce written words. By age four, children may demonstrate knowledge of word structure by recognising syllables and rhyming. It has been established that phonological awareness, phonemic awareness and a knowledge of phonics are the best predictors of spelling and reading outcomes in early development (Morrow, 2012). Strong phonological awareness skills prior to and in the first year of school are therefore influential factors in school readiness and success (Owens, 2004; Rohl & Pratt, 1995). These studies conclude that phonological awareness training is a vital component of early intervention and that such intervention facilitates reading and spelling acquisition.

Development of phonological awareness is sequential and difficulties at one phase may lead to delay in ongoing development. For example, if children have had poor exposure to oral language due to perhaps HL or a low stimulus environment, they may not recognise that language can be segmented (Bentin, 1992; Blachman, Tangel, Ball, Black, & McGraw, 1999; Nittrouer & Burton, 2005). If they are

unaware of the larger components such as sentences and words then they will have considerable difficulty progressing to smaller phonological units. This will then lead to difficulties decoding the symbols as the child is not familiar with the sounds to which they correspond. This stems from a lack of explicit knowledge of the alphabet and phonics (Morrow, 2012). Nevertheless, evidence also confirms that phonological awareness is amenable to explicit training and, with specific instruction, phonological awareness can improve (Blachman, et al., 1994)., as will the subsequent reading and spelling skills (Ehri, 2011; Hulme, Bowyer-Crane, Carroll, Duff, & Snowling, 2011). Since phonological awareness skills in early school years are said to be strong predictors of later literacy performance (Walker & Wigglesworth, 2001), they should be a prime focus of literacy intervention.

2.1.1.2 Letter knowledge

Beginner English readers require an awareness of the shapes, names and sounds of 52 upper and lower case letters (Ehri, 2011). When reading, children with developing pre-literacy skills may utilise sequential letter-by-letter decoding (Juel & Minden-Cupp, 2000). This requires considerable input from the child's memory of what the letters look like and how they sound. Children who are also familiar with the names of the letters prior to reading, appear to be advantaged in this decoding process as most names of the English alphabet letters contain the sounds they represent (Ehri, 2011). This is known as *alphabet knowledge*. Grapheme-phoneme correspondence, matching phonemes to the corresponding graphemes where graphemes are "the functional letter units symbolizing phonemes" (Ehri, 2011, p. 13), is known as g*rapheme-phoneme knowledge* (GPK). As in reading, spelling also requires decoding that relies on orthographic knowledge, the storage of information

allowing spoken word to be represented in written form (Apel, 2011). Apel (2011) presents a tutorial on *orthographic knowledge* that refers to two specific components of the development of reading and writing. First, *mental graphemic representations* provide a mental image of a word and a sequence of phonemes representing the spoken word in preparation for writing the word. Second, *orthographic patterns* allow for the representation of sound combinations and irregular sounds where simple one-to-one letter correspondences will not suffice (Apel, 2011). In the current dissertation, alphabet knowledge, GPK and orthographic knowledge will be referred to as letter knowledge.

Literature on the development of letter knowledge, as well as appropriate assessment and intervention tasks is diverse, most likely due to the range of definitions, terms or components of the different skills involved. In terms of development, there appears to be consensus that the initial process involves connecting the most salient letters with sounds therefore establishing early connections between sound and print (Ehri, 1995). For example, while learning to write their name, children isolate familiar letters and recognize them in other text. They begin to acknowledge that despite, size, font, colour or context English graphemes have a consistent relationship with a corresponding sound. Once connections are made between all printed phonemes and the associated letters and letter combinations, readers can identify thousands of words uniquely represented in their mental lexicon, the dictionary of letter combinations (Ehri, 1995). The mental lexicon stores learned words, called sight words, for future efficient retrieval but grapheme phoneme connections are also made accessible for decoding new and

unfamiliar words (Ehri, 1995). These processes are discussed in more detail in section 2.1.2 on reading below.

Children become aware of features that distinguish one sound from another and, in early school, they are explicitly taught to listen for similarities in beginning and ending sounds and the use of these sounds to manipulate language such as rhyme or alliteration (Otto, 2010). The use of these skills in identifying spelling patterns and more broadly in literacy development is explained in the section 2.1.1.1 on phonological awareness above.

School entry is also the stage when most children acquire knowledge of phonemes in written form. They become aware that combinations of letters can have meaning. Otto (2010, p. 239) provides an applicable example, explaining that when a particular kindergarten student was asked to write a story, he said “I can write letters, but they won’t spell anything” and proceeded to write the letters A to K. When asked to tell his story he produced “Once the bear jumped over the log, then, he climbed a tree and fell down the tree, and picked an apple from the tree and ate it. The end”. Despite not writing correctly, he demonstrated successful storytelling and awareness that his letters were intended to have meaning. Similarly, when reading, children may indicate that they do not understand a word, acknowledging that it has meaning but not recognizing the combination of graphemes.

One study, on factors that contribute to the school readiness of children, reports that the most influential skills were letter knowledge and phoneme awareness (Prior, Bavin, & Ong, 2011). Another author reports that the reading skills of children in the first year at school are significantly correlated with their ability to segment the sounds in words as they are decoding the text, requiring a combination

of letter knowledge and phonological awareness (Bentin, 1992). The poorest readers often initially had difficulty identifying phonemic segments in speech leading to poor representation of the corresponding graphemes (Blachman et al., 1999) hence the importance of letter knowledge in the development of reading as described below.

2.1.2 Reading.

The development and processes of reading and spelling are tightly interconnected (Ehri, 1997). They are also highly dependent on the pre-literacy skills discussed above (Ehri, 2011). The following sections set out theories of reading and spelling development, discussing stages and skills pertinent to single word reading.

It has been reported that learning to read involves, firstly, learning to decipher the print and, secondly, to comprehend the meaning of the print (Hoover & Gough, 1990). Both skills indicate the need for a more specialised language system than when learning to speak because, while words in speech appear continuous, deciphering print requires learning of the phonemic units and the ability to separate them within words (Ehri, 2011). Learning to read requires specific experience deciphering print and specific sources of knowledge (Nittrouer & Burton, 2005). Ehri (2011) discusses a number of knowledge sources, including the two most relevant to early single word reading; knowledge of the graphophonic system (referring to the relationship between the graphemes and the phonemes) and storage for learned words known as sight words. These sources both enable the deciphering skills needed for decoding unfamiliar words and for recalling learned words from memory. Readers have a number of ways in which they can decipher words which involve

four processing methods relevant to single word reading as summarised from Ehri (2001, 1995).

2.1.2.1 Decoding by assembling letters into a blend of sounds.

The first processing method involves decoding by assembling letters into a blend of sounds and would be appropriate for words that are unfamiliar to the child such as new words or non-words. The child will still need an awareness of phonemes that match the relevant graphemes for not only single letters but also digraphs (e.g. sh, ee). This strategy is slow and dependant on the absence of irregular pronunciations, common in English.

2.1.2.2 Advanced decoding by pronouncing and blending familiar spelling patterns.

A more advanced decoding of pronouncing and blending familiar spelling patterns is a second method where a child with more experience with written text may be familiar with chunks of letters and use these familiar cues to decode words. They appear to recognize combinations of graphophonic units without the need to segment individually. These chunks include word endings (e.g. -uck, -ash, -est) and affixes (e.g. dis-, -ed).

2.1.2.3 Retrieving sight words from memory.

Words that do not conform to the conventional English spelling system require different processing methods. These words need to be learned and stored for later recall and are called sight words. All words can become sight words if practiced to the point of efficient automatic retrieval (Ehri, 2005). Sight word vocabulary allows for efficient retrieval for reading the learned words as whole units. More

mature readers are able to recognize sight words and read the text automatically and do not need to invest effort into decoding.

2.1.2.4 Analogizing to words already known by sight.

The final method of processing single words requires both sight words and decoding skills. When reading a new word, children may recognize some chunks as similar to a stored sight word. They will then be required to adjust the pronunciation of the word by adding to the familiar sounds and decoding the remaining unfamiliar segments.

For the purpose of the current study this summary of suggested single word reading processing methodology provides emphasis on the following points. Firstly, it further highlights how phonological awareness and grapheme phoneme knowledge are involved in the reading process. Letters are the distinctive cues that a child learns for distinguishing between one written word and another (Ehri, 2011). Knowledge of written letters and the ability to segment phonemes in speech are shown to be related skills. For example, adults who had never learned alphabetic orthography also found it difficult to identify phonemes in speech (Mann, 1986). These skills, knowledge of letter shapes, knowledge that they typically symbolize phonemes in words and knowledge of phoneme segmentation, were found to be the strongest predictors of single word reading ability in early literature (Share, Jorm, Maclean, & Matthews, 1984) and continue to be today (Ehri, 2011).

Secondly, it is an introduction to the complexity of reading assessment and intervention. Considerations when forming and interpreting an assessment include the use of real words or non-words, irregular or conventional spelling, error patterns

displaying the use of single sound or sound combination decoding or use of sight words.

Finally, acquiring the ability to decode new words and to store and recall learned sight words is invaluable for ongoing reading success. These skills are needed for longer text such as book reading, literacy activities and written instruction in the classroom (Adams, 1990; Ehri, 1997; Morrow, 2012). Acquiring the skill of decoding in the first year or two of school is essential; failure to do so will significantly limit subsequent reading achievement (Gough & Juel, 1991).

2.1.3 Spelling.

The term spelling, as a noun, refers to the prescribed sequence of a word that is written or, as a verb, refers to the process of writing the word (Ehri, 2011). In either sense, the skills required are very similar to those described for reading, though often with greater cognitive demand. Importantly, both reading and spelling develop in much the same way (Morrow, 2012). A task designed to track eye movements while reading text that included misspelt words revealed that spelling processing is also occurring during a reading task (McConkie & Zola, 1981). This suggests that both pre-literacy skills and learned word storage are also required for spelling. Ehri (2011) reports on an earlier study, where children in grade two were taught to read eight non-words. Each word had two alternative plausible spellings, for example ‘ghirp’ versus ‘gurp’. Two groups of children were taught to read one alternative list each. Both groups were then asked to spell the list of words, which they did so with a 69% match to the word that they were originally taught. This provides evidence that a substantial interplay between spelling and reading skills occurred during this task.

As in letter-by-letter decoding during reading, letter knowledge and phonological awareness are heavily relied upon during spelling of new and unfamiliar words. Children have been shown to use their knowledge of the alphabetic names when inventing spelling words where letter names are similar to the sounds which they represent (Treiman, 1993). The subtle difference between this reading and spelling processing lies in the grapheme-phoneme correspondence, or in the case of spelling, phoneme to grapheme correspondence (Ehri, 2011). Despite the presence of only 26 letters in the English alphabet, these translate to approximately 40 distinctive sounds which can in turn be represented by approximately 70 letters and letter combinations (Cronnell, 1978). When reading, children are presented with a combination of letters from a large pool of stimuli. They are then required to allocate a sound from a smaller pool. However, spelling requires drawing from a smaller pool of phonemes and choosing the relevant symbol from a much larger set of possible responses (Cronnell, 1978). Spelling new words, then, demands more processing resources than reading new words. Cronnell (1978) provides an example explaining that when reading, *d* and *dd* are both pronounced /d/ though when spelling, the child will need to acknowledge that /d/ can be spelt one of two ways and must choose the most appropriate for the linguistic context. This task is made more difficult in English words that do not conform to the learned spelling conventions and phoneme to grapheme correspondences. Rules of English spelling apply constraints to the positioning of letters, for example, ‘tch’ can never occur at the initial position of a word. These are known as orthotactic rules and children build upon their orthographic knowledge when applying individual letter to sound correspondences (Apel, 2011). Often, however, English spelling does not conform to a learned orthotactic rule.

For the words with non-conventional spelling and for frequently used words awaiting efficient retrieval, there is a lexical store available. This store for spelling is related to the store for sight words in reading and contains information about words gained from reading and previous spelling experience (Ehri, 2011). Storing learned words is necessary in English because of the multiple possible spellings. Ehri (2011) provides an example where the word *telephone* (spelled conventionally) might be spelled as ‘telephone’, ‘tellafown’ or ‘telufown’. The author summarises an extensive list of studies that observe the connections between skills and storage needed for reading and those needed for spelling and concludes that when beginners read single words, the word specific information is retained and also used to spell words. Ehri (2011) provides this as evidence that reading intervention, which focuses on letter knowledge, pre-literacy skills and learned vocabulary, will also benefit the child’s spelling.

This brief discussion on reading and spelling focuses only on single word decoding and the related preceding skills. This is only the beginning of a vast amount of literacy development expected in the first years of school due to explicit teaching (Bentin, 1992). In a longitudinal study of 54 children from a school largely attended by a low socioeconomic, ethnic minority population, fourth grade children with poor reading were found to have had limited phonological awareness at school entry (Juel, 1988). This initial limited knowledge of word structure led to a poor understanding of decoding and letter sound correspondences which, in turn, appeared to result in ongoing reduced achievement (Blachman et al., 1999). These results are supported by a more recent study which provided evidence for a causal relationship between directly taught letter-sound knowledge and phoneme awareness with word level

literacy skills (Hulme et al., 2011). These examples highlight the importance of explicit teaching of pre-literacy skills and consolidation of early literacy skills for ongoing academic success.

2.1.4 Language and literacy in Indigenous Australian populations.

In Sydney, New South Wales, Indigenous Australian families and educators have been involved in discussion about how to ensure positive transition to school for their children (Dockett, Mason, & Perry, 2006). A key motive for these discussions was observation of the inequality between the literacy experiences of Indigenous children prior to starting school and that of their non-Indigenous peers. Given the established importance of specific pre-school literacy experiences (Morrow, 2012), these Indigenous children were often entering school with less developed pre-literacy skills than their peers. Upon entering school, Indigenous students are exposed, often for the first time, to the skills required for successful literacy development, such as phonological awareness. Difference in the value placed on particular competencies was also observed. The participants in the discussions reported low expectations of teachers for their Indigenous students. This was seen to instil a negative self-perception in the children, who were good communicators but not achieving the same reading or spelling levels as their peers (Dockett et al., 2006). The combined effect of differing pre-school literacy experiences and attitudes to learning appeared to place Indigenous students at an immediate disadvantage for commensurate literacy performance. While it is recognised that the attitudes of Indigenous parents towards school vary, it was reported that all agreed on the need for a positive start at school to succeed (Dockett et al., 2006). This section outlines the existing data on language and literacy outcomes for Indigenous children; existing

methods to combat the reduced outcomes are summarised and issues specific to Indigenous children in their first years at school are discussed.

2.1.4.1 Language and literacy outcomes.

Indigenous Australian children are three times more likely than their peers to have literacy problems in early school years (Hewer & Whyatt, 2006). They are also far less likely to reach literacy levels expected for their age than their non-Indigenous peers. A recent publication by the Australian Research Alliance for Children and Youth (ARACY) documented that 22% of Indigenous children in their first year of school presented with developmental vulnerability in terms of language and cognition. In contrast, less than 7% of the total population showed vulnerability in this area (ARACY, 2013). A longitudinal study provided analysis of the language competence of a large cohort of Indigenous Australian school children (McLeod, Verdon, & Kneebone, 2014). They also reported an initial discrepancy in early school which led to significant disadvantages for later schooling, impacting on school completion and future employment (McLeod et al., 2014). A Department of Employment, Education and Training report in the Northern Territory indicated that in year three, five and seven, 40%, 38% and 37% of Indigenous Australian children, respectively, achieved the national reading benchmark and 85%, 91% and 90% of non-Indigenous children reached the benchmark in the same school years (Northern Territory Department of Employment Education and Training, 2006/2007). Section 2.1.4.3 on cultural considerations, reviews literature on the appropriateness of the interpretation of these national surveys and standardised assessment given their generalist nature that may not allow for adequate detection of Indigenous children's language learning experience and competence (McLeod et al., 2014; Pearce & C.

Williams, 2013). There are, however, very few other options in the research that provide a more objective comparison.

One study concluded that the spelling and reading scores of Indigenous Australian school children presented as, on average, six years behind the standardised scores for their age (Yonovitz & Yonovitz, 2000). This gap is not easily closed and the effects may continue beyond school years into their academic, social and professional lives.

A study specific to urban Western Australia found significantly poorer early literacy outcomes in Indigenous school children when compared to Australian norms and a non-Indigenous control group from the same schools (C. Williams & Masterson, 2010). Contrary to the discussion so far, their suggested reason for the discrepancy in scores goes beyond pre-school literacy experiences. In their discussion they identify otitis media (OM) as one of the potential contributing factors for poor educational performance.

Other researchers have also suggested that high rates of OM and hearing loss (HL) in Indigenous Australian populations are possible contributors to poor literacy outcomes. A model of cumulative risk has been used to demonstrate that HL is one of a number of factors that contribute to poor educational outcomes (Stenton, 2007). Other factors include the level of parental education, reduced exposure to Standard Australian English prior to school entry (Western Australian Department of Education, 2002), supportiveness of the child's home environment (Roberts, 2002) and reduced access to quality education and assistance including enrolment in a quality day-care centre (Stenton, 2007). OM and HL, as potential players in the language and literacy disadvantage of Indigenous Australian children, are the focus

of the current study and will be discussed in much greater detail throughout. A report on *Intervention Strategies for Aboriginal Children with Conductive Hearing Loss,* produced by the Western Australian Department of Education (2002), provides a summary of a small amount of early literature highlighting the risk of OM contributing to speech, language and literacy problems. In a study reporting the prevalence of middle ear disease and hearing loss in Indigenous Australian school children in New South Wales, the authors claim that high rates of the disease are one of the greatest contributors to educational problems in Indigenous Australian populations and must be addressed to avoid ongoing problems (Thorne, 2003/4). Despite these strong premises, literature clearly indicating a causality or significant relationship between OM and HL in school years and educational outcomes is scarce.

2.1.4.2 Addressing literacy deficits.

It has been established that literacy outcomes in Indigenous Australian children are poor, the consequences of which are far reaching. It has been suggested that high rates of OM can contribute to poor academic performance. Addressing prevalence of OM would, therefore, be an appropriate starting point for decreasing poor academic performance. Vaccines and antibiotics have been shown to decrease the prevalence of OM as well as resolve episodes of the disease in Indigenous Australian children (Couzos, Lea, Mueller, Murray, & Culbong, 2003; Leach, Morris, & Mathews, 2008; Mackenzie, Carapetis, Leach, & Morris, 2009). However, implementation of these methods on a large scale has been difficult due to lack of initial diagnosis and failure to monitor prescription progress, as well as poor compliance with the treatment regime. The Telethon Speech and Hearing Centre in Western Australia fund a number of screening buses that travel to schools with

Indigenous enrolment (Telethon Speech and Hearing, 2013). The trained staff provide hearing screening as well as raise caregiver awareness and refer affected children to appropriate medical practitioners. Preliminary analysis of the outcomes would suggest that this program is contributing to a decline in OM rates in Western Australian Indigenous children (Timms, Grauaug, & C. Williams, 2012). This program, however, does not address literacy outcomes of the children identified with OM and HL.

Poor literacy skills in children from low-income, ethnic minority communities have been well established and over the past decade numerous publications have reported on the success, or otherwise, of phonological awareness and early literacy skill intervention (Blachman et al., 1994; Blachman et al., 1999; Brand, 2006; Nancollis, Lawrie, & Dodd, 2005). Implementing the knowledge that phoneme awareness has a positive impact on reading and spelling, researchers in New York trained kindergarten teachers working in low socioeconomic (SES) suburbs in targeted phonological awareness instruction. The 86 children receiving the 11 week, 41 session program did not differ from the 75 demographically comparable control children on phonemic segmentation, letter knowledge and some early reading and spelling measures before the program but showed significantly higher scores on these measures post-intervention (Blachman et al., 1994). Some years later, the same author led a larger and longer intervention in a similar population (Blachman et al., 1999). Following a two year teacher implemented intervention specifically targeting phonological awareness and word recognition skills, children who received the treatment (n=66) significantly outperformed the children who received regular classroom reading instruction (n=62) on measures of the targeted outcome

(Blachman et al., 1999). The authors were not able to isolate what specific sections of the treatment over the two years contributed to the improvement nor do they report on later reading success.

A longitudinal study in the UK set out to report on the later outcomes of children following a phonological awareness intervention program (Nancollis et al., 2005). Two groups of children aged between four and five years, from low socioeconomic status (SES) areas as defined by the UK local deprivation index, were recruited; 196 in 2000 as a control group and 186 in 2001 as the experimental group. A speech pathologist provided the experimental group with weekly phonological awareness targeted sessions for a nine week period. Two years following the intervention the experimental group had maintained enhanced rhyme awareness and non-word spelling skills. Their phoneme segmentations skills were reduced compared to the control group and no difference was noted in reading or spelling measures. The authors concluded that immediately following the intervention, phonological awareness skills were enhanced, but a program targeting syllable and rhyme awareness alone does not result in later literacy improvement (Nancollis et al., 2005).

These interventions differ greatly in presentation, group size, age or literacy level and the length and intensity of the intervention. Further, assessors and trainers have been teachers or speech pathologists with varying levels of training and experience. Each of these differences are important considerations when reviewing and implementing an intervention. Results of international studies cannot, therefore, be applied directly to discussions of Indigenous Australian populations but can be used as a guide to understand the phonological awareness programs available to

these populations and the limited rigorous evaluation of efficacy. In the following section, a number of these programs will be presented. The first discussion includes treatments implemented in Indigenous Australian communities for young and early school children. The second discussion describes the very limited information available about literacy interventions with Indigenous Australian children with a specific focus on middle ear disease and hearing impairment.

Literacy programs in Indigenous Australian communities.

Researchers and educators have focussed on addressing poor literacy outcomes in Indigenous Australian children for over a decade. In 2002, a literacy program was devised for implementation by Child Health Nurses (CHN) working in regional Western Australia (Hewer & Whyatt, 2006). At both non-Indigenous and Indigenous children's 7-9 month check-up, the CHN provided the caregivers with a book, designed to be appropriate for Indigenous Australian children, and information about the importance of reading to their child. Analyses of the 704 health records available and interviews with eight of the CHNs were used to determine the effectiveness of the program. The majority of CHN reports from the interview data were positive about the program and reported that many parents were previously unaware of the benefits of reading to young children. However, CHNs often did not instruct the parents on the appropriate frequency of reading, the posture and style of reading and demonstrated inconsistency in the amount of information about literacy provided when delivering the book. Further, CHNs were not instructed to follow-up on the book reading in later health check-up periods. Only 21% of health records noted delivery of the book packages with attendance rates of Indigenous clients significantly lower than the non-Indigenous families. Hewer and Whyatt (2006)

report on the potential of utilising CHNs and local community health initiatives to encourage early literacy despite the challenges faced in a regional, Indigenous community. However, consistent delivery of the program and evaluation of the effectiveness requires continued development.

In 2005 The National Accelerated Literacy Program (NALP) was introduced into Northern Territory Department of Employment, Education and Training schools and was later introduced to Western Australia, Queensland and South Australia. Although not exclusively aimed at Indigenous Australian students, the program was acknowledged cultural difference in learning styles and experiences of the school system. The intervention, designed to increase enjoyment of literacy, incorporated literacy teaching strategies into the daily teaching routine (Cowey, 2005). Teachers were provided with resources to implement a focused literacy teaching sequence; Literate orientation (contextualising literacy), Transformations (teaching literacy strategies), Spelling (analysing words within the system of English spelling) and Writing (practicing implementation of newly learned techniques). Although not yet formally evaluated, cohort tracking of The National Assessment Program – Literacy and Numeracy (NAPLAN) reading scores from 2008 to 2011 revealed significant improvements in participating schools (Accelerating Literacy Learning, n.d.). An internal audit of the program also reported an increase in confidences and effectiveness of the teachers trained in Accelerated Literacy Learning.

More recently, researchers have sought the assistance of technology to contribute to educational improvement. ABRACADABRA (ABRA) is a web-based tool targeting reading, letter knowledge and phonological awareness and was implemented in primary schools of Australia's Northern Territory in 2010

(Wolgemuth et al., 2013). Classroom teachers from kindergarten or year one or two at six schools were trained to deliver lessons using the ABRA computer program. A multi-site randomised control trial was used to evaluate the effectiveness of the program and students' early literacy skills were measured using the Group Reading Assessment and Diagnostic Evaluation (GRADE) and the Performance Indicators in Primary School Baseline Assessment (PIPS-BLA). The post-test phonological awareness subscale showed significantly higher scores in students who had received ABRA when compared to their peers provided with normal classroom activities. The reading scores of the two groups did not show a significant difference. A high percentage of students in this study were identified as Indigenous Australian, however, their non-Indigenous peers were also included in the training. An analysis of between subjects co-variance revealed a significantly greater improvement in Indigenous students receiving ABRA than their non-Indigenous peers who received ABRA and their Indigenous peers who received normal classroom activities. Despite a rigorous design and positive potential shown for use of ABRA as early literacy training in Indigenous primary school children, the authors identified a number of barriers. These included high rates of attrition throughout the study, limited involvement of more rural schools because of computer and internet access and difficulty training and retaining staff for the program (Wolgemuth et al., 2013).

Authors of these interventions faced difficulties assessing the outcomes because they recognised the absence of a published spelling, reading or pre literacy assessment developed specifically for Indigenous Australian students with appropriate norms. This was particularly true for students who are learning English as a second or third language as in many of the remote Indigenous communities

(Yonovitz & Yonovitz, 2000). Godfrey and Galloway (2004), confronted with difficulties ascertaining the reading skills of Indigenous Australian Children, reviewed the assessments available in this area. The authors reported a wide range of reasons as to why most assessments were not suitable, including length and complexity of administration, language and vocabulary differences and inadequacy to assess children younger than year three.

Literacy programs for Indigenous Australian children with poor ear health.

There are very few intervention plans or programs that have been designed with a focus on the population of the current study. The few published studies report on broad strategies without evaluation. The most relevant intervention reported in recent literature was conducted within rural and remote Indigenous Australian communities in the Northern Territory. This program, labelled PA-EFL: A Phonological Awareness Program For Indigenous English as a Foreign Language (EFL) Students With Hearing Disabilities, was funded by the Commonwealth Department of Education following a successful pilot in 1996-1997 (Yonovitz & Yonovitz, 2000). The authors devised a holistic approach by first implementing in-service education for education staff. They also provided FM sound field amplification systems, hearing aids, ear examinations and hearing testing before applying the intervention. The program was designed to target phonological awareness in older students and was presented by teachers in a game format to 1032 Indigenous Australian students from six schools, predominantly secondary students. Throughout the school year, the intervention targeted pre-phonics skills, alphabet, segmentation, short vowels, long vowels and diphthongs, multisyllabic sequences and consonant clusters. Pre and post testing of phonological awareness, spelling and

reading was conducted in groups using the Waddington Diagnostic Reading and Spelling Tests with the outcomes evaluated on a whole school basis. Only data from students who attended at least 75% of school days and were present on both testing occasions were reported. All six schools showed significant improvement on the measure of phonological awareness, four schools showed overall significant improvement in reading and five schools improved significantly on spelling outcomes. The authors reported the PA-EFL program as a success. They concluded that cultural differences, middle ear disease, English being first introduced at schools and poor living conditions contribute to reduced literacy rates but suggest that a similar intervention to the one reported would increase the confidence and success of these diverse learners (Yonovitz & Yonovitz, 2000).

The Western Australian Department of Education adopted a different approach and designed a classroom resource to provide teachers with information on OM and its effect on literacy. *Do You Hear What I Hear?* (Department of Education, 2002) provided detailed strategies to optimise the classroom environment for students with HL such as reducing background noise, pre-planned seating arrangements, maximised hearing opportunities by modifying communication behaviour, allowing for small group work, making use of amplification, repeating instructions and implementing a buddy system between peers. The authors also provided suggestions for activities to promote language learning which were broadly summarised into four categories; focus on oral language as the foundation of literacy, focus on the sound system, linking sounds to written code and implementing a peer tutor program. Another Department of Education initiative, *Time for Talk* (Department of Education, 1998), although not specifically designed for students

with OM, also documents culturally sensitive strategies to facilitate oral language development in the classroom. Both programs were implemented as a widespread roll out where every school in Western Australia was allocated two copies of each kit, one for the library and one for a classroom teacher who could make best use of the resource. Since the implementation of *Do You Hear What I Hear?* and *Time for Talk* in 2002 and 1998 respectively, there have been no evaluations of the success within the targeted literacy goals or of the proportion of implementation. Further, there are no publications documenting feedback from the programs nor any plans to update and continue the program in schools. Despite both excellent resources being readily available in most primary schools, however, individual students with literacy and cultural needs are still being overlooked (Centre for Community Child Health, 2009; Thorne, 2003/4).

The interventions outlined, for both Indigenous Australian children as a wider community and specifically for Indigenous children with OM, have attempted to contribute to a growing body of knowledge and improved literacy outcomes. They also aim to raise awareness of the challenges faced in a culturally diverse classroom with a wide variety of language and pre-literacy experiences. Despite the limited number of evaluations, results do provide evidence that a phonological awareness intervention is likely to assist in the improvement of early literacy skills in the target population (Freeman, & Bochner, 2008; Partington & Galloway, 2005). However, an intervention specifically designed to combat the literacy deficits in Indigenous Australian children with OM is required. Theory indicates that these programs will be most effective in early school years if centred on the development of phonological awareness skills (Walker, 2001).

2.1.4.3 Cultural considerations.

In countries where Indigenous populations represent a minority, these children typically experience poor educational outcomes (Gould, 2008). It has been argued that cultural marginalisation is also a key factor in poor academic performance of Indigenous Australian children (Mellor & Corrigan, 2004). Culture is a system of shared beliefs which influence a person's social and cognitive styles (Valsiner & Lawrence, 1997), both of which play a significant role in the school environment. Although it is understood that there is no single Indigenous culture in Australia, there are a number of cultural factors to consider when developing an assessment or intervention or establishing a classroom structure for Indigenous Australian children.

Prior to school.

Indigenous Australian children have a different pre-school upbringing from their non-Indigenous peers. For example, Indigenous Australian culture encourages independence and assertiveness in children. This behaviour may be seen as inappropriate in a classroom and the children may become confused at the differentiation of cultural expectations and classroom standards (Mellor & Corrigan, 2004). Indigenous Australian upbringing provides children with an extensive knowledge base. Upon entering school, increased value is placed on knowledge acquired from pre-school upbringing in western society. This may cause the knowledge base gained as a child raised Indigenous communities to be overlooked (Mellor & Corrigan, 2004). In their early home environment, Indigenous Australian children are provided with this knowledge in oral form (Simpson, 2005). As Indigenous Australian history and language is predominantly unwritten, it has not

been an expectation that children understand written forms to be connected with their culture. However, classroom success, particularly with pre-literacy skills, depends heavily on an awareness of written language.

Learning style.

The learning style of Indigenous Australian children differs from that of their non-Indigenous peers. Indigenous Australian school children suffer the consequences of a culturally inappropriate teaching and learning model (Simpson, 2005). While Indigenous students are more likely to learn in cooperation with their peers, non-Indigenous students are often more competitive learners (Bortoli & Cresswell, 2004).Tasks can be modified in a number of ways to be appropriate for the learning styles of Indigenous Australian children. For example, it has been suggested that play based tasks will encourage the most effective participation (Gould, 2008). This reduces the impact of 'shame', a concept which describes the fact that Indigenous Australian children prefer not to draw attention to themselves and are reluctant to be separated from their peers because they value group membership above individual achievement (Gould, 2008). Play based tasks may reduce shame and increase the likelihood that Indigenous Australian children will have success. A second approach is to reduce the cultural bias of an assessment task. This could mean using non-words so as to draw on metalinguistic knowledge rather than what could possibly be unfamiliar vocabulary (Gould, 2008). Conversation or indirect questions, rather than direct questions, are encouraged during an assessment to reduce the potential for bias when working with Indigenous Australian children (Pearce & C. Williams, 2013).

Dialectal differences.

A third cultural factor possibly contributing to poor educational outcomes in Indigenous Australian children is the difference between the language variety used pre-school and outside school and Standard Australian English expected in school (Simpson, 2005). The vast majority of over 100 languages spoken by Indigenous people in Western Australian history are now extinct (Zubrick, et al., 2004). Currently, most Indigenous Australians speak a combination of Standard Australian English, their traditional languages and new local variations known as Aboriginal English (Simpson, 2005). Research that documents the nature of Indigenous children's language environments is limited, particularly as it relates to their language and literacy competence (McLeod et al., 2014).

Almost 97% of Indigenous Australian children under 14 years of age who live in metropolitan Australia speak only English, which includes varying degrees of Aboriginal English. Only 1% of these children can speak an Indigenous Australian language (Australian Bureau of Statistics, 2010). Characteristics of non-standard English dialects have been noted to replicate some features of language impairment (Pearce, C. Williams, & Steed, 2014; Pearson, 2004). This becomes an issue at school entry if teachers consider Aboriginal English as inferior or incorrect when compared to Standard Australian English (Dockett et al., 2006). Aboriginal English differs from Standard Australian English in syntax, lexicon and phonology (Butcher, 2008; Malcolm et al., 1999). Aboriginal English is seen as a continuum where the degree of difference from Standard Australian English ranges from a light variety (which is close to Standard Australian English) to heavy variety (which is closer to a traditional language or Creole) (Butcher, 2008). Although it is typical practice for

Australian classrooms to be conducted in Standard Australian English, research indicates that literacy and language assessments of children who identify as Indigenous Australian are less reliable when conducted according to western culture and in Standard Australian English (Gould, 2008; Pearce & C. Williams, 2013). A small scale study conducted with 19 Indigenous Australian primary school children in Queensland compared the result of a standardised language test and a non-verbal intelligence test (Pearce & C. Williams, 2013). Despite recording average non-verbal intelligence scores, the students performed poorly on the standardised measures of language. The authors attributed this discrepancy to dialectal differences concluding that the characteristics of Aboriginal English may disadvantage children when an assessment is based on Standard Australian English (Pearce & C. Williams, 2013). Upon adjusting the standard scores to allow for dialectal differences, Pearce and Williams (2013) reported more accurate alignment with both teacher ratings of ability and the intelligence scores. Gould (2008) suggests that children should not be penalised for differences in use of sounds and grammatical structures. Such practices may result in Indigenous students appearing to have a less adequate knowledge base than is actually the case. Language and literacy assessments should, therefore, cater for possible language differences in Indigenous Australian children. The cultural sensitivity and acknowledgement of dialectal differences should also continue into the implementation of language and literacy intervention programs (Gould, 2008).

Literacy assessment.

There is an absence of literacy assessments specifically designed for Indigenous Australian children. Unlike other ethnic minority groups such as the Maori in New Zealand or the Spanish people in the US, there is no standardised

literacy assessment with norms for Indigenous Australia children. When documenting the status of educational assessment for Indigenous Australian children, Gould (2008) concludes that a culturally appropriate assessment is required if literacy results are to be a true representation of the participant skills and not a reflection of cultural differences.

Much of the national data on Indigenous Australian literacy outcomes is obtained from large scale assessments or reports. The National Assessment Program – Literacy and Numeracy (NAPLAN) is an assessment that has been administered annually to students in Years three, five, seven and nine in all Australian schools since 2008. NAPLAN provides information about how individual students and schools are addressing the school curriculum (Australian Curriculum Assessment and Reporting Authority, 2011). The Australian Research Alliance for Children and Youth (ARACY) have also published a 'report card' on the wellbeing of young Australians that provides a comparison of the literacy outcomes of Indigenous and non-Indigenous children (ARACY, 2013). These resources, along with the National Report on Schooling in Australia published by the Ministerial Council on Education, Employment, Training and Youth Affairs (MCEETYA, 2006), provide benchmarks which articulate a minimum acceptable standard for literacy in each year level (Curriculum Corporation, 2000). These assessments, reports and benchmarks are controversial for use within the context of Indigenous education as they focus on English language and learning. They rarely take into account Indigenous language use, Aboriginal English dialectal use or the different cultural learning. NAPLAN, in particular, is a generalised diagnostic tool considered inappropriate for use with Indigenous children, particularly those with Standard Australian English (SAE) as a

second language or dialect. NAPLAN provides comparison data normed from results of children with predominantly SAE. In addition, the cultural, grammatical and vocabulary knowledge required for NAPLAN may mean reduced reading and spelling scores for Indigenous students that do not reflect their true literacy ability (Wigglesworth, Jane & Loakes, 2011). These resources are therefore unlikely to provide an adequate description of the richness of the language competence demonstrated by Indigenous Australian children (McLeod et al., 2014).

Following a comprehensive review of Indigenous education literature, the Ministerial Council on Education, Employment, Training and Youth Affairs (MCEETYA) recognised the need for the Australian education system to be socially just. To do this, they suggested teachers and non-Indigenous students should develop a knowledge and appreciation of Indigenous Australian culture (MCEETYA, 1999). If Indigenous Australian students are to begin performing at the same academic level as their peers, it is critical that schools acknowledge and integrate Indigenous Australian childrearing, learning styles and language in their education (Malin, 2003). The success of assessment and intervention conducted outside the classroom can also be maximised with a culturally sensitive delivery approach.

2.2 Otitis Media

2.2.1 Otitis media in the literature.

OM is referred to in the literature with greatly varied specificity. Studies may discuss OM while referring to a stage or condition of the disease. Equally, literature reporting with broader terms such as *middle ear disease* or *ear health problems* may also be including cases of OM. Bluestone (1998) developed a flow chart to demonstrate the pathogenesis of OM which highlights the stages of the disease with

the relevant names. As seen in Figure 1, acute OM can resolve quickly or result in the far more serious chronic suppurative OM. The former is defined as fluid in the middle ear with signs of bacterial infection (Dickson, 2014) while the latter is a common recurrence or persistence of perforation and discharge (Jensen, 2011). Both have the potential to cause mild to moderate conductive HL as outlined in section 2.3 on hearing loss. An understanding of the development of the disease is valuable when explaining the large variation of use of the terms in the literature.

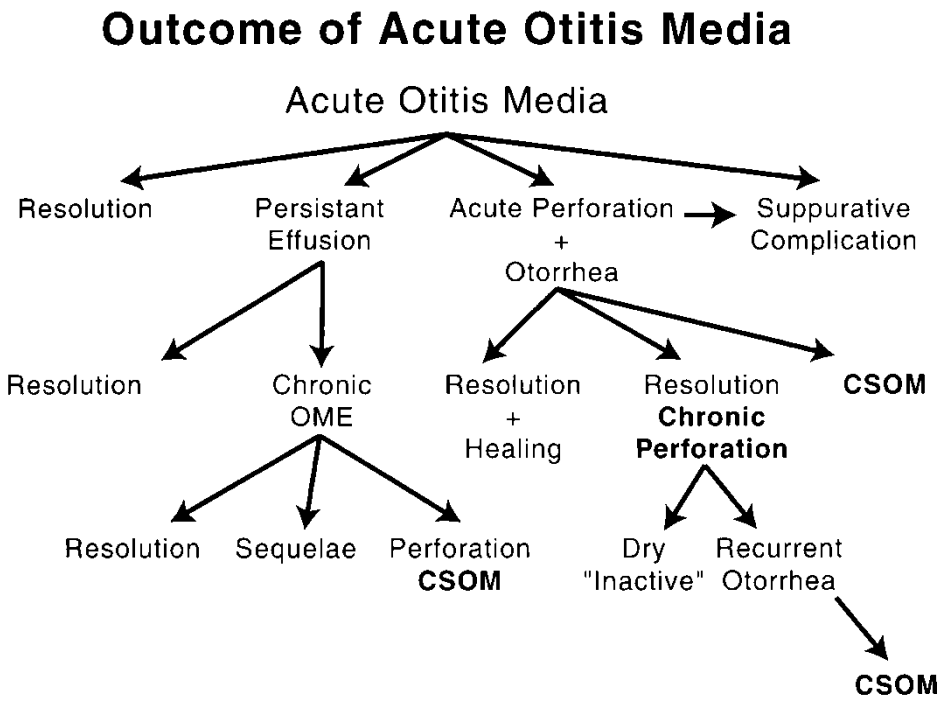

Figure 1. Possible outcomes of acute otitis media. Reprinted from Bluestone (1998, p. 211) with permission from Elsevier (Appendix U).

Caution is required when reading comparative discussions of prevalence, risk factors and potential impact of OM so that realistic conclusions can be made. For example, a longitudinal study used parent reports from a mailed questionnaire and interviews (Yiengprugsawan, Hogan, & Strazdins, 2013). Authors indicated that their figures were likely to indicate acute OM, CSOM, OME and uncommon ear diseases, however, they did not collect information on severity or duration (Yiengprugsawan

et al., 2013). Comparing this with a far stricter criteria or specific participant inclusion criteria makes prevalence data ambiguous (Bowd, 2004). Widely accepted diagnostic criteria are needed to contribute to more consistent management of OM (Gunasekera, Morris, McIntyre, & Craig, 2009).

2.2.2 Risk factors.

While some research suggests a genetic component (Bluestone, 2004; Casselbrant et al., 2004), there is consensus on a number of lifestyle factors that increase the likelihood of developing OM or suffering from recurring OM. OM is often considered a disease of poverty with rates of the disease comparatively rare in the general population of developed countries and non-Indigenous Australian children (Lyons & Janca, 2012). The World Health Organization report from the Prevention of Hearing Impairment from Chronic Otitis Media Workshop in London in 1996 states that overcrowded households, poor nutrition and poor hygiene levels are among a large list of risk factors for the development of OM (World Health Organization, 2000). Poverty was also reported a major risk factor for developing the disease and many of the subsequent conditions associated with lower social status are more common in participants with OM (World Health Organization, 2000; Zhang et al., 2014). Neither reported figures on these conditions nor details on the correlation with OM are provided in this publication, however, other studies provide some evidence for the relationship between risk of developing OM and other lifestyle factors or living conditions. For example, poor quality or accessibility of health care services may result in inadequate management of the disease and therefore longer or more frequent episodes. This is discussed in a Brazilian study (see 2.2.3) where the authors commented on possible treatment more likely to be implemented in higher

rather than lower socioeconomic groups (Castagno & Lavinsky, 2002). Reducing exposure to cigarette smoke is reported also to be a primary prevention strategy (Alpert, Behm, Connolly, & Kabir, 2011; Coates, 2002; Zhang et al., 2014). The absence of breastfeeding or the use of pacifiers as risk factors have less evidence but have been shown to play a role in increased risk of OM (Bowd, 2004).

A study conducted in regional Western Australia addressed a number of these risk factors within an Indigenous Australian cohort of children aged under two years (Jacoby, 2011). Samples of bacterial carriage were collected throughout these first two years of life. Each of the three bacterial pathogens most strongly associated with OM were recorded. Families of the participants were visited regularly and interviewed for information on breastfeeding, tobacco smoke exposure, size of the house (number of rooms), and number of children and adults living in each house. The latter two factors are of particular importance as overcrowding within homes of Indigenous Australian families has been reported (Jacoby, 2011). Jacoby (2011) reported that a third of the Indigenous Australian participants whose families were interviewed lived with three or more children, and a third also lived in homes with less than three rooms. In contrast, the families of the non-Indigenous participants revealed more than half of the children were the only child in their home and less than 10% lived in houses with less than four rooms. Of the information gleaned, all factors appeared to play some role in an increased risk of OM. Risk of carriage for some or all of the OM related bacteria declined with increasing number of rooms and increased significantly with greater number of children in a household. The effect of tobacco smoke exposure was slight and the authors concluded that the smoke was more likely to negatively affect the transition from nasopharyngeal carriage to the

ear, rather than an increase in the bacteria themselves. Exclusive breast feeding for the first 8 weeks post birth appeared to also significantly reduce one of the three bacteria. The authors suggest that contradictions in studies on breastfeeding and OM may be due to definition of duration or exclusivity of the breastfeeding practice (Jacoby, 2011).

There is evidence of other risk factors not related to socioeconomic status. Males are more susceptible to OM than females (Bowd, 2004) and present in greater proportions (Paradise, 1997). The prevalence of the disease appears to decrease with age, however this decline is not as apparent in Indigenous Australian populations (Nienhuys, Boswell, & McConnel, 1994; Ward, McPherson, & Thomason, 1994; C. Williams, Coates, Pascoe, Axford, & Nannup, 2009); this is also true for repeat episodes (Yiengprugsawan et al., 2013). Infants with cleft palate, Down Syndrome or other conditions that cause pathological changes to the eustachian tube and surrounding structures are known to have higher rates of OM (Bluestone, 2004; C. Williams, 2003). Upper respiratory tract infections are closely related to OM (Bowd, 2004). Some studies record that OM is more common in winter and more likely to resolve quickly in summer (Gordon, Grunstein, & Burton, 2004), however, this trend was not supported in all studies (Langan, Sockalingam, Caissie, & Corsten, 2007; C. Williams et al., 2009). Interestingly, in a study conducted with Indigenous Australian school age children in Western Australia, a significant interaction of season and middle ear disease in children from regional areas of the state was found while no seasonal influence on the occurrence of middle ear disease in children from metropolitan Perth was reported (Timms et al., 2012).

Despite a long history of international investigation, it is difficult to clearly summarise the prevalence and epidemiology of OM. This is due, firstly, to the varying methodology of the studies, specifically the definitions used to categorise participants into groups with and without OM. The broad definition of OM as used in this appraisal of knowledge and in the data collection was outlined in section 1.1.1. A second difficulty lies in the diversity of cultures in which the disease has been studied, as shown in section 2.1.4.3 on cultural considerations and socioeconomic status related comparisons.

2.2.3 Otitis media in the international community.

OM is a widely studied disease. The definition of OM provided earlier indicates a spectrum of conditions associated with the disease. OM, in various forms, is considered one of the most prevalent diseases detected in childhood (Arguedas, Kvaerner, Liese, Schilder, & Pelton, 2010; Casby, 2001). A survey of almost 2000 physicians in nine countries investigated the burden of OM on the respondents' clinical practice (Arguedas et al., 2010). The survey covered a culturally and geographically diverse population from France, Germany, Spain, Poland, Argentina, Mexico, South Korea, Thailand and Saudi Arabia. In one year, the respondents reported an average of 375 children attending a clinic with an initial episode or repeated episode of OM of whom 15% required referral to a specialist. Respondents from all countries deemed the disease enough of a clinical burden to consider a vaccination against the common pathogens associated with the disease. This multinational survey displays a high level of awareness of the disease and concludes that OM remains a significant global burden for children under the age of five.

The statistics presented in literature from the U.S. show a similarly high clinic attendance for OM. In fact, OM accounts for one third of doctor appointments for children in the U.S. (Castagno & Lavinsky, 2002). A large cohort of 1439 children in the Netherlands was tested with serial tympanometry between the age of two and four years. The authors reported that up to 80% of children suffered from at least one episode of OM during this time (Zielhuis, 1990). While OM continues to be a common childhood disease, healthy children or those provided with correct antibiotic treatment usually recover quickly and only suffer minor, temporary effects of the disease (Nyquist, 1998). North American statistics indicate that 70% of episodes resolve within 30 days (Casby, 2001). Bluestone (2004) described the disease as transient, explaining that medical intervention is most often not required. The disease becomes a greater problem, with higher prevalence rates, higher rates of repeated episodes and more severe forms of the disease, in developing countries and ethnic minority groups such as those from South East Asia, Western Pacific, Africa and Indigenous Australians. An earlier review reports on epidemiology and prevalence of OM prior to 1998 (Bluestone, 1998). The reports included the prevalence rates of chronic perforation with and without suppuration in over 24 international communities from developed and developing countries. The developed countries of UK, Denmark, Finland and much of US, were recorded with the lowest prevalence, reporting figures less than 1%. Communities of the South Pacific islands and Africa were recorded with higher rates, up to 6%. The communities with the highest prevalence rates, Inuit people of Alaska, were recorded with up to 46%. Studies reporting on Indigenous Australian participants recorded up to 33%.

Castagno and Lavinsky (2002) report on the socioeconomic and seasonal factors associated with OM in 156 Brazilian children. Half of the children, classified with lower socioeconomic status, had higher rates of OM in all seasons and a particularly high peak of prevalence in winter in comparison with participants classified as of higher socioeconomic status. The authors conclude that having OM in autumn and belonging to a lower socioeconomic group may result in higher chance of increased prevalence and length of episodes (Castagno & Lavinsky, 2002). They did note, however, that possible treatments were not accounted for and they reflected that children from the higher socioeconomic group may have received treatment which may have led to an overestimation of the group effect. This provides further support for the discussion in section 2.2.2 where it is reported that risk factors associated with the disease are often present in poor or ethnic minority communities (Bluestone, 1998).

2.2.4 OM in the Australian community.

Generally, there is a wide range of reported prevalence rates, potentially due to the varied manifestation of the disease in the affected demographic groups. Within Australia, there is also a great diversity of cultural and socioeconomic groups. It has been suggested that this diversity in Australia, and the varying rates documented internationally, are a barrier for consensus regarding the burden of OM in Australia (Taylor et al., 2009). A longitudinal study published in 2013 (Yiengprugsawan et al.) followed almost 5000 Australian children from birth to eight years and presented parent reported proportions of OM every two years. Between 3.7% and 5% of the non-Indigenous children were reported to have an ear infection in the previous two years. Note that ‘ear infection’ was included under ongoing problems and as a result

the figure may represent those who had more than one episode of OM. The longitudinal study population was likely to include predominantly English speaking, middle-class, dual parent homes with parent education at high school graduation or higher. The authors reflected that the nature of the data collection meant this participant population was targeted and Indigenous families were likely to be underrepresented (Yiengprugsawan et al., 2013). These low figures are widely featured in predominantly middle class non-Indigenous Australian population research.

A study aiming to estimate the burden of the disease in Australia commented on the difficulty of generalizing prevalence rates from one group to another (Taylor et al., 2009). Australian Bureau of Statistics data was used to project the population by age and gender in 2008 and used national and international studies to estimate upper and lower bounds for annual prevalence rates. Using these population projections, the authors reported on a cohort of children born in 2008. Taylor (2009) and colleagues report that 63% of the children had at least one episode of OM in their first year and 59%, 41%, 43% and 43% in their next four years of life respectively. Over the four years, children had between 1.74 and 1.98 episodes per year. Local studies were generalised for information on health service utilization such as GP attendance and emergency department usage for the disease. The authors applied unit costs to the different management options at each health service and estimated a cost of between $85.6million and $163.2million for the year of 2008, a high cost for the Australian health system. The authors provided some insight into the demographic context (Taylor et al., 2009). In 2008, approximately 3% of the Australian population presented with OM. When this was restricted by age, almost

9% of children under 14 years of age presented with OM. The authors acknowledged that rates in Indigenous Australian children were disproportionate with these children experiencing 12.8% of the OM episodes yet representing only 5% of the Australian child population (0-14 years in 2006)(Australian Bureau of Statistics, 2008). The cost evaluation was adjusted for these figures.

2.2.5 OM in the Indigenous Australian community.

OM is a substantial problem to the health of Indigenous Australian populations. Indigenous Australians were listed in a World Health Organization (WHO) report as having the second highest prevalence rate of OM in the world (World Health Organisation, 1996). This was supported by a review on international papers which showed that Indigenous Australians closely followed the Inuit people of Alaska in their prevalence of the disease (Bluestone, 1998).

Of 1300 Indigenous children up to 30 months of age, tested in rural Australia, 25% had acute OM with an additional 6% suffering from OM with perforation (Morris, 2007). Medical records analysed in one study of Indigenous children in remote Australia indicated that all 41 children had experienced at least one episode of OM in their first year of life and that, in a number of these children, the episode persisted for more than two months (Boswell, 1997). These concerning rates are not isolated to infants or rural and remote populations. In a study of 408 school aged Indigenous children in Perth, 30% of children were detected with OM (Timms, et al., 2012). An even higher rate of 42% of school aged children with middle ear disease was recorded in another study of Indigenous children in Perth (C. Williams, et al., 2009). In Australia, as in the international studies discussed in section 2.2.3, disadvantages such as the limited economic resources, lack of services, inadequate

nutrition, low health expectations and poor living conditions have been proposed to influence the high incidence of OM in Indigenous Australian children (Coates et al., 2002; Walker & Wigglesworth, 2001). Additionally, research suggests that outward signs of OM such as redness, pain and fever may not be as evident in Indigenous Australian children when compared to non-Indigenous children with the disease (Morris et al., 2007). It has been suggested that these differences in the manifestation of the disease may reduce the likelihood that OM is noticed, diagnosed and treated in Indigenous Australian children (Timms et al., 2012). Despite decades of research, the high rates of OM continue to be common in this population (Gunasekera, et al., 2009; Thorne, 2003/4).

2.3 Hearing Loss

Temporary HL can occur at various phases and in different forms of OM (Casby, 2001). Fluid in the middle ear and eustachian tube reduces the equalisation of pressure and the transfer of sound waves (Marieb, 2007). This can result in mild to moderate conductive HL depending on the amount of fluid present (Walker & Wigglesworth, 2001). HL can fluctuate dramatically throughout and beyond an episode of OM (Roberts, 2002). The HL may continue when the infections resolve and reoccur if the infection returns (Marieb, 2007). In the Canadian Indigenous population, OM is the primary cause of HL in children and may range from mild fluctuating levels to permanent damage to the tympanic membrane or, in severe chronic cases, sensorineural loss (Bowd, 2004). A study of Australian children found that those with bilateral OM in the first three years of life had significantly poorer hearing than children without ear disease (Winskel, 2010).

The Western Australian Aboriginal Child Health Survey (Zubrick et al., 2004) found that there was a substantial rate of HL in Indigenous children with ear infections. The authors explain that repeated damage to the tympanic membrane from the infection can result in scarring and cause permanent HL (Zubrick, et al., 2004). In Indigenous Australian children, OM is more likely to recur, to result in a ruptured ear drum and to take longer to resolve (S. Williams & O'Brien, 2008) than is the case in non-Indigenous children. Statistics show that Indigenous Australian children are 22 times less likely to return to normal ear health following an episode of ear disease (C. Williams, 2003). Indigenous Australian children are therefore more likely to have ongoing hearing problems.

OM is the most common cause of HL in Indigenous Australian children (Aithal, Yonovitz, & Aithal, 2006). The Office for Aboriginal and Torres Strait Islander Health has reported that up to 80% of Indigenous Australian school aged children have hearing thresholds of greater than 25dB (Aithal et al., 2006). Another study confirmed that a high proportion of this population with OM have mild or moderate HL (C. Williams et al., 2009). Some of these children experience hearing levels in excess of 60dB during the acute phase of the disease (S. Williams & O'Brien, 2008). OM and the subsequent HL is of particular concern in school aged children as it may affect literacy learning (Aithal et al., 2008).

2.4 The Relationship between Otitis Media and Language and Literacy Outcomes

2.4.1 A theoretical relationship.

Research indicates that delays in language development and academic achievement are apparent in children with mild and moderate HL (Yoshinaga-Itano,

Sedey, Coulter, & Mehl, 1998). In one American study, children in the early primary school years with HL demonstrated similar traits to those of children with specific language impairment. For example, they performed poorly in tests of phonological awareness, phonological discrimination and non-word repetition (Wake & Poulakis, 2004). Given this knowledge, it has been suggested that children with OM and subsequent HL are more likely to demonstrate language delay than their normal hearing peers (Shriberg et al., 2000; Sonnenschein, 2004; Wake & Poulakis, 2004). An accompanying indication from the research is that the HL associated with OM may cause a form of auditory deprivation. Although in the past there has been limited evidence of this, theoretical models of language development indicate that HL, including temporary episodes, can cause delays in stages of development. For example, the Stackhouse and Wells psycholinguistic model (Stackhouse & Wells, 1997) identifies possible levels of breakdown in the speech processing chain. If a breakdown occurs at the first stage, *auditory input*, due to HL, then there are follow-on consequences in later stages. The acoustic or auditory properties of words such as voicing, nasality or vowel quality are used to distinguish one word from another and an inability to detect these may lead to poor storage of phonological information, knows as *phonological representation*. Poor hearing, leading to the inability to detect phonetic differences known as *peripheral auditory processing*, may also lead to difficulties discriminating words. According to Stackhouse and Wells (1997), development of speech processing occurs within the first five years of life. However, school age literacy skills, such as rhyme detection, identifying syllabic or sub-syllabic units or early reading and spelling, can continue to be affected by earlier delay or disorder. HL may cause an immature or disrupted speech processing system reducing a child's understanding of the sounds and structure of their language, an

awareness essential for phonological awareness and literacy success (Stackhouse & Wells, 1997). On the contrary, evidence of neural plasticity and continual auditory input in children's early years would suggest that any deficit caused by mild to moderate fluctuating conductive HL may resolve at the end of an episode of OM (Gravel & Wallace, 1998). Despite this premise, the unpredictable and recurring nature of OM has led researchers to investigate the effect that OM and its associated HL may have on language development. This section outlines the literature on the role OM plays in child development and highlights the limited data available specific to the age and population of the current paper, with a particular focus on school aged children.

2.4.1.1 Auditory processing.

Auditory processing, including binaural hearing and auditory-linguistic experiences may be affected by the OM associated HL. It is important to distinguish the characteristics of permanent, severe or sensorineural HL to those of HL associated with OM which is temporary, variable in degree and duration, can reoccur and may not be noticeable (Gravel & Wallace, 1998). Atypical auditory experiences in young children, such as that modulated by recurring fluctuating peripheral HL, may pose a risk for subsequent developmental difficulties. This is heightened in young children in comparison to their older peers as disruption at an early stage of auditory skill development may impact the subsequent skill development (Gravel & Wallace, 1998).

A small study (n=36) conducted in a remote Indigenous community aimed to investigate binaural hearing in school children aged 7 to 14 years (Aithal et al., 2006). The investigation followed discussion on the effects of early onset and long-

lasting OM on a child's ability to localize sound in a complex auditory environment. The children presented with a history of at least two years of HL due to OM. This ability of binaural hearing in noise can be tested by measuring masking level difference (MLD) which is an "indicator of how well tones and speech signals are processed in noise" (Yonovitz, Yonovitz, Nienhuys, & Boswell, 1995, p. 40). The Indigenous Australian students in the study had low MLD values. A major flaw in the study by Aithal and colleagues (2006) is their comparison with a control group of non-Indigenous children with no history of OM, making it difficult to determine whether the reduced MLD was due to a history of OM or another factor on which the two groups differed. Despite this, the authors concluded that psychoacoustic measures were more objective than language measures and discussed the consequences of sound deprivation, resulting from OM, on auditory development (Pillsbury, Grose, & Hall, 1991). This can be applied practically to the current study with the suggestion that children with OM and subsequent HL may find it difficult to distinguish explicit language teaching experiences, such as literacy lessons, from the noise of the classroom environment (Aithal et al., 2006). This is particularly pertinent for phonological awareness learning which requires children to identify and manipulate sounds in words. Reduced auditory processing in early school may be the link to poor literacy acquisition (Yonovitz et al., 1995). A later study by the same authors concluded that amplification in classrooms and addressing the HL is not an adequate combatant of literacy difficulties but that phonological awareness programs need to be integrated into Indigenous Australian children's learning (Aithal et al., 2008).

2.4.1.2 Malaise, Attention and Behaviour.

The HL associated with OM is said to be a primary mediator causing developmental difficulties in Indigenous Australian children (C. Williams & Jacobs, 2009). However, other factors that may also play a role in the academic success of this population have also been identified in the literature. These include general malaise associated with the disease, attention difficulties and poor behaviour.

It has been suggested that symptoms of OM, such as pain or illness, may account for some developmental delay (Gravel & Wallace, 1998). Reasons could include lack of motivation to participate in communication exchanges or reduced attention to the language environment. However, this is a simplified explanation and not likely to play a significant role within an Indigenous Australian context as episodes of OM are often silent. Asymptomatic bulging, where OM is present without the accompanying redness, pain or discharge, is common in Indigenous Australian children and may increase the likelihood of tympanic perforation (C. Williams, 2003). Given this, OM in these children is less likely to contribute to the malaise that usually accompanies OM.

Otto (2010) summarises the behaviours affected by ear infections and HL as listening, comprehending, speaking, getting along with others, attending, concentrating, reading, writing and following directions activities essential to engage during learning activities. A study of high school children in Australia revealed that students with a history of OM self-reported less social confidence and more behavioural problems. The authors attributed the behavioural problems to difficulties listening to auditory information which resulted in reduced interest and concentration in classrooms (Stenton, 2007). The capacity to accommodate for children with HL in

the classroom is limited. Background noise in a classroom is found to be mildly disruptive to students with normal hearing but highly disruptive to those with mild to moderate loss (Wake & Poulakis, 2004). A study with children who had attended Dunedin hospital, New Zealand, for bilateral OM at the age of five, analysed the behavioural characteristics of the students (Silva, Chalmers, & Stewart, 1986). Teachers, using the Rutter child scales, reported significantly higher behaviour problems than a comparison group at age five, seven, nine and eleven years. Interestingly, these behavioural difficulties were particularly high at age seven. The authors suggested that this reflected the difficulty faced by students with OM at this point of schooling where specific reading instruction was being emphasised (Silva et al., 1986). A more recent paper reports on the behaviour of these same children from follow-up testing at age 13 and 15 years. Analysis of both parent and teacher reports indicated significantly higher ongoing inattentive and antisocial behaviours in the children with a history of OM (Bennett, Haggard, Silva, & Stewart, 2001). There does not appear to be any recent rigorous data confirming school age behaviour problems in Australian or specifically Indigenous Australian children with OM.

2.4.2 An equivocal relationship.

A theoretical approach appears to advocate for a clear causal negative effect of OM with fluctuating mild to moderate HL on language development and subsequent educational success. A connection is not so clear in the literature and the research exploring this relationship is extensive but diverse. Like OM prevalence rates, it has been suggested that the debate regarding the effect of OM on educational outcomes can be contributed in part to disagreement on classifying and measuring the disease (Walker & Wigglesworth, 2001) as well as the population in which the

study is occurring. For example, the age at which evidence of OM and HL is tested would likely impact the opportunity for the disease to negatively affect language development. The type of language outcome will also be dependent on the age of the participants and there is far less research focused on school aged language outcomes. This section provides a description of the international, general Australian and Indigenous Australian studies that report on varying educational outcomes and the role that OM and HL play.

2.4.3 The relationship in the international community.

An international meta-analysis recognised that the negative consequences of OM on language development appeared to be a widely held belief and that a research review was required to dispel the discrepancy of reported prevalence rates (Casby, 2001). The 22 studies analysed found no or only minor correlations between OM and measures of language. These measures included tests of vocabulary, comprehension, early language development, verbal expression, length of utterances and mother's ratings of language ability. Neither phonological awareness nor literacy skills were measured. This is important to note as the authors did not recommend that the conclusions of their analysis be extended to outcomes of oral language. It was suggested that although HL was present during an episode of OM, it was variable and children are able to compensate for a large amount of variability (Casby, 2001). There are two noteworthy issues to be raised from the results of this analysis. First, equivocal results indicate the need for a large scale, methodologically sound study to identify and describe the relationship between OM and language. Secondly, none of the studies analysed Indigenous Australian populations or other ethnic minorities in which OM is said to be more frequent and severe (Castagno & Lavinsky, 2002).

A more recent meta-analysis reviewed articles specifically researching OM in early childhood and later speech and language outcomes (Roberts, Rosenfeld, et al., 2004). These authors also stress the diversity of the research investigating whether a history of OM during critical language learning periods causes later speech and language difficulties. They drew attention to problems in the methodology of such studies, including the meta-analysis previously discussed (Casby, 2001), that may hinder the validity of the results. Roberts et al (2004) attempted to combat these methodological limitations in a number of ways. First, the authors only included studies with random control trial designs as well as prospective controlled cohort studies. Second, studies with different designs, such as correlation or between groups studies were separated and only studies with participants in a similar age bracket were compared. Finally, the focus remained on early life OM history with later speech and language outcomes. These outcomes included broad measures of expressive and receptive language as well as more specific domains of speech production, vocabulary and syntax. These studies only included participants aged one to five years due to a lack of sufficient data available for comparison beyond this age. These restrictions resulted in multiple meta-analyses for three or more studies.

Within broad receptive language outcomes of children aged two to five, no association between OM and receptive language in correlation studies was shown, however, a significant negative association in the between-group studies did exist (Roberts, Rosenfeld, et al., 2004). A significant negative association was found between receptive language and OM for children under the age of two. Meta-analyses of expressive language outcomes revealed a significant negative association with OM for children aged two to five in between groups studies but not within the

correlation studies. A statistically significant negative association was found between HL and expressive language prior to age two. This was the only comparison with OM related HL included in the research. Within the studies of specific speech domains, there was no significant association between OM and receptive vocabulary, expressive vocabulary, length of utterance or speech development. A small but significant negative association was shown in 4 of the 11 meta-analyses providing further support for the premise of a possible small but controversial relationship between OM and language development. Roberts et al (2004) raise a number of issues to be considered in ongoing research. Firstly, results should be interpreted with caution as most data did not account for confounding variables such as socioeconomic status, parent education or childcare attendance that may also impact language skills. The authors also highlighted the difference in, or absence of, documentation reporting how OM was identified or defined. Thirdly, only one of the analysed studies factored HL into the associations with the language outcomes. The authors indicated surprise that HL did not feature more prominently and indicated the need to pursue associated HL as the predictor of language development rather than OM. Fourth, the studies often excluded populations more vulnerable to developmental delays where, in reality, the OM may intensify any already existing difficulties (Roberts et al., 2004).

Numerous articles outside of these meta-analyses also discuss various aspects of the relationship between OM, HL and language. Some report broad exploratory results. For example, a small scale survey of paediatricians in metropolitan regions of the United States of America (U.S.) reported a high awareness level of the diverse nature of literature on the relationship between OM and language development. The

paediatricians reported consultation with parents of children with OM about speech and language development but did not agree that OM affects this development (Sonnenschein, 2004). Other studies are more methodologically rigorous than the paediatrician survey. For example, a study using a prospective cohort design analysed the language and cognition of 86 African American two year old children attending child-care centres. The authors defined OM based on an average of 33.3 ear examinations in the 18 months prior to language assessment (Roberts et al., 1998). A percentage of examinations with unilateral OM (with effusion, indicated by a type B tympanogram) and bilateral OM and total OM was computed. They found a significant negative relationship between time with OM and measures of expressive communication. This article responded to the need for studies on this relationship specific to populations at risk for language development difficulties. The study was also strengthened by accounting for quality of home and childcare environment and proportion of time with HL.

More recent studies have continued to explore the relationship of OM and language development in lower socioeconomic status or ethnic minority populations where the disease is far more prevalent (Bowd, 2004). Methodological difficulties are exacerbated in these populations due to cross cultural issues, differences in how the disease is manifested, sample size and access.

Further research has suggested a possible explanation for the equivocal nature of international OM and language data; that some speech and language measures may not detect any subtle deficits associated with OM (Roberts et al., 1998; Sonnenschein, 2004). Mody and colleagues (Mody, Schwartz, Gravel, & Ruben, 1999) conducted a small scale (n=14) longitudinal study, testing a five year history

of OM. The first year of auditory screening was rigorous as the participants were recruited for a separate study. In the remaining four years, testing was less frequent. The study was designed to test the effect of an accumulation of the subtle impact of each OM episode in the groups of nine year old children with and without a history of OM. The authors indicate that poor phonological representations, working memory, selective attention and difficulties with speech perception are negative repercussions of a history of mild fluctuating HL (Mody et al., 1999) but that other studies may not have detected adverse effects due to their subtlety and perhaps inadequate measures.

Nittrouer and Burton (2005) criticise studies such as those contained in the Roberts et al. meta-analysis (2004) for the lack of in-depth measures of children's abilities in specific language domains. Studies that use standardised tests of language or parent reports may not detect differences in language processing which is said to be specifically affected by OM. In contrast, these authors used numerous specific tests of speech and language such as voice onset time, comprehension of complex syntax and temporal processing (Nittrouer & Burton, 2005). The study was further strengthened by including a middle socioeconomic status (SES) group with OM to separate the possible compounding impact of SES on the OM comparisons. The 49 participants recruited were classified into four groups. A control group consisting of middle class children with no history of OM was compared with a group of middle class children with OM, children with no OM from low SES homes and a group consisting of children with OM from low SES homes. This study is particularly relevant to the current research as it reports on literacy outcomes. The authors hypothesised that OM causes language deprivation. They defined the OM groups as

having at least seven episodes of the disease recorded in medical records prior to age three. Based on expected duration, these participants presented with OM for at least 20% of their lifetime. Three phonological awareness tasks were used, namely syllable counting, identifying the same initial consonant from a choice of three, and identifying whether a pair of words had the same or different initial consonant. At the time of testing, the participants were around five years. This age was chosen as a time immediately prior to explicit teaching. While the control group scored a higher number of syllables counted correctly, all groups were high and there were no significant group differences. There was initially a significant difference between the control group and the OM groups on identifying same-different initial consonant words however this significance was not maintained once Bonferroni corrections were applied. A significant difference was shown between the control group and the OM groups on the task requiring identification of the initial consonant from a choice of three. Results supported the researchers' hypothesis that a poor early language experience, as facilitated by episodes of OM, hindered the development necessary for accessing phonetic structure (Nittrouer & Burton, 2005). The low SES group with no OM was found to have similar results to the middle SES group with OM. This negates somewhat the suggested role that other variables of SES may play on language development.

2.4.4 The relationship in the Australian community.

Results from a study of non-Indigenous Australian children provided support for the presumption that there is an association between recurrent OM and problems with reading (Winskel, 2010). The study reported that six to eight year old children with a history of OM performed significantly poorer on measures of phonological

awareness, semantic knowledge and reading ability than their peers without OM. The vast majority of Australian literature with a specific focus on the correlation between OM and language outcomes utilises data from within Indigenous Australian communities as addressed in more detail in the next section. More generally, OM does feature in discussion on academic failure as a risk factor leading to adverse outcomes such as juvenile offending (Snow & Powell, 2004).

2.4.5 The relationship in the Indigenous Australian community.

A review of school readiness of Indigenous Australian children identified OM as a key player in reduced school readiness and success (Mc Turk, Nutton, Lea, Robinson, & Carapetis, 2008). One study reported a school attendance rate of 69% for children with chronic suppurative OM compared to a 79% for the Indigenous children who did not present with OM. Both attendance rates were lower than the 88% reported for non-Indigenous children (NACCHO, 2003). It was hypothesised that reduced attendance may not only be caused by illness but also shame or frustration associated with reduced academic success (Mc Turk, Nutton, Lea, Robinson, & Carapetis, 2008). A review of literature targeting HL in Indigenous Australian communities suggests that the impact of OM does not appear to be limited to the classroom and in fact contributes to a vicious cycle of adverse outcomes. The authors reported that children with OM are at a high risk for anti-social behaviour (Burrow, Galloway, & Weissofner, 2009) which in turn may reflect back on their ongoing academic performance.

The evidence from international studies linking OM to literacy difficulties is inconclusive; however the high rates of OM and HL in Indigenous Australian children may still contribute to deficiencies in the skills required for literacy in this

population, and to poor academic outcomes in the long term. On average, an Indigenous child is said to experience approximately 32 months of OM between the age of 2 and 20 years compared to less than three months for a non-Indigenous child (Couzos, Metcalf, & Murray, 2001; McGilchrist & Hills, 1986), suggesting an increased time suffering from HL. Between the age of 2 and 20 years, the average Indigenous Australian will experience 32 weeks of compromised hearing due to OM compared to the 2 weeks experienced by the average non-Indigenous Australian (Coates, 2002). During this time, the quality of auditory stimuli received by the child is reduced. However, there is only one study concluding that OM and associated conductive HL leads to difficulties developing reading and spelling in Indigenous Australian children (Walker & Wigglesworth, 2001).

The presentation of literature thus far has provided an insight into the strengths and weaknesses in the body of research addressing the topic of this dissertation. The development of reading and spelling, including the many interrelated skills needed for single word decoding, has been documented in abundance. It has also been highlighted that Indigenous Australian children have not benefited from the same degree of knowledge profusion and are, as reported in the literature, continuing to present with poor reading, spelling and pre-literacy skills. This appraisal of knowledge gives insight to the conclusive data for high rates of middle ear disease, such as OM and the subsequent HL, in Indigenous Australian rural, regional and metropolitan communities. Far less conclusive, is evidence regarding the relationship between this disease and the presence of successful literacy learning. There is a paucity of investigation into this relationship when

specifically applied to Indigenous Australian children and their early school literacy skills. The current research aims to address this paucity.

2.5 Research Questions

This dissertation contributes to discussion on the impact that OM (and the associated HL) has on language and literacy outcomes for Indigenous Australian children. Given the paucity of discussion within the specific context of this population, where literacy rates are low, the following two broad aims were addressed.

First, to determine if a relationship exists between OM and HL in the first 18 months of school with the pre-literacy and early literacy skills in this same period. Research questions one to three below specifically address this aim.

Second, to determine if an intervention targeted to increase culturally appropriate exposure to pre-literacy skills improves the outcomes of the students, particularly those with OM and HL. This aim is addressed more specifically by research questions four to six below.

2.5.1 Research question one.

Is there a significant difference in the literacy outcomes (spelling, reading, letter knowledge and phonological awareness skills) of Indigenous children compared to an age matched group of their non-Indigenous peers?

2.5.2 Research question two a.

Is there a significant difference in literacy outcomes of Indigenous children with OM compared to Indigenous children without OM in the year prior to assessment?

2.5.3 Research question two b.

Is there a significant difference in literacy outcomes between Indigenous children with recurring OM and those with a single episode of OM in the year prior to assessment?

2.5.4 Research question three.

Is there a significant difference in literacy outcomes of Indigenous children with HL and OM compared to Indigenous children without HL or OM in the year prior to assessment?

2.5.5 Research question four a.

Is there a significant improvement in the Indigenous children's literacy skills immediately following and in the year following a targeted phonological awareness program when compared to the pre intervention results?

2.5.6 Research question four b.

Is there a significant improvement in the Indigenous children's literacy skills following intervention when compared to Indigenous children who are attending normal schooling for the same period of time, accounting for usual maturation and school attendance?

2.5.7 Research question five.

Is there a significant difference between the literacy outcomes of the Indigenous children with OM in the year prior to the assessment who received the intervention when compared with the literacy outcomes of the Indigenous children without OM who received the intervention?

2.5.8 Research question six.

Is there a significant difference in the literacy outcomes of Indigenous children with OM and HL in the year prior to the assessment who received the intervention when compared to Indigenous children with neither OM nor HL who received the intervention?

Chapter Three: Research Process

3.1 Research Origins

Indigenous Australians are arguably the most researched population in the world (Fredericks, 2008). The history of research of this group of people is long and concerns have been raised about the impact on those studied. Recent efforts, however, have seen research methods become more engaging. The current research was undertaken with a desire to see collaboration among Indigenous and non-Indigenous researchers, education and health workers and participants and with respect to Indigenous Australian culture. The researcher is not Indigenous however has aimed to understand and engage with the cultural and social context in which the participants learn language. Consultation with education assistants, cultural advisors, Aboriginal and Islander Education Officers (AIEOs), Indigenous grandparents, Indigenous health professionals and other speech pathologists working with Indigenous children was undertaken to prepare for the task. The study was purposefully designed to incorporate assessment and extended intervention to ensure reciprocity and engagement between researchers and Indigenous participants (AIATSIS, 2011). This chapter details the research process.

3.2 Ethics

The participants in this study are considered a vulnerable population according to the Curtin University ethics approval process. The study focuses on school aged Indigenous Australian children and part of a population identified with a severe health problem. As such, ethical guidelines pertinent to both child populations and Indigenous Australian communities were followed.

Initial approval was gained from the Human Research Ethics Committee at Curtin University. Following this, the Department of Education, Western Australia and the Western Australian Aboriginal Health Ethics Committee provided approval for the project as seen in Appendix A and Appendix B. A letter of support was sought and received from the Telethon Speech and Hearing Centre for Children (WA) and Derbarl Yerrigan Health Service as seen in Appendix C and Appendix D.

The author of this study maintained a current Working With Children Check throughout the course of the study as required by the Department of Child Protection.

3.3 Study Overview

Data were collected over a period of 15 months. This included a recruitment phase, four assessment phases and two blocks of intervention. A third block of intervention was also provided to the older group of participants on request of the teachers however no data was collected at this stage. A flow chart of the phases and participant groups can be seen in Figure 2. All recruitment and literacy data collection was completed by the researcher and a hard copy was stored in a locked cabinet on the Curtin University campus. Data were coded and kept on a password protected computer.

3.3.1 Ear health and hearing assessments.

The ear health data were collected by the Telethon Speech and Hearing Centre Earbus. Parents granted permission for the testing and use of data for research purposes. The Earbus is staffed by trained hearing screeners with experience working in Indigenous Health. The program provides a visiting service to schools where children who identify as Aboriginal or Torres Strait Islander are enrolled. These

children are screened up to four times a year. The screeners categorise the ear health data of the children as pass, review, or refer. When categorised as pass they are not seen until the next scheduled school visit, if categorised as review, children are seen at a follow-up Earbus visit. When categorised as refer, the children's parents are advised and a GP will visit the school for further assessment.

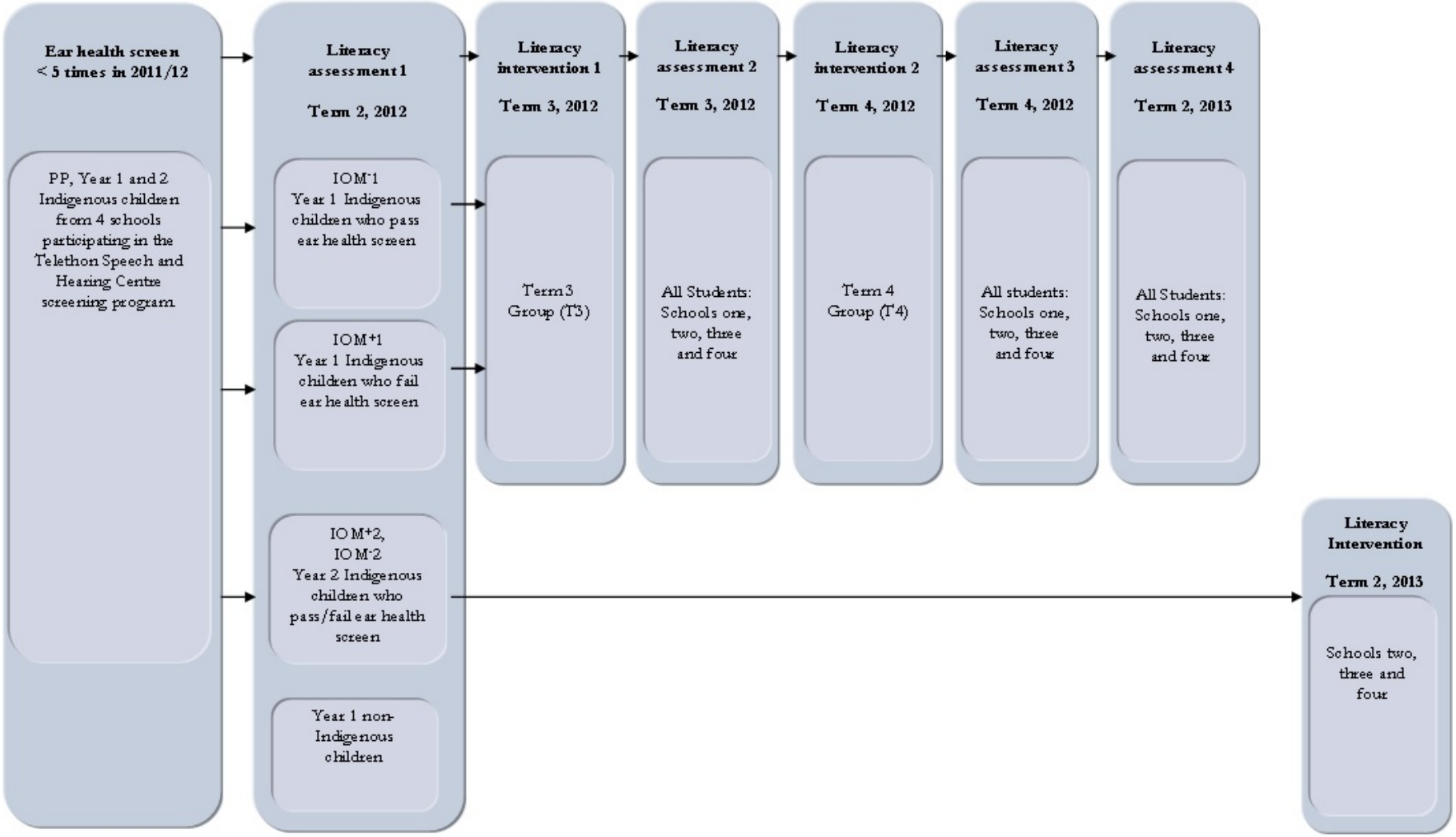

Figure 2. A flow Chart of Data Collection Phases and Corresponding Participant Groups

The schools included in this study have been visited by the Earbus since prior to 2010 (Higginbotham & Shur, 2012). The ear health screen included otoscopy, tympanometry and pure-tone audiometry. All ear health information is recorded in an electronic health record (Kimberley Aboriginal Medical Services Council and UWA Centre for Software Practice, 2013).

3.3.1.1 Otoscopy.

A Welch Allyn video otoscope was used to examine the condition of the ear canal and tympanic membrane. The screener recorded the presence of discharge, wax, redness, perforation, bubbles or grommets or if the tympanic membrane appeared retracted or dull.

3.3.1.2 Tympanometry.

A GSI 38 Auto Tympanometer was used to measure the condition of the middle ear by assessing the movement of the tympanic membrane and the health of the middle ear. Tympanograms taken for each of the participant's ears were classed as either Type A (normal, static compliance 0.0–1.6 cc, MEP −150 to +100 mmH_20. This includes Type As and Ad), Type B (OM) or Type C (Eustachian tube dysfunction, MEP −150 to –400 mmH_20) (Timms et al., 2012). The canal volume, compliance and pressure of both tympanic membranes were tested. Middle ear health was then classified as either normal middle ear function (Type A), middle ear pathology (Type B), eustachian tube dysfunction (Type C), patent grommet, hyper or limited compliance of the middle ear, positive pressure or did not test.

3.3.1.3 Pure-tone audiometry.

An Amplivox audiometer was used to assess the hearing thresholds for each of the participant's ears using air conduction. If middle ear pathology was present, tones of 500 hertz (Hz), 1000Hz, 2000Hz, and 4000Hz were screened. Tones of 1000Hz and 4000Hz were screened for all other children (Timms et al., 2012). Hearing levels at 25dB or below were considered to be within the normal range and were recorded as a pass on the hearing screen. Hearing levels at greater than 25dB were considered indicative of hearing loss (HL). Students with HL were either noted and screened at a follow-up visit or referred to the consulting GP. Outcomes of the hearing screening were recorded as pass (hearing level less than 25dB) or refer (hearing level over 25dB) in each ear.

3.3.1.4 Reliability.

All instruments are calibrated annually. Audiologists from the Telethon Speech and Hearing Centre systematically reviewed screening results and provided feedback to ensure quality and consistency throughout the testing periods (Timms et al., 2012).

3.3.1.5 Data recording and management.

The researcher was provided with a hard copy summary of each of the ear screens over the testing period. To ensure assessment was conducted blind to ear health status, the researcher did not view this information until after the initial literacy assessment. The relevant results were compiled into an excel document matching each participant code. The document was divided by school term providing between two and five sets of results for each child (term one through four in 2011 and term one in 2012). Students with only one screen or no ear health data were not

recruited for the current study. If no otitis media (OM) was identified in either set, these students were allocated to the ‘no OM’ group. If OM occurred at only one set then these students were place in the ‘single episode OM’ group. If OM occurred at more than one set these students were placed in the ‘recurring OM’ group. The same process was completed for HL for all Indigenous participants at each of the screening points. The participants were allocated to one group if they had both OM and HL recorded throughout the screening period and a second group if neither OM nor HL was recorded. Note that some participants were recorded with ‘OM but no HL’ or only ‘HL and no OM’, these participants were excluded from some analyses as outlined in the results of the applicable questions below.

3.3.2 Recruitment.

The school principal or AIEO of four schools in the north west of Perth who participated in the metropolitan Earbus screening were contacted and agreed to be involved in the study. The principals of these schools were provided with information as seen in Appendix E and the forms for their signed consent seen in Appendix F. School staff were consulted to determine the best way to recruit Indigenous students in pre-primary (children turning five before June in the year of pre-primary), year one (children turning six before June) and year two (children turning seven before June). Indigenous status was identified by the parents on their child’s school enrolment forms. A similar number of non-Indigenous participants from the same school and year were randomly selected from the class lists and the information sheet and consent form was sent home with each student. Teachers confirmed that the randomly selected control participants spoke English as their first language. The following section outlines the varying approaches to recruitment of

Indigenous children deemed best by the staff at each school. See Appendix G and Appendix H for the plain language information provided to the caregivers of Indigenous children and the form for their signed consent. Appendix I shows the full length letter of information given to these caregivers providing more detailed information if required and Appendix J shows a modified letter of information provided to the caregivers of non-Indigenous participants who would not be receiving the intervention.

3.3.2.1 School one.

The parents of pre-primary (PP), year one and year two students were invited to an information afternoon tea. A small group of caregivers attended and agreed to participate. The AIEO continued to recruit the remaining students by approaching parents before and after school with the information sheets and consent forms. The researcher accompanied the AIEO on the recruitment days. There was a 96% return rate for consent forms at this school.

3.3.2.2 School two.

The teacher of the mixed year one, two and three class assisted with the recruiting. Information sheets and consent forms were sent home with each student and a small reward was provided by the teacher for returning the completed forms. The researcher attended a barbeque promoted as a networking lunch for all Indigenous parents of the school hosted by the AIEO, however at this lunch only one participant caregiver attended. Consent form return rate was 62% at this school.

3.3.2.3 School three and four.

Information letters and consent forms were given to the AIEO who met with parents individually before and after school. The researcher accompanied the AIEO

on the recruitment days. There was a 93% and 77% return rate of consent forms at schools three and four respectively.

Following consent from school site managers and participant caregivers, the researcher met with the participants individually. Participants were provided with an explanation of the project as in Appendix K and invited to agree to participate by circling the happy face on the consent form as seen in Appendix L. Only one child circled the unhappy face and was not included in the study.

3.3.3 Participants.

Participants were included in the study if they had at least one complete set of ear health data, provided parental and personal consent, and were in PP, year one or year two. A total of 97 participants (57 Indigenous) were assessed in the initial literacy assessment phase (see Table 1)

Table 1
Participants in Each School across Gender, Indigenous Status and Year Group

School	Participants (N=97)									
	Female (n=46)	Male (n=51)	I (n=57)	NI (n=40)	Pre-Primary (n=31)		Year One (n=37)		Year Two (n=29)	
					I	NI	I	NI	I	NI
1 (n=45)	22	23	26	19	8	7	10	7	8	5
2 (n=6)	3	3	6	0	0	0	3	0	3	0
3 (n=29)	14	15	14	15	3	4	6	7	5	4
4 (n=17)	7	10	11	6	6	3	2	2	3	1

Note. I = Indigenous Participants, NI = non-Indigenous participants

3.3.4 Assessments of pre-literacy and literacy skills.

This study included four phases of assessment. The first phase, the initial assessment, included all participants. In phase two and three, the literacy of all Indigenous participants was assessed immediately following a block of intervention,

including both participants involved in the intervention and those participating in normal classroom activities. The fourth phase, the follow-up assessment at 12 months after the initial assessment, assessed all Indigenous participants that had been involved in the intervention blocks. All four assessments were conducted in the same format however the stimuli were changed. The assessment scoring sheets and stimuli can be seen in Appendix M. The researcher scripted the assessment session to ensure consistent order, task explanations and examples. Sessions where both caregiver and participant had given consent for video recording were recorded. These consent forms can be seen in Appendix N and Appendix O. Scoring for all subtests except spelling and reading were carried out online and methods are described below.

Phonological awareness (PA) and early literacy skills were assessed using adapted subtests of the Queensland University Inventory of Literacy (QUIL)(Dodd, Holm, Oerlemans, & McCormick, 1996) plus real word spelling and reading tasks and a letter knowledge task generated by the researcher to accompany the QUIL. A pilot of the adaptations and generated tasks was not possible in the time frame and not deemed necessary as target skills did not deviate significantly from the original QUIL, results were not being compared to the norms provided and both real word spelling tasks and letter knowledge tasks are widely accepted inclusions in literacy assessments (see section 2.1 on language and literacy).

The QUIL was chosen as a simple to use, objective, Australian based assessment. It is a standardised phonological awareness assessment for children aged six years to twelve years and was developed in Queensland for an Australian school aged population. The authors provide evidence for concurrent validity. Every subtest significantly correlated with spelling accuracy as graded by another literacy

assessment. The construct validity of the QUIL was also established where it was used to identify phonological awareness deficits correctly in 20 out of 21 children. The QUIL standardisation study included 706 children within middle socio-economic areas. The authors report high internal consistency and test-retest reliability as well as a high inter-rater reliability for the spelling and reading subtests. Despite high reliability and validity, the QUIL did not meet all the requirements of the current research. The normative sample did not include Indigenous Australian children, some stimuli contained speech sounds considered ambiguous in Aboriginal English, the participants of the current study were at the youngest end of the age bracket prescribed by the QUIL and the formality of the assessment did not allow for an Indigenous Australian interaction style. Assessment modifications to account for these deficits are described below. In addition to the QUIL subtests, subtests of real word spelling and reading and grapheme phoneme knowledge were also included. The QUIL and additional subtests used in the current study, in order of presentation to the participant, were real word spelling, non-word spelling, real word reading, non-word reading, grapheme phoneme knowledge, syllable segmentation, spoken rhyme recognition, phoneme detection, phoneme segmentation and phoneme manipulation.

3.3.4.1 Spelling assessment tasks.

Real word spelling materials.

Five real words were randomly selected from the MacArthur Communicative Development Inventory (CDI): Words and Sentences assessment (Fenson et al., 1993) and included as items in the real word spelling task. This MacArthur CDI is designed for use with children aged between 16 and 30 months. Norming of the assessment reveals that by the age of 30 months children will be producing over 500

of the 680 word vocabulary checklist. The words are therefore likely to be high frequency or familiar (spoken) words by the early school years. Numbers were allocated to each word from the following categories; Vehicles, Animals, Food and Drink, Body Parts and Clothing. These categories were chosen as they were less likely to include culturally unfamiliar words. Appendix P provides a list of the relevant vocab numbered in preparation for random selection. An online random number generator was used to select the five items for each assessment. Items longer than two syllables (e.g. belly button or pyjamas) and items deemed not appropriate for an Australian cohort (e.g. lorry) were excluded and another word randomly selected.

Non-word spelling materials.

The first five stimuli from the non-word spelling task in the QUIL were used for the initial assessment. Note the word 'sheve' (/ʃiv/) was modified to become 'sheke' (/ʃik/) in order to account for characteristics of Aboriginal English (see section 3.3.4.5 on assessment modifications and additions). For the remaining three assessments, five non-words were generated based on the phonotactic structure of the stimuli in the initial assessment. For example, the second stimulus for the initial assessment was 'lont'(/lɒnt/) with a short vowel and a final consonant cluster and the second stimuli for the remaining assessments were 'sont'(/sɒnt/), 'lant'(/lænt/), 'lams'(/læms/), also forms with a short vowel and consonant-vowel-consonant-consonant (CVCC) structure.

Real word and non-word spelling procedure.

This task was conducted in small groups of between two and five participants. Each child was given the spelling page with 10 blank lines (five for real

word and five for non-word spelling), and a pencil. Children completed the task using leaning boards placed around the room so they could not see each other's papers. The children were instructed not to look at the papers of their peers and to remain silent during the activity. Some participants needed reminding not to 'sound out' the words aloud. The researcher said each word twice approximately 5 seconds apart. The word was spoken a third time if requested by a student or if a student required additional prompting to attempt the word. Approximately 20 to 30 seconds were allowed between each word. The non-word spelling task was administered in the same small groups and in the same manner as the real word spelling subtest. Pronunciations for each word can be found in the score sheets as outlined in Appendix M.

Real word and non-word spelling scoring.

The children's word and non-word spelling was scored using the Spelling Sensitivity Scoring Procedure (Masterson & Apel, 2007). The results of both tests were totalled for a final spelling score. Participants' written responses were entered into the program as graphemes that represented the child's attempt to represent phonemes in the target word, matched to the corresponding segment in the target word (e.g. the child's attempt at /wump/ was entered as w u _ p). Each phoneme was scored as follows. A score of zero was assigned if an attempt to represent a phoneme was not made (e.g. the missing 'm' in /wump/). A score of one was assigned if the sound was represented with an illegal spelling (e.g. spelling /u/ in glue (/g/ /l/ /u/) with a single letter such as'o'which is never representative of the sound). A score of two was assigned if the sound was spelled legally (e.g. spelling /u/ in /glue/ with the letter 'u' as this representsthe /u/ sound in other words like /flu/). Three points were

assigned to each phoneme represented correctly by the target grapheme(s). For non-word targets, there was deemed to be only legal spelling rather than correct spelling so two is the maximum number of points possible for each phoneme. Further examples are shown in Table 2. An element score was derived for each word. This score is calculated by summing all points awarded and dividing by the total number of phonemes in the target words (e.g. the word /tiger/ spelt correctly is allocated a total of 15 points. This is then divided by the number of phonemes giving an element score of three). The maximum element score for real words is three points and the maximum element score for non-words is two points. Note that the phonemes clearly represented by a reversed phoneme (e.g. b/p) were marked as correct. The Spelling Element Score is the total element score for the five real words and five non-words, a total of 25 possible points. This score remains consistent for all word lengths and phoneme combinations. It is suggested that this procedure provides a sensitive measure of spelling ability and a detailed analysis of the children's spelling skills (C. Williams & Masterson, 2010).

Table 2

Examples of Words Scored using the Spelling Sensitivity Scoring Element Score Procedure

Target	/lɪps/ (lips)	l	ɪ	p	s	
Child's Spelling	lips	l	ɪ	p	s	
Points		3	3	3	3	12/4=3.00
Target	/ʃip/ (Sheep)	sh	ee	p		
Child's Spelling	sep	s	e	p		
Points		1	1	3		5/3=1.67
Target	/geɪm/ (Game)	g	aCe	m		
Child's Spelling	gam	g	a	m		
Points		3	1	3		7/3=2.33
Target	/gɪmp/	g	i	m	p	
Child's Spelling	gip	g	i		p	
Points		3	3	0	3	9/4=2.25
Target	/bɜd/ (bird)	b	ir	d		
Child's Spelling	berd	b	er	d		
Points		3	2	3		8/3=2.67

3.3.4.2 Reading assessment tasks.

Real word reading materials.

Five real words were randomly selected from the MacArthur Communicative Development Inventory Vocabulary lists as target reading items in the same manner as the random selection for the real word spelling subtest.

Non-word reading materials.

The first five stimuli for the non-word reading task in the QUIL were used for the initial assessment. For the remaining three assessments, five non-words were generated based on the word structure of the stimuli in the initial assessment. In most cases, phonotactic structure remained consistent and only the phonemes were changed.

Real word and non-word reading procedure.

Each word was typed using comic sans ms, size 60, black font on a single powerpoint slide and presented on the researcher's laptop. The participants were asked to read the word on the screen. If they hesitated the researcher pointed to the first letter of the word. If the participant continued to hesitate the researcher encouraged them to 'sound it out'. If the child did sound out the word, the researcher asked them what the word said. The researcher recorded each response for later coding. Neither reading tasks provided practice stimuli.

The non-words were presented in the same format and directly following the real word reading stimuli. Note that for /acked/ where there were two pronunciation options, both were scored correct.

Real word and non-word reading scoring.

Non word and real word reading was scored in the same way. Initially, participant responses were scored as correct or incorrect however further analysis required a more detailed scoring method. An appropriate scoring method for single word reading was not available so a system based on stages of reading development (Stuart & Coltheart, 1988) was devised. A scale scoring approach was developed around a cognitive-developmental theory by Marsh and colleagues (Marsh, Friedman, Welch, & Desberg, 1981). The four stages of development; linguistic guessing, discrimination net guessing, sequential decoding and hierarchical decoding were placed in a scale 0-6. See Table 3 for a breakdown of the scores with examples from the participant answers.

Table 3
Explanation of Scoring Method for Reading Subtests with Participant Answer Examples.

Model Stages (Marsh et al., 1981)	Definition for scale score	Target	Attempt	Score
Linguistic guessing	No answer OR unrelated guess	egg slet coffee	Don't know eye id	0
Discrimination net guessing	Guess based on visual or linguistic cues - first OR last OR clear middle phoneme	food bocks egg	frog duck gig	1
	Guess based on visual or linguistic cues - more than one phoneme	coffee slet sord	cough lest sed	2
Sequential decoding	Decoding from left to right - attempting to sound out correctly however no attempt or incorrect attempt to blend	acked sord	a-k-d/dog s o r d	3
	Decoding from left to right – attempting to sound out correctly mostly correct blend	sed bunny	s ee d/seed b u n j/bun	4
Hierarchical decoding	Sounds out the word and correctly blend except for inverse letters ie b/d	sord bocks	sorb docks	5
	Correctly read without sounding out			6

A second speech pathologist scored 10% of the reading scores randomly selected for reliability. Inconsistencies between the two scorers' results were noted for 5% of cases. The causes of differences in scores were examined and differences resolved by consensus, any modifications were applied to all participants.

3.3.4.3 Letter knowledge task.

All 26 lowercase alphabet letters were presented in comic sans ms font, size 166, black directly following the non-word reading task. Each new phoneme was

presented as a new slide. An online random number generator determined the order of presentation of the letters which varied for each of the four assessments. The participants were asked to provide either the name of the letter or the corresponding sound (e.g. for the alphabet letter b, both /bi/ and /b/ were considered correct responses). Participants' responses were marked as correct or incorrect and each participant received a score out of 26.

3.3.4.4 Phonological awareness assessment tasks.

For the initial assessment, each of the following subtests presented stimuli provided by the QUIL. The QUIL procedure was followed, including generic explanation, practice opportunities and clarification, and remained the same for all children. The only difference was the inclusion of an additional example as outlined in section 3.3.4.5 on assessment additions and modifications. In the final three assessments the structure, procedure and level of explanations and practice opportunities remained the same. The stimuli were altered to avoid any effect of practice from assessment to assessment. However, the researcher endeavoured to make all stimuli as close to the original as possible to ensure the same skills set was being tested at each time point.

Syllable segmentation.

Multisyllabic words for this subtest were randomly selected from online vocabulary lists found at http://www.ontrackreading.com/wordlists/multisyllable-words-by-vowel-sound (accessed February 2012). The lists of words were organised by number of syllables and numbered. An online random number generator was used to select three each of two, three and four syllable words. The order of the number of syllables remained the same for each assessment. Participants were asked to clap the

syllables in each word. They were not required to provide a number, the researcher counted the claps as the child said the word. Participants' responses were marked as correct or incorrect and each participant received a score out of nine.

Rhyme recognition.

In the initial assessment, this subtest consisted of the stimuli from the spoken rhyme recognition task in the QUIL which included three rhyming pairs, two visually similar non-rhyming pairs (e.g. said/paid, wait/wet) and one non-rhyming pair that was not visually similar (e.g. hat/fall). For the following assessments, the researcher generated three lists of word pairs matching those three categories. The word pairs conformed to the same length and lexical complexity as the QUIL stimuli. The lists of pairs were numbered and the online random number generator was used to randomly select three from the rhyming pair list, two from the visually similar non-rhyming pair list and one from the non-rhyming, visually dissimilar pair list for each assessment. The presentation order of the different pairs remained the same for all assessments. Participants listened to the researcher say each pair and indicated whether it was a rhyming pair or not. The participant was given a mark for each correctly identified rhyming pair and received a score out of six.

Phoneme detection.

In the initial assessment, this subtest consisted of the stimuli from the phoneme detection subtest of the QUIL. The first part contained three sets of four words where all but one started with the same phoneme. The second part contained three sets of four words where all but one ended with the same phoneme. The researcher read the four items in each set twice slowly. If the child requested or hesitated, the set was read a third time. The participant identified which word had the

different first or last phoneme. The word lists were modified by the researcher for each of the remaining three assessments, however phonotactic structure remained the same and the position of the odd word out in the list remained the same. The participant was given a point for each correctly identified odd word out and received a score out of six.

Phoneme segmentation.

Two each of two, three and four syllable words were chosen from the Phoneme Segmentation stimuli in the QUIL (originally three each of two, three, four and five syllable words) for this task in the initial assessment. These words were slightly modified for each of the remaining three assessments however, ensuring that the word structure (e.g. initial consonant cluster), position (e.g. two syllable word came first) and number (e.g. two of each word length) of segments remained the same. The researcher read the word twice and the participants segmented each word and identified the phonemes. They were not asked to provide the number of phonemes. Each participant received a score out of six.

Phoneme manipulation.

Six stimuli were chosen from the Phoneme Segmentation stimuli in the QUIL (originally ten stimuli) for this task in the initial assessment, representing manipulation of phonemes in a variety of positions. The participant was required to identify the word remaining when the target phoneme was removed (e.g. *pl*a*et* without /l/ becomes *p*a*et*) The words were slightly modified for each of the remaining three assessments however ensuring that the number and position of the sound removed remained the same. All original stimuli and the target word following the removal of the target phoneme were real words. The researcher repeated each

stimulus twice. If the participant asked for a repetition or hesitated a third repetition was allowed. They received a score out of six.

3.3.4.5 Assessment modifications and additions.

While the QUIL is suitable to assess the phonological awareness skills of school age children in Australia in general, there are a number of aspects of the assessment that do not fulfil the needs of this study. Firstly, a number of subtests outside the range of the QUIL battery were required to provide additional information on participants' early literacy skills. Secondly, the assessments had to be practical within the confines of the time and expected skill level of the participants. The time frame allowed for the assessment was 30 minutes to fit within a school timetable. The participants, aged 5, 6 and 7 were on the lower end of the QUIL age range. Previously reported literacy outcomes of Indigenous students also indicates these students will likely be performing at the lower skill range (Hewer & Whyatt, 2006; Northern Territory Department of Employment Education and Training, 2006/2007). Thirdly, the assessment may not accurately tap into the language skills of Indigenous Australian children given cultural and phonological differences. Changes, as outlined in Table 4, were made to some stimuli, the format and length of the assessment battery and the manner in which the assessment was conducted. In addition to modifying tasks, the administration of the assessment was changed to take into account Indigenous Australian communication methods and Indigenous Australian learning style in order to reflect the true ability of the child (Gould, 2008).

Table 4
Modifications to the Queensland University Inventory of Literacy with Rationale

Modification	Rationale
Removed Subtests	
Removed the syllable identification subtest e.g. Identify which parts of two words are the same. The ending of *awful* and *helpful* is the same but there are no parts the same in *provide* and *enough*.	This was the more difficult of the two syllable based tasks. Removal of this subtest leaves one task for each phonological awareness category. This removal reduced the length of the assessment.
Removed the visual rhyme recognition subtest e.g. Identify words that sound alike by looking at two words. Sing and *ring* look and sound alike. Post and *lost* look alike but they do not sound the same.	This was the more difficult of the two rhyme based tasks. In addition to rhyme knowledge the child would be required to read the words. This skill was tested separately. Removal of this subtest left one task for each phonological awareness category. This removal reduced the length of the assessment.
Removed the spoonerisms subtest e.g. Swap the first letters of two words to make two new words. *Long* and *sigh* become *song* and *lie.*	This was the more difficult of the phoneme manipulation tasks and was considered too complex for the participants. Removal of this subtest left one task for each phonological awareness category. This removal reduced the length of the assessment.
Added Subtests	
Added letter knowledge subtest	Along with PA, letter knowledge is known to be a predictor of learning to read (Foulin, 2005). This subtest was also included to identify reading abilities e.g. mirroring letters (b/d) or lack of letter recognition which might lead to poor outcomes in the reading subtest.
Added real word spelling and reading subtests	Spelling non-words requires letter by letter decoding or the blending of graphemes/phonemes with familiar chunks. Spelling real words, if unfamiliar or unconventional according to English spelling rules, may also require these skills. However, real words that are in a child's vocabulary, such as sight words, are read or spelt with greater efficiency and automaticity (Ehri, 2011). This task acknowledged this skill in testing the early spelling and reading of the participants.

Reworded Task Explanations	
Changed ‘made-up’ to ‘silly’ in the non-word spelling and reading subtests and the phoneme segmentation subtest Changed ‘syllables’ to ‘parts’ in the syllable segmentation subtest Changed ‘rhyme’ to ‘sounds the same at the end’ in the rhyme recognition subtest	These substitutions were part of the simplification process of task explanations. They reduced the number of words or complexity of words in explanations. The new words were provided with the intention of being more self-explanatory and the shorter length allowed time for more examples.
Modified Tasks	
Retained only the first five non-word spelling and non-word reading targets in the spelling and reading subtests	QUIL recommended discontinuation after item 5 of the non-word spelling subtest for grade one students. This removal reduced the difficulty and length of the subtests.
Removed words with five phonemes from the phoneme segmentation subtest	This removed the most difficult stimuli from this task and reduced the length and difficulty.
Removed requirement to identify the number of syllables in the syllable segmentation subtest and the number of phonemes in the phoneme segmentation subtest	Counting the syllables and phonemes required additional cognitive load e.g. coordinating fingers to count syllables or devising methods to count and sound out simultaneously. This reduced the cognitive load and ensured the outcome was conveying true segmentation ability.
Removed the stimuli for middle and end position in the phoneme detection subtest. e.g. /DOLL/ has a different end sound to /ran/, /can/ and /fan/ and /CALLER/ has a different middle sound to /maple/, /sipping/ and /happen/.	This removal left two phoneme detection tasks, first and last sounds, and reduced the length and difficulty of the task.
Modifications to account for Aboriginal English Phonological Characteristics	
Replaced /sheve/ with /sheke/ in the non-word reading subtest. Removed /fir/-/fat/, /laugh/-/staff/, /fought/-/port/ stimuli and replaced /through/ with /drew/ in the rhyme recognition subtest. Replaced /thought/ with /caught/ and removed /hunt/ and /hurt/ from the phoneme manipulation subtest.	Consonant characteristics of Aboriginal English that are distinct from Standard Australian English may affect the results of the assessment. For example, a participant might segment the word /hunt/ as /unt/ if using Aboriginal English where it is appropriate to drop the /h/ sound. While this is a reflection of their dialect use it would be scored as incorrect and not adequately represent their segmenting skills. In Aboriginal English examples of ambiguous consonants relevant to the QUIL stimuli

	are as follows (Butcher, 2008): /f/ becomes /p/ or /b/ /v/ become /b/ or /p/ /th/ becomes /t/ or /d/ Tasks that required verbal production or recognition of ambiguous consonant sounds or manipulation of the associated phonemes were removed or replaced.
Administration and rapport	
Provided an additional example in the syllable segmentation, rhyme recognition, phoneme segmentation and phoneme manipulation tasks. As an additional rapport building tool, the participant was invited to choose the colour of the slide background. Allowing time for more positive feedback during examples/explanation Comments and positive non-specific feedback allowed throughout the assessment. Repetition of assessment stimuli also allowed.	These additions were made to allow for more opportunity for the student to observe the task and the researcher to provide additional feedback. These are general strategies for modification to comply with the more informal style of Indigenous Australian learning. The changes assist to build rapport between researcher and participant, to compensate for reduced attention, to reduce participant assessment anxiety, and to affirm good behaviour.

3.3.4.6 Inter-rater reliability.

A second speech pathologist viewed and scored videos of a random selection of 10% of the sessions. Both the researcher and second scorer were not privy to the Earbus data throughout assessment and were, therefore, blind to the ear health status of the participants. The inter-rater agreement on the score of these participants was 90%. A random selection of sessions of the third assessment were also video recorded and reviewed by a second scorer. The inter-rater agreement was 87.5%. The discrepancies were clarified and cross checked with all participants to maintain consistency.

3.3.5 Intervention of literacy and pre-literacy skills.

All 57 Indigenous participants who were involved in the initial assessment were offered intervention. In addition to the 38 pre-primary and year one students, two grade two students who attended a mixed one to three class were also included in the first and second intervention blocks during either term three or term four of 2012. The remaining 17 students who were in year two at the time of the initial assessment were provided with a block of intervention in term two of 2013. The first and second block consisted of 15 sessions over 8 weeks. The third block, which was not part of the study, consisted of 5-6 sessions over three weeks.

3.3.5.1 Intervention modifications and strategies.

The intervention was adapted from the Gillon Phonological Awareness Training Programme (Gillon, 2008). This program, designed for children aged 5-7, is based on research supported principles as outlined in Gillon (2004). These principles formed the basis of Phonological Awareness training and were maintained throughout the intervention for the current project. However, additional principles and strategies that addressed the cultural and practical needs of the population of this research were also required. These principles and strategies were compiled from publications providing advice, suggestions and reflections on language based intervention with Indigenous Australian children. These publications include: ‘Solid English’ (Education Department of Western Australia, 1999), ‘Making The Jump, a Resource Book for Teachers of Aboriginal Students’ (Berry & Hudson, 1997), ‘Intervention Strategies for Aboriginal Children with Conductive Hearing Loss’ (Western Australian Department of Education, 2002) and ‘Do You Hear What I Hear, Resource Book’ (Department of Education, 2002).

Table 5
Principle of Intervention with Indigenous Australian Children and Related Implementation Strategies

Principles (Education Department of Western Australia, 1999)	Strategies
Learning by doing: Learning is best in the immediate situation not by imagining events. Repetition of an immediate action assists learning and, according to an Indigenous Australian world view, will develop experience and knowledge.	*Play based tasks*: Games used as an effective language tool, using visual rather than verbal explanation and allow for repetition, turn taking, peer shared knowledge and a relaxed and co-operative atmosphere (Berry & Hudson, 1997). *Resources:* A collection of photos ie people, animals, places, natural and man-made objects provide tangible props for intervention tasks (Berry & Hudson, 1997).
Contextualisation: Indigenous Australian mind set proposes that the big picture is important and that the individual elements to be learned must be understood within the context.	*Reiteration:* Time dedicated each session to reiterate the linguistic context of tasks. For example, isolate a word from the story book and count the number of syllables with the students. Then pick a syllable and sound out the phonemes. This might be the introduction to a final phoneme identification task, initially focusing on the whole and gradually shifting to the specific components.
Watch and learn: In the pre-school years, Indigenous Australian children's learning experience centres on observation. Verbal accompaniment, such as yarning or stories, is present but does not seem to be a dominant strategy for information absorption. The students should not feel immediate pressure to perform a task, especially if showing signs of discomfort.	*Modelling:* Verbal explanations provided in the context of a model and stronger students encouraged to provide explanations and modelling. Verbal explanation used as a supplement to learning as is often expected in a classroom, however ample opportunity for observation allowed before a child's attempt at a task. Students allowed to watch and try and watch again.
Group orientation: Indigenous Australian children do not feel comfortable when isolated from their peer group. They learn better when there is no 'shame' when they can take risks and support each other. Working in small groups allows children the opportunity to analyse their own speech and language and to better hear what their peers and researcher are saying.	*Peer mentoring and small groups:* When a student was stuck on a problem the researcher would direct the question first to the peers. While this is not direct peer to peer mentoring it does allow the students to learn from each other and to be comfortable in their difficulties.

Relevance: Students engage better when learning activities are based on known and valued topics.	*Topic choice:* Students were asked what they liked and sessions were constructed around these preferences. Books shared were based on Indigenous way of life and motivational activities involved topics such as the beach, food, barbeques, football, family and cars.
Orientation to persons: Rapport building is a necessity for working with Indigenous Australian students, especially for non-Indigenous clinicians. Humour, mutual trust and respect and common ground contribute to an effective working relationship. Indigenous Australian students will notice if no effort is made to build a relationship outside specific learning tasks.	*Daily chats:* It is extremely valuable for Indigenous children to feel comfortable with the researcher for successful interaction. 'Daily chats' began each session and successfully built positive relationships. The speech pathologist and the children took turns reading books, discussing their weekends or looking at photographs.

Valuing Aboriginal English.

There is considerable literature summarising differences between Aboriginal English and Standard Australian English (Butcher, 2008; Education Department of Western Australia, 1999; Haig, Konigsberg, & Collard, 2005; Simpson, Munns, & Clancy, 1999). As urban Australian students, the participants of this study spoke a light dialectal variety of Aboriginal English but pragmatic, syntactic, semantic and phonological differences did exist. Analysis of the Aboriginal English features of a small group of urban Indigenous Australian school children revealed a range of dialect densities (Pearce et al., 2014), a variety noted empirically in the current participant population. The following strategies were adopted to ensure that use of Aboriginal English in the intervention sessions was valued yet did not interfere with classroom expectations.

Indirect questioning. Where possible, the researcher did not direct specific tasks and questions to individual students. Instead, trigger or leading statements were

used that would encourage the student to respond. This is based on the pragmatic principle of Aboriginal English that direct questions are confusing, especially when the researcher already knows the answer (Education Department of Western Australia, 1999). For example, in response to a picture in a segmenting task the researcher would say “this is a crab, I think there are four sounds in crab, /c/ /r/ /a/ /b/”. The pictures will then be presented to another student or to the group with the commentary: “I wonder what this one is”.

Modelling. When a target word contained a phonological feature of Aboriginal English (e.g. a word with /h/ in the initial position), the researcher modelled a response in Standard Australian English. If the student response was in Aboriginal English, they were directed toward the written word or given another example to help distinguish the sounds. This strategy is based on the understanding that difficulties distinguishing Standard Australian English sounds can be heightened by the presence of OM (Education Department of Western Australia, 1999). It is important that a distinction between the two codes is made (Berry & Hudson, 1997).

Difference integration. When the students demonstrated use of Aboriginal English in the sessions they were not corrected. However, the researcher integrated the example into the session and spoke with the students about the difference between school talk and home talk. The discussions were not often required; they occurred between one and five times throughout each intervention block depending on the group. For example in an initial sound categorisation task the researcher might say “at home you might say /pinish/ and it would be right but at school we need to think carefully about the first sound, see this word starts with a /f/ sound, /finish/ so it goes with the other words that start with /f/”.

3.3.5.2 Scheduling.

Participants at each school were divided into small groups based on skill level and behaviour as determined by the classroom teacher and AIEO. In one case, this meant a lower performing year one student was scheduled with pre-primary students, in all other cases groups were restricted to year group. Teachers were also asked to provide their preference for the session time so as to minimise classroom disruption, particularly during classroom literacy sessions. Sessions were scheduled so that no group had the two sessions on consecutive days. In an attempt to ensure an even mix of students in each block of intervention, groups from each school and each year group were scheduled in both blocks. See Appendix Q for the intervention session schedule for the first and second blocks of intervention in term three and four.

3.3.5.3 Sessions.

Each session was conducted for 45 to 50 minutes in an onsite quiet office space. Each session began with a rapport building activity (typically a book share). This time was called ‘daily chat’. The participants were not pressured to contribute in this time and it was designed to calm the students, help them become comfortable with each other and the researcher and to prepare them for the rest of the session. In some sessions these books were an ‘I spy’ style book and researcher and students played phonological based games with the pictures. For example, “who can see something starting with /k/” or “who can see something that rhymes with ‘hat’”. Other books were story based and the researcher and participants took turns reading the book and discussing the pictures. These books include ‘Jakobi& Nan’ by Esther Fisher, ‘Look See, Look at Me’ by Leonie Norrington, ‘Hunt with HooRoo’ (an I spy style book) by Murray Van, ‘Wonky-Donkey’ by Craig Smith, ‘Punzie, Icq’ by

Havel Geoff and ‘Hound Bee’ by TIME-LIFE early learning program. A number of these books were shortlisted in 2011 for The Speech Pathology Australia Book of the Year Awards for Indigenous children.

Following the daily chat, the researcher briefly explained the aims of the session and how it would fit in with the larger picture of phonological awareness. For example, participants were frequently reminded that sentences are made up of words, words are made up of syllables, syllables are made up of sounds etc (see contextualisation principle in Table 5). The remainder of the session consisted of 3-4 activities focusing on the different areas of phonological awareness with a short break if necessary. Consistency between groups was maintained when possible, however session plans were somewhat individualized for each group. This was to account for the different pace across groups due to language development, behaviour and group size. The primary goal of each session was for each student to develop their pre-literacy skills. Every session finished with a phoneme tracking task as recommended by Gillon (2008). This task initially involved tracking sounds with coloured blocks. As the participants progressed, letters were introduced and the word structure was lengthened. See Appendix R and Appendix S for examples of session structure and the types of phonological awareness tasks and associated motivational games used in the intervention sessions.

3.3.5.4 Attendance.

Poor attendance is a known issue in Indigenous Australian school children (Mc Turk et al., 2008; Western Australian Department of Education, 2002). All four schools were implementing strategies to combat absenteeism. Participants’ data was not included in analyses if they were absent for more than 4 of the 15 intervention

sessions. Six students attended between 1 and 8 session and were absent for the remaining sessions. The remaining 34 students attended between 11 to 15 sessions with an average of 13.9 sessions in block one and an average of 12.8 sessions in block two.

3.3.5.5 Behaviour.

Behaviour management strategies were implemented to ensure maximum use of session time on task. These were discussed with the cultural reference group, AIEOs and classroom teachers during the planning stages. They include calm, personable interaction with the researcher, edible motivators, practical and active learning tasks and in one case, additional support from an education assistant. Two students caused difficulty for their peers and the researcher and were removed from the intervention sessions. These two are included in the six removed for under attendance above.

3.4 Statistical Analyses

When planning for analysis of the data for each of the six research questions, it was important to note some characteristics of the data. Firstly, this research investigates the differences between the group of non-Indigenous Australian participants, and Indigenous Australian participants who present with varying categories of otitis media (OM) and HL. These groups were expected to present with very different distributions when analysed by literacy outcomes. To address this, an analysis method that accounts for markedly non-normal distributions and considerable variation in outcome variables was needed. Second, the data included both fixed and random variables where categories such as school, gender and year group would restrict group numbers. To address this, an analysis method that could

accommodate intra-year and intra-school dependencies and is robust to large variations in group sizes was needed. Third, data has been collected longitudinally and therefore required an analysis method that is less sensitive to participant attrition.

After a review of statistical options a traditional ANOVA was deemed most appropriate for the preliminary analyses of the data as a whole while a generalised linear mixed model (GLMM) robust statistics approach was used to respond to each of the research questions. The GLMM represents a special class of regression model. The GLMM is generalised in the sense that it can handle outcome variables with markedly non-normal distributions; the GLMM is mixed in the sense that it includes both random and fixed effects (IBM Software Group, 2013). GLMM is proven to be a valid approach for complex data (Holden, Kelley, & Agarwal, 2008) and allows for nesting to be applied in data organisation (IBM Corporation, 2010). A GLMM does not rely on participants providing data at every assessment; instead, it estimates missing data to allow for any missing information at an assessment point. This full information estimation procedure reduces sampling bias and the need to remove or replace missing data (IBM Software Group, 2013). See table 6 below for a detailed outline of the analysis process.

Table 6

An Outline of Plans for Preliminary Analysis of Data and Statistical Analysis to Respond to the Research Questions

Preliminary assumptions testing
Statistical tests of normality (such as the Kolmogorov-Smirnov and the Shapiro-Wilk) are sensitive to the *slightest* departures from normality – departures that have absolutely no impact on parametric tests. Visual examinations of the histograms can aid the researcher to infer non-normality, particularly distributions that are markedly non-normal. Non-parametric tests will be conducted on non-normal outcomes, but only if the shape of the non-normal distribution is consistent across the groups being investigated (Cardone, 2010)

Preliminary parametric analyses
- Independent samples *t*-test to compare literacy outcomes between genders. - One-way ANOVA to compare literacy outcomes between year groups - One-way ANOVA to compare literacy outcomes between schools - Pearson's correlations to determine relationship between literacy outcomes

GLMM analyses
- Year, school, and participant will be treated as nominal random effects, and time will be treated as an ordinal random effect. - Data will therefore be analysed within the context of a hierarchical structure in which time is nested within participant, participant is nested within year, and year is nested within school (IBM Corporation, 2010). - Classification to groups based on presence of OM and HL history will be treated as a nominal fixed effect. - If gender is correlated with a particular literacy outcome, then it will be included as a covariate in the GLMM for that outcome. - GLMM robust option will be applied to account for violations of normality and homogeneity of variance (IBM Software Group, 2013). - Violations of sphericity will be accommodated by changing the covariance matrix from the default of compound symmetry to autoregressive.

Research Question One	Research Question Two	Research Question Three	Research Question Four a	Research Question Four b	Research Question Five	Research Question Six
Comparison of Indigenous and non-Indigenous participants	Comparisons within Indigenous Participants		Comparisons within Indigenous participants who received a block of intervention			
GLMM analysis of 2 groups (Indigenous – *n*=57 and non-Indigenous – *n*=40) and 4 outcomes…	GLMM analysis of 4 groups (No OM – *n*=30, Single episode OM – *n*=15 and Recurring OM – *n*=7 and perforation n=5) and 4 outcomes	GLMM analysis of 2 groups (no HL and OM – n=28, with HL and OM – n=18) and 4 outcomes	GLMM time effects analysis of 4 time points (n=34) and 4 outcomes	GLMM interaction analysis 2 groups (intervention in term 3 – n= 19 and intervention in term 4 – n=15) across 4 time points and 4 outcomes	GLMM interaction analysis 2 groups (no OM – n= 17 and OM – n=17) across 2 time points and 4 outcomes	GLMM interaction analysis 2 groups (both OM and HL – n=13 and no OM or HL – n=13) at 2 time points and 4 outcomes

Chapter Four: Results

4.1 Preliminary Analyses

This section reports on three literacy outcomes; spelling which is the total element score for the 10 real words and non-words (maximum score=25), reading which is the total scale score for the 10 real words and non-words (maximum score = 60) and phonological awareness which is the combined score on all the phonological awareness subtests (maximum score = 33). Letter knowledge has not been included in the preliminary analyses as it is not deemed sensitive to differentiating participants; it is included in section 4.1.4 on correlations as it is known to interact significantly with the other literacy skills. The participants differed from each other on a number of independent variables such as gender, year group or school. The following paragraphs briefly describe preliminary analyses that test the relationship of each of these variables with the main literacy outcomes. This section provides evidence for the validity of the assessment as discussed in the following chapters and ensures that the results are not impacted by the differing independent variables.

An analysis of the histograms of each outcome (See Appendix V) revealed, in some cases, a strong deviation from a normal distribution. Visual examination of the histograms for spelling, reading and phonological awareness revealed that the non-identifiable distributions varied across the groups in each outcome. Parametric-tests are therefore reported on below.

4.1.1 Gender.

An independent samples *t*-test revealed no significant difference between male (*n*=51) and female (*n*=46) participants on the literacy outcomes. The means, standard deviations and *p*-values for the spelling, reading and total phonological awareness tests can be seen in Table 6. Although there were no statistically significant differences, the female scores were slightly higher than the male scores on every outcome.

Table 7
Descriptive Statistics for the Literacy Outcomes of Male and Female Participants

	Male		Female		Effect Size	*p*
	Mean	*Std Dev*	*Mean*	*Std Dev*	(d)	
Spelling Element Score	14.27	8.30	16.44	7.13	0.28	.172
Reading Score	26.63	17.64	30.63	18.86	0.22	.280
Total PA	19.94	7.12	21.33	6.20	0.21	.311

4.1.2 Year group.

A one-way ANOVA revealed a significant difference in scores on all outcomes between pre-primary (*n*=31), Year one (*n*=37) and Year two (*n*=29). See Table 7 for the means, standard deviations and *p*-values for the spelling, reading and total phonological awareness tests.

Table 8
Descriptive Statistics for the Literacy Outcomes of Participants in Pre-Primary, Year 1 and Year 2

	Pre-primary		Year 1		Year 2		*p*
	Mean	*Std Dev*	*Mean*	*Std Dev*	*Mean*	*Std Dev*	
Spelling Element Score	8.67	7.13	17.07	6.30	20.11	5.14	<.001
Reading Score	16.55	16.06	29.73	16.33	39.79	15.16	<.001
Total PA	16.35	5.77	20.73	5.35	24.96	6.45	<.001

4.1.3 School.

A one-way ANOVA revealed no significant difference in the spelling, reading or total phonological awareness scores of the children at the four schools. See Table 8 for the means, standard deviations and *p*-values. These results are difficult to interpret given the large difference in the number of participants at each school and that the proportion of students from each year group is not uniform across the four schools.

Table 9
Descriptive Statistics for the Literacy Outcomes of Participants in School 1 to 4

School	1 (*n*=45)		2 (*n*=6)		3 (*n*=29)		4 (*n*=17)		*p*
	Mean	*Std Dev*	*Mean*	*Std Dev*	*Mean*	*Std Dev*	*Mean*	*Std Dev*	
Spelling Element Score	14.75	7.61	17.24	7.89	17.31	7.40	12.60	8.56	.208
Reading Score	28.42	17.31	24.17	16.19	32.28	18.33	23.94	21.17	.444
Total PA	19.15	6.65	21.67	6.12	22.86	6.28	20.18	7.13	.130

4.1.4 Correlations.

Pearson correlation analyses revealed significant correlations between spelling, reading, total phonological awareness and letter knowledge. Table 9 shows Pearson's r and statistical significance for all comparisons. Further investigation using factor analysis confirmed that the four outcomes are loaded on the same factor. When results were split by year group, the significant correlations remained.

Table 10
Pearson Correlation Analysis Significance for Literacy Outcomes

	Reading Score	Letter Knowledge	Total PA
Spelling Element Score	r(95)=.78, p < .001	r(95)=.83, p < .001	r(95)=.78, p < .001
Reading Score		r(95)=.72, p < .001	r(95)=.78, p < .001
Letter Knowledge			r(95)=.64, p < .001

4.2 Response to Research Questions

The GLMMs were implemented through SPSS's (Version 20) GENLINMIXED procedure. In order to optimise the likelihood of convergence, a separate GLMM analysis was run for each of the outcome variables in each research question. Analysing each outcome independently of the others will inflate the familywise error rate. The per-test alpha was therefore corrected to control the inflation. The correction involved dividing the conventional per-test alpha of .05 by four, the number of outcomes analysed. The results of these GLMM analyses for all research questions are reported below.

Research question one is supported by data from all participants. The data from all Indigenous participants only is used in research questions two and three. For the remaining three questions only data from the Indigenous participants who received the intervention was used.

4.3 Research Question One

Research question one asked if there was a significant difference in the literacy outcomes of Indigenous children compared to a non-Indigenous control group. It was expected that the Indigenous participants would perform more poorly on the literacy outcomes than the non-Indigenous participants in the control group. A GLMM was conducted to compare the two groups on spelling, reading, letter knowledge and phonological awareness outcomes. The non-Indigenous participants performed significantly better on all four literacy outcomes than the Indigenous participants (See Table 10 for means and significance values).

Table 11
The Means and Statistical Difference between Non-Indigenous and Indigenous Participants on the Literacy Outcomes

	Non-Indigenous Participants (*n*=40)		Indigenous Participants (*n=57*)			
	Mean	Std Error	Mean	Std Error	Statistical Significance	Effect Size (d)
Spelling	19.43	1.90	13.42	1.80	$F(1,95) = 27.37$, $p < .001$	1.09
Reading	39.04	4.09	22.64	3.83	$F(1,95) = 34.26$, $p < .001$	1.22
Letter Knowledge	24.29	1.39	19.93	1.29	$F(1,95) = 18.24$, $p < .001$	0.89
Phonological Awareness	24.29	1.50	19.37	1.40	$F(1,95) = 21.11$, $p < .001$	0.96

4.4 Research Question Two

Research question two was asked in two related parts. First, of the Indigenous participants, was there a significant difference in literacy outcomes for children with one or more episodes of OM in the screening period prior to the initial assessment when compared to the children with normal ear health? Second, was there a significant difference in literacy outcomes in participants with recurring OM compared to participants with a single episode of OM?

A GLMM analysis revealed a non-significant main effect for group for all four outcomes. See Table 11 for the means and standard errors for participants without OM, participants with a single episode of OM, participants with more than one episode of OM and participants exhibiting a perforated tympanic membrane one or more times.

A significant main effect for phonological awareness outcomes was found when gender was introduced as a covariate ($F(3,52)=2.787$, $p = .050$). While the adjusted means remain close (17.02, 22.73, 17.93 and 19.37), post hoc analyses reveal that the participants with a single episode of OM scored significantly higher

on the test of phonological awareness than the participants with no OM (t(52)=2.84, p = .006). All other comparisons remained non-significant.

Table 12
The Means and Standard Errors of Participants With and Without OM on Literacy Outcomes

	No OM (*n*=30)		Single Episode OM (*n*=15)		Recurring OM (*n*=7)		Perforation (*n*=5)	
	Mean	Std Error	Mean	Std Error	Mean	Std Error	Mean	Std Error
Spelling	12.28	2.30	15.15	2.47	11.49	2.98	13.65	3.21
Reading	22.23	4.77	23.54	5.12	18.35	6.40	27.24	6.94
Letter Knowledge	19.40	2.08	19.82	2.24	22.44	2.71	20.16	2.93
Phonological Awareness	16.76	12.42	22.33	12.78	19.18	13.87	19.53	14.42

4.5 Research Question Three

Research question three asked if there was a significant difference in literacy outcomes of Indigenous children with HL and OM compared to Indigenous children without HL or OM. Note that participants with episodes of OM but no HL or HL but no evidence of OM (*n*=11) are excluded from this analysis. There were no statistically significant differences between the participants with both HL and OM at least once and the participants with neither OM or HL (See Table 12).

Table 13
The Means and Statistical Difference Between Participants With and Without Otitis Media and Hearing Loss on the Literacy Outcomes

	Neither HL nor OM (*n* = 28)	Both HL and OM (*n* = 18)	Statistical Significance	Effect size (d)
Spelling	13.61	13.95	$F(2,44) = 0.05$, $p = .823$	0.07
Reading	23.91	25.36	$F(1,44) = 0.11$, $p = .738$	0.10
Letter Knowledge	19.16	20.022	$F(1,44) = 0.242$, $p = .625$	0.15
Phonological Awareness	18.17	21.36	$F(1,44) = 3.316$, $p = .075$	0.56

The remaining research questions address the literacy outcomes during and following the blocks of intervention. Of the 57 Indigenous participants, only students in pre-primary and Year one received the intervention. Four of these students were excluded due to poor attendance or attrition leaving the data of 34 participants to be used in the following analyses. Of these, 19 (group known as T3) received the intervention in Term 3 and maintained normal classroom activities in Term 4 and 15 (group known as T4) received the intervention in Term 4 but maintained normal classroom activities in Term 3.

4.6 Research Question Four

Research question four was asked in two parts. First, did students' literacy skills improve significantly following implementation of a targeted phonological awareness intervention. In other words, did students score better on the tests of spelling, reading, letter knowledge and phonological awareness in the assessment immediately following their block of intervention and at a follow-up assessment when compared to their pre intervention result? Second, given that some improvement would be expected due to maturation and time spent in normal classroom activities between assessments, it was asked if improvements remained when accounting for these factors. In other words, were any improvements between assessments significantly greater for those students receiving the intervention in that block compared to those students who did not receive intervention in that block?

To respond to the first part, a GLMM time effects analysis was conducted independently for the two group of participants (T3 and T4) on each literacy outcome. A GLMM interaction analysis was used to respond to the second part

where the change in literacy outcomes of the two groups was compared in the first intervention block (Ax1 to Ax2) and the second intervention block (Ax2 to Ax3).

4.6.1 Spelling.

The GLMM time effects analysis revealed steady and significant improvement across the four assessments ($F(3,125) = 54.229$, $p < .001$). The T3 students showed significant improvement overall and between the Ax1 and Ax2 and between Ax3 and Ax4. Their increase in scores between the Ax2 and Ax3 was not significant. The results of T4 students showed a significant increase in spelling results at all assessment points (See Figure 3 for means and Table 13 for significance values).

Table 14
Significance reports, Confidence Interval Range and Effect Size for T3 and T4 Participants' Spelling Scores for Each Assessment Block

	T3		T4	
	Statistical Significance	Effect Size (d)	Statistical Significance	Effect Size (d)
Ax1-Ax2	$t(125) = 6.521$, $p < .001$	1.500	$t(125) = 3.807$, $p < .001$	0.9829
Ax2-Ax3	$t(125) = 0.581$, $p = .562$	0.133	$t(125) = 3.253$, $p < .001$	0.840
Ax3-Ax4	$t(125) = 3.755$, $p < .001$	0.861	$t(125) = 2.541$, $p = .012$	0.656

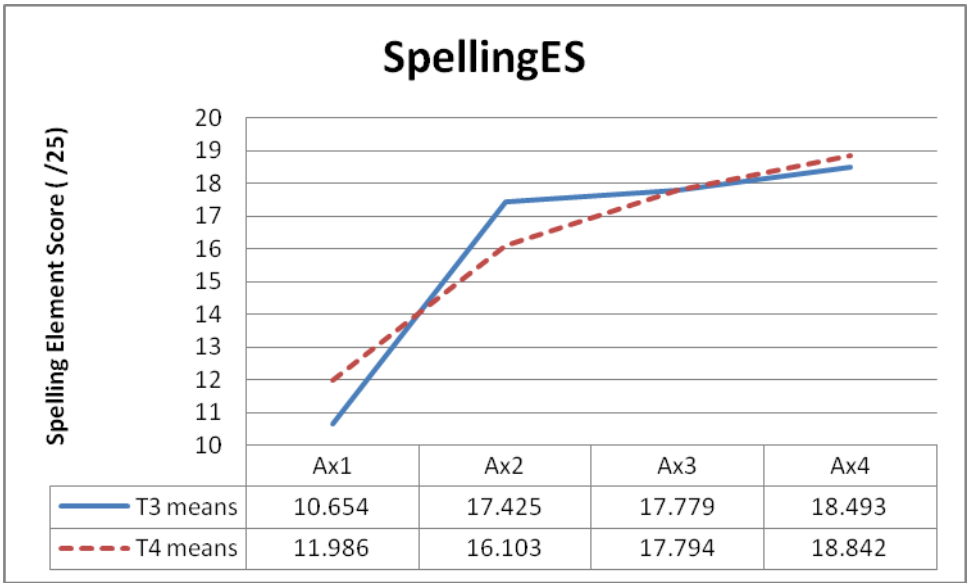

Figure 1. Means and plot of spelling progress of T3 and T4 participants

An interaction analysis compared the change in outcomes of T3 and T4 during the two intervention blocks. No significant difference was noted between Ax1 and Ax2 ($F(1,64) = 2.255$, $p = .138$). The interaction between Ax2 and Ax3 indicated that T4 participants showed a significantly greater improvement than T3 participants ($F(1,64) = 15.941$, $p < .001$).

4.6.2 Reading.

The GLMM analysis revealed an overall significant improvement in reading scores across the four assessments ($F(3,124) = 43.477$, $p < .001$). The T3 students showed significant improvement between Ax1 and Ax2 as well as Ax3 and Ax4 however their scores decreased significantly between Ax2 and Ax 3. The T4 students also showed overall significant improvement with significant increases in reading scores between Ax1 and Ax2 as well as Ax3 and Ax4. The means can be seen in Figure 4 and significance values in Table 14.

Table 15
Significance reports, Confidence Interval Range and Effect Size for T3 and T4 Participants' Reading Scores for Each Assessment Block

	T3		T4	
	Statistical Significance	Effect Size (d)	Statistical Significance	Effect Size (d)
Ax1-Ax2	$t(124) = 8.423$, $p < .001$	1.932	$t(124) = 3.418$, $p < .001$	0.883
Ax2-Ax3	$t(124) = -3.014$, $p = .003$	0.691	$t(124) = 1.248$, $p = .214$	0.322
Ax3-Ax4	$t(124) = 4.521$, $p < .001$	1.037	$t(124) = 2.454$, $p = .015$	0.634

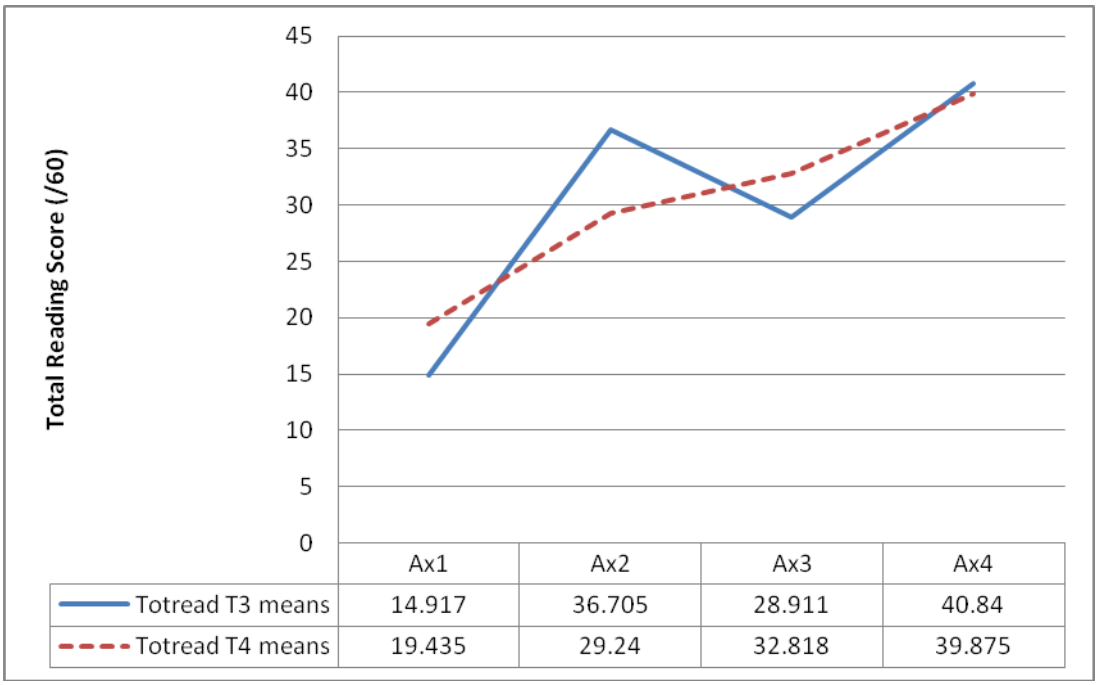

Figure 2. Means and plots of reading progress of T3 and T4 participants

The interaction between change made between Ax2 and Ax3 by T3 and the change made by T4 was significant ($F(1,63) = 13.716$, $p < .001$). The interaction of change between Ax2 and Ax3 was also significant ($F(1,63) = 14.184$, $p < .001$).

4.6.3 Letter knowledge.

A significant main effect ($F(3,125) = 11.649$, $p < .001$) showed an overall increase in letter knowledge scores. Both T3 and T4 students improved significantly between Ax1 and Ax2. There were no significant differences between Ax2 and Ax3

or Ax3 and Ax4 for either groups (see Figure 5 for the means and Table 15 for significance values).

Table 16
Significance reports, Confidence Interval Range and Effect Size for T3 and T4 Participants' Letter Knowledge Scores for Each Assessment Block

	T3		T4	
	Statistical Significance	Effect Size (d)	Statistical Significance	Effect Size (d)
Ax1-Ax2	$t(125) = 5.338$, $p < .001$	1.225	$t(125) = 2.556$, $p = .012$	0.660
Ax2-Ax3	$t(125) = -0.683$, $p = .496$	0.157	$t(125) = 1.150$, $p = .252$	0.297
Ax3-Ax4	$t(125) = 1.386$, $p = .168$	0.318	$t(125) = 0.405$, $p = .686$	0.105

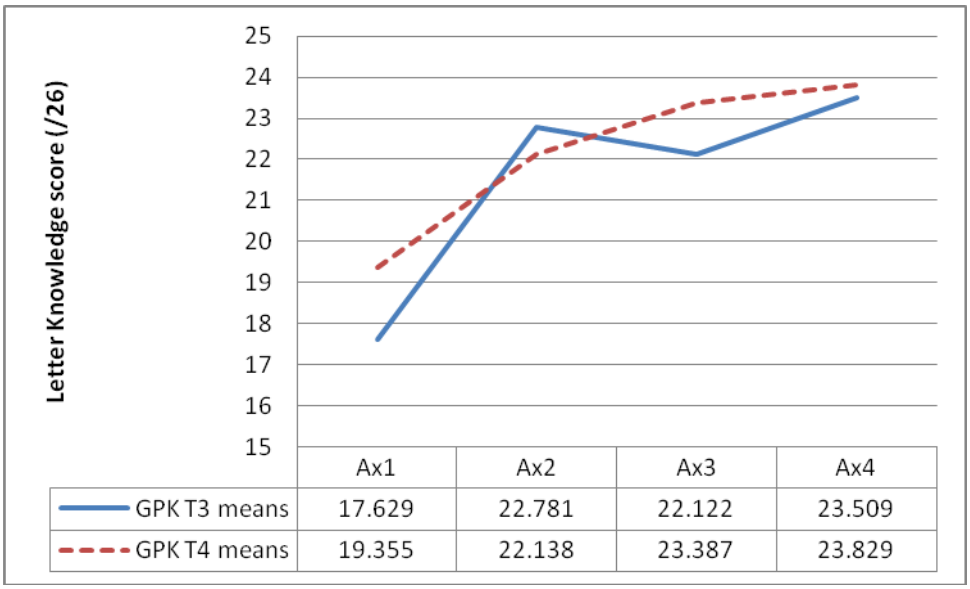

Figure 3. Means and Visual Representation of Letter Knowledge Progress of T3 and T4 Participants

There was no significant interaction between T3 and T4 on change in letter knowledge between Ax1 and Ax2 ($F(1,64) = 3.022$, $p = .087$). Analysis of the interaction between the two groups across term four (Ax2-Ax3) revealed a significant difference ($F(1,64) = 5.626$, $p = .021$).

4.6.4 Phonological awareness.

The main effect of a GLMM analysis revealed a significant overall increase in phonological awareness scores ($F(3,124) = 62.976$, $p < .001$). T3 participants

demonstrated significant improvement between Ax1 and Ax2 and T4 participants demonstrated significant improvement between Ax2 and Ax3. No other significant individual time differences were noted (see Figure 6 for the means and Table 16 for significance values).

Table 17
Significance reports, Confidence Interval Range and Effect Size for T3 and T4 Participants' Phonological Awareness Scores for Each Assessment Block

	T3		T4	
	Statistical Significance	Effect Size (d)	Statistical Significance	Effect Size (d)
Ax1-Ax2	t(124) = 10.491, p < .001	2.401	t(124) = -0.439, p = .662	0.113
Ax2-Ax3	t(124) = -0.965, p = .336	0.221	t(124) = 11.882, p < .001	3.068
Ax3-Ax4	t(124) = 1.799, p = .074	0.413	t(124) = -0.591, p = .556	0.153

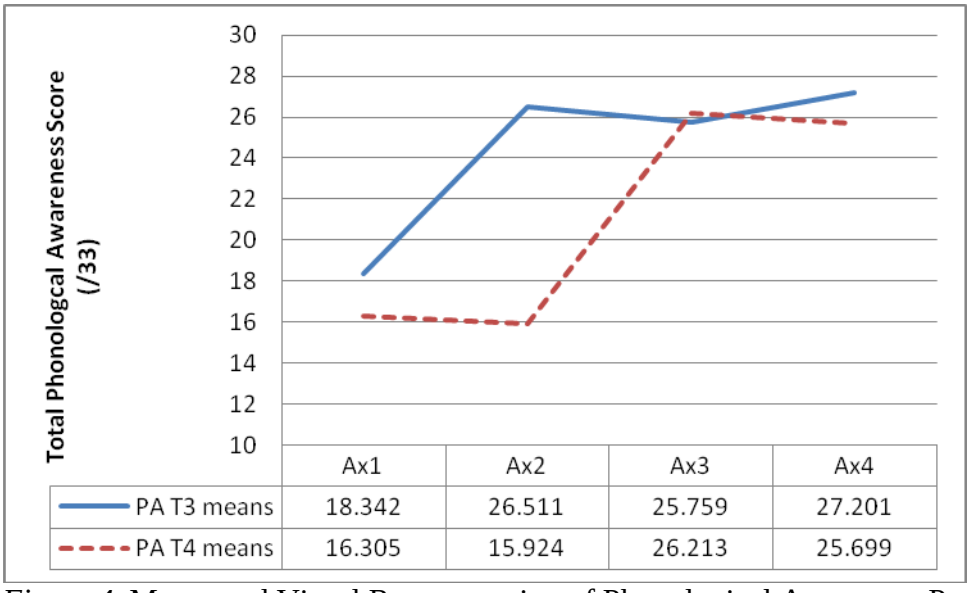

Figure 4. Means and Visual Representation of Phonological Awareness Progress of T3 and T4 Participants

The interaction between change on phonological awareness scores between Ax1 and Ax2 for T3 and T4 was significant ($F(1,63) = 60.660$, $p < .001$). Analysis of the interaction of change between the two groups between Ax2 and Ax3 revealed statistical significance ($F(1,63) = 144.366$, $p < .001$).

4.7 Research Question Five

Research question five asked if there was a significant difference between the pre and post intervention assessment of literacy outcomes of the children with OM compared with children without OM. The spelling, reading, letter knowledge and phonological awareness skills of the participants with evidence of OM in the year prior to the intervention were compared to those who did not have an episode of OM.

GLMM interaction analyses were conducted on the progress between the assessment immediately before the intervention (Ax1 for T3 and Ax2 for T4) and the assessment immediately after the intervention (Ax2 for T3 and Ax 3 for T4). This comparison compares the progress of the participants who did not present with an episode of OM (n = 17) and the combined results of those who had a single episode of OM (n = 9), recurring episodes of OM (n = 6) and one or more perforation (n = 2). See Table 11 for the means and effect sizes on each literacy outcome immediately pre and post the intervention block. There was no significant interaction between the two groups on either outcome.

Table 18
Means and Effect Sizes for Participants With and Without Otitis Media on the Four Literacy outcomes Immediately Pre and Post Intervention

	No OM (n = 17)			OM (n = 17)		
	Pre	Post	Effect size (d)	Pre	Post	Effect size (d)
Spelling	11.685	17.227	1.004	14.039	17.636	0.855
Reading	19.189	33.011	1.084	23.794	36.088	0.987
Letter Knowledge	19.185	22.526	0.579	19.558	23.288	0.707
Phonological Awareness	14.928	24.717	2.413	19.310	27.317	2.219

4.8 Research Question Six

Research question six asked if there was a significant difference in the progress of literacy outcomes of Indigenous children with OM and HL compared to Indigenous children with neither OM nor HL. In other words, would participants who had both OM and HL in the year prior to the initial assessment improve at a greater rate following a block of intervention than the participants who had neither OM nor HL prior to the initial assessment?

GLMM interaction analyses were conducted on the progress between the assessment immediately before the intervention (Ax1 for T3 and Ax2 for T4) and the assessment immediately after the intervention (Ax2 for T3 and Ax3 for T4). These analyses include participants who were recorded with both OM and HL at least once in the year prior to intervention (n = 13) and the participants who were not recorded with either OM or HL in the same time period (n = 13). As before, the participants with either OM or HL but not both (n = 8) were excluded from this analysis. Both groups made significant progress on all four outcomes and the interaction between the groups was not significant on either outcome.

Table 19
Means and Effect Sizes for Participants With and Without Otitis Media and Hearing Loss on the Four Literacy outcomes Immediately Pre and Post Intervention

	No OM or HL			Both OM and HL		
	Pre	Post	Effect size (d)	Pre	Post	Effect size (d)
Spelling	14.156	19.661	1.726	12.554	16.704	1.169
Reading	23.217	38.683	1.181	23.225	32.148	0.704
Letter Knowledge	18.754	22.354	0.640	19.388	23.347	0.762
Phonological Awareness	19.111	27.903	1.642	17.716	26.715	1.862

4.9 Summary

This section began with a description of the preliminary analyses of the impact of certain participant characteristics on the literacy outcomes of spelling, reading and PA. Despite some deviation from a normal distribution, results of more rigorous parametric tests were reported. The participants from each school and from each gender did not differ significantly on literacy outcomes. This uniformity assists with interpretation of the results in Chapter Five below. As expected, older participants as a whole showed consistently better outcomes for each of the literacy measures than the students in the younger years. As established in section 2.1, phonological awareness, letter knowledge, reading and spelling were all shown to be significantly correlated.

The six research questions were answered using the SPSS generalised linear mixed model. It was found that the non-Indigenous participants significantly outperformed the Indigenous participants on all outcome measures. Participants with and without OM, recurring or single episode only, did not differ on literacy performance. This non-significance remained with the addition of HL into the analysis. Indigenous participants with and without OM and HL improved significantly following the intervention but by similar degrees. The reasons for and implications of these results are discussed in detail in the following chapters.

Chapter Five: Assessment Interpretations and Discussion

This chapter addresses the early literacy outcomes of the 97 Indigenous and non-Indigenous Australian participants who completed a culturally adapted assessment devised predominantly from the Queensland University Inventory of Literacy (Dodd & Holm, 1996). The quantitative data collected for this study included the spelling, reading and phonological awareness scores from this assessment as well as additional spelling, reading and letter knowledge tasks devised specifically for the project. The scores of non-Indigenous and Indigenous Australian participants were used to respond to research question one. This question asked if non-Indigenous participants outperformed their Indigenous peers on the literacy outcomes. The affirmative was upheld by the results of the study. For research questions two and three, the literacy scores of the Indigenous participants were compared based on their ear health and hearing status in the year prior to the literacy assessment as measured by the Telethon Speech and Hearing Centre Earbus screening program. Research question two asked if participants with no otitis media (OM) outperformed the participants with a single episode of OM, recurring episodes of OM or evidence of a perforated tympanic membrane. Research question three asked if participants with neither OM nor HL outperformed the participants with both OM and HL. The affirmative was not supported by the results. In the following pages the outcomes of each question are discussed and the findings are placed in the relevant cultural context with the literature.

5.1 Comparing Literacy Skills of Indigenous and Non-Indigenous Participants

The results of this study demonstrate that non-Indigenous students outperformed Indigenous participants on the literacy assessment outcomes. On all

outcomes measured, the mean score of the 57 Indigenous students was significantly less than the mean score of the 40 non-Indigenous participants. These results are consistent with the trends shown by other studies on Indigenous Australian education and more specifically, literacy development in Indigenous Australian children.

5.1.1 Indigenous Australian education.

In a summary of the education issues faced by Indigenous Australian children entering school, Dockett, Mason and Perry (2006) describe Indigenous Australians as having the greatest educational disadvantage in Australia. There is a large collection of data supporting such statements and identifying the challenges faced by Indigenous Australian children when it comes to measurements of educational success. A Queensland study revealed that there are a disproportionate number of Indigenous students who repeat a year level at school, an indication of school failure or unpreparedness for school (Anderson, 2014). The Australian Government Productivity Commission Report on Government Services reported that 77% of urban Indigenous students in Western Australia achieved at or above the national minimum standard for reading in 2011 while over 94% of urban non-Indigenous students reached this benchmark (Productivity Commission, 2013). Numeracy, attendance and retention into senior secondary education remain low for Indigenous Australian students, contributing to an overall educational disadvantage (Mellor & Corrigan, 2004).

5.1.2 Indigenous Australian literacy.

There are few studies that specifically and adequately document comparisons of literacy skills of Indigenous and non-Indigenous Australians. This is despite knowledge that Indigenous Australian children are less likely to reach acceptable

levels of literacy by the end of schooling (Sharifian, 2005). A study conducted in urban Perth identified significant results showing that Indigenous Australian year one students performed more poorly at non-word spelling and reading and phoneme segmentation than age matched non-Indigenous students from the same schools (C. Williams & Masterson, 2010). The authors compared 10 Indigenous students with 10 non-Indigenous students using the Queensland University Inventory of Literacy (QUIL) and a real word spelling task. The current study supports these findings in a larger cohort.

Much discussion has arisen regarding possible reasons for this divergence and the educational disadvantage faced by children from ethnic minority communities such as Indigenous Australian children. These reasons include extrinsic risk factors such as socioeconomic disadvantage (Prior et al., 2011), less rich pre-school language experience due to, for example, not attending day care (Vernon-Feagans et al., 2002) or poor pre-school participation (Anderson, 2014). Poor formal education of the child's primary caregiver (V. Johnston, 2009) as well as teaching that does not appropriately acknowledge language history or address differences in dialect use (Zeegers, Muir, & Lin, 2003) have also been said to contribute to educational disparity. Intrinsic risk factors also play a role in educational disadvantage. Recent discussion on the link between health and education highlight low birth weight and the subsequent higher risk of language impairment (Bishop & Adams, 1990; Miller, Webster, Knight, & Comino, 2014), deficiencies in personal hygiene and nutrition (V. Johnston, 2009) and middle ear disease (Timms et al., 2012). Specific to the current study, a high rate of OM has been labelled a risk factor and the remaining two questions of this chapter address this issue. It was not possible

in the current research to access evidence of a history of language impairment, parent education, pre-school attendance or a number of other factors that may impact school age language learning (addressed further in section 7.4 on limitations of the study). This research did, however, address another issue pertaining to differences in language and literacy outcomes between Indigenous and non-Indigenous children. The type and approach of assessments is said to have an impact on the results in culturally and linguistically diverse cultures (Laing & Kamhi, 2003) and more specifically it has been suggested that language and literacy difficulties may have been over-identified in Indigenous Australian children (Toohill, McLeod, & McCormack, 2012). The researcher incorporated these concerns into the development of the research procedure and the outcome will be discussed in the following section.

5.1.3 Culturally appropriate teaching and assessment.

Williams and Masterson (2010) chose to use the QUIL, a standardised assessment, to provide Australian norms for the subtests of phonological awareness. The current author also chose the QUIL as part of the assessment procedure, however norms were not used and the approach was modified to be culturally appropriate as outlined in the section 3.3.4.5 on assessment modifications and additions. Standardised assessments are valuable as they indicate a range of scores considered normal in the target population (Malcolm, 2011), are efficient for assessing high numbers of students and ensure inter-rater reliability (Miller et al., 2014). However, given the cultural, linguistic, historical, socio-political and educational context of Indigenous Australian children, standardised assessments may

not appropriately measure their skills and are likely to be biased towards Standard Australian English learners (Malcolm, 2011; Pearce & C. Williams, 2013).

Although dialect was not formally identified in the study, all Indigenous participants demonstrated features of the light Aboriginal English known to be spoken by urban Indigenous Australian children. The dialect is characterised by subtle syntactic, semantic and lexical differences from Standard Australian English (Butcher, 2008). Language has been reported by urban Indigenous Australian children as a matter of difference between themselves and their non-Indigenous peers (Kickett-Tucker, 2009). This being the case, the researcher took great care when compiling and conducting the assessment to ensure guidelines for culturally appropriate language assessments were met (Gould, 2008; Malcolm, 2011; Pearce & C. Williams, 2013). This is particularly important given the understanding that higher levels of dialect density (more features of Aboriginal English) are more likely to interfere with the interpretation of an assessment than a light dialectal variety (Pearce et al., 2014). The modifications of the assessment to account for phonological differences, lexical variations and inadequate rapport with the assessor were implemented to ensure any differences between the two groups could be attributed as much as possible to differences in phonological awareness ability rather than language. Significant differences between the groups remained following efforts to reduce the bias of a standardised or culturally inappropriate assessment. The study by Williams and Masterson (2010) concluded that their Indigenous participants were within normal ranges but were significantly worse than the non-Indigenous participants, but did not account for the potential effect of dialect difference. The current study drew similar conclusions while taking into consideration Indigenous

learning styles and language use, thus confirming the poor literacy and pre literacy skills of Indigenous school children in urban Perth.

The remainder of this chapter addresses research questions two and three which were designed to determine whether OM and the co-occurring HL in early school years played a part in the reduced literacy outcomes.

5.2 Comparing Literacy Skills of Indigenous Participants With and Without Otitis Media

It was questioned whether children with normal ear health in the year prior to the assessment would achieve higher scores than those with evidence of OM in the same time frame. Children with OM during the screening period were divided into three groups; those that showed evidence of a single episode of OM only, those that were recorded with more than one episode of OM and those that presented with a perforated tympanic membrane at one or more screens. This difference was not shown, neither did the children with recurring episodes of OM score more poorly than those with a single episode of OM. There is very little research that specifically addresses the effect of OM in school aged Indigenous Australian students on their early school literacy outcomes. The existing research publications are linked to low socioeconomic or ethnic minority populations outside Australia. This research has predominantly focused on children experiencing high rates of OM in their first year of life which then affects later educational outcomes, rather than OM at school age. The outcomes are equivocal. The following section discusses reasons for these discrepancies and how the current results can be placed within the literature.

It is important to note the timeframe of the ear health screening in this study. Data contributing to the identification of OM was collected up to five times in the 15

months prior to the language assessment, when the children were aged between four and five years of age. The research question therefore addresses the impact on the literacy and pre-literacy outcomes of OM which occurs during the first years of school. Most discussion of the relationship of OM with literacy and language development begins with episodes of OM in the earlier stages of life. A study in urban Sydney, not restricted to Indigenous Australian children, collected data on the ear health of participants in their first 36 months of life (Winskel, 2010). The school age language skills of children with a history of severe OM were then compared with those of children with no history of OM. The children with a history of OM were shown to have significantly reduced scores on tests of phonological awareness and reading (Winskel, 2010). There was no mention of the occurrence of OM post 36 months. Similar studies outside Australia overwhelmingly focus on early OM. A study conducted in Nebraska, USA examined the medical records of five year old children and found that those with a history of seven or more documented episodes of OM with effusion before the age of three performed significantly more poorly on two out of three phonological awareness tasks than their peers with no history of OM (Nittrouer & Burton, 2005). This negative relationship between early OM and later literacy skills is, however, not consistently shown in the literature. A U.S. study tested the ear health of 83 students from African American families in low socioeconomic suburbs in their first four years of life (Roberts, 2002). Their findings showed that children with OM and HL in these early years were performing at par with children without ear health problems on measures of reading and word recognition. Results emerging from Belgium confirmed these findings. Majerus (2005) did not report significant differences in the phonological processing of school

aged children with no history of OM and those with recurrent OM prior to the age of three.

There is very little data available on school age OM to place the current study in context, even though it is in the first years of school that most Indigenous students are first exposed to formal teaching of pre-literacy and early literacy skills (Dockett et al., 2006). A meta-analysis of literature combining OM and language identified 32 relevant studies (Casby, 2001). All but one of the papers, an article published in 1978, used ear health data of the children before the age of five. This is likely because international papers conclude that the frequency of OM episodes reduces significantly as children grow(Gordon et al., 2004). Indigenous Australian data on the other hand reveals that OM frequency remains high beyond school entry (Timms et al., 2012; C. Williams et al., 2009). The vast majority of the papers in the meta-analysis included ear health data from the first year of life compared with later pre-school language skills. Few addressed phonological awareness. The meta-analysis concluded that the presence of OM in early years did not appear to impact the measures of language (Casby, 2001). It is within this equivocal context that the current study is to be viewed.

Despite the differing results in a variety of contexts, it is a widely held belief that OM is detrimental to educational outcomes (Coates et al., 2002; Department of Education, 2002; Gravel & Wallace, 1998; Northern Territory Department of Employment Education and Training, 2006/2007; C. Williams & Jacobs, 2009). Policies, funding decisions and identification and intervention programs have been based on this premise. The limited investigation into the impact of concurrent OM with literacy learning is surprising given the continued high rates of the disease in

Indigenous Australians at this age (Timms et al., 2012). The current study provides evidence that the Indigenous children without OM in the first years of school perform just as poorly on measures of literacy and phonological awareness as their peers who have had OM.

5.3 Comparing Literacy Skills of Indigenous Participants With and Without Otitis Media and Hearing Loss

Previous research has identified that ear infections frequently result in hearing impairment (Yiengprugsawan et al., 2013; Zubrick et al., 2004) and that a characteristic of OM is mild to moderate, predominantly low-frequency (J. Johnston & Green, 2002), fluctuating (Zumach et al., 2010) conductive hearing loss (HL). Some the authors addressing the nature of OM related HL conclude that this associated HL, if present during school years, may have negative consequences on the children's literacy learning (Aithal et al., 2008). In terms of language and literacy, the HL is a major concern associated with the disease (J. Johnston & Green, 2002).

It was therefore questioned whether children with both OM and HL in the year prior to the literacy assessment would have poor outcomes on the assessment compared to their peers who had neither OM nor HL. This was not found to be the case. The children with OM and HL performed slightly better on spelling, reading, letter knowledge and phonological awareness than children without OM or HL, however these differences were not statistically significant.

As discussed above, methodological differences may have an impact on the research outcomes. The measurements of OM and HL in the current study were

made when the participants were aged between five and seven years, attending pre-primary and year one. This age range and the specificity to measures of early literacy as opposed to other language skills or later reading ability limits comparison to previously reported literature. To date, the vast majority of literature reports on early language skills being hindered by OM and HL. A number of these studies do, however, hold some relevance to the current paper given the relationship between early language and later literacy development and will be used in discussion below. To understand these comparisons, a brief insight into the literature linking early language skills and school aged literacy skills is provided. A study with 350 children from low income homes in the U.S. supports the notion that a large range of oral language skills in early childhood contribute to early and later reading skills (Dickinson, McCabe, Anastasopoulos, Peisner-Feinberg, & Poe, 2003). It is important to distinguish between early and later reading skills as the current study assesses single word reading where the predominant skill required is decoding or sight word vocabulary as opposed to later reading which involves a detailed interplay of more advanced literacy skills such as semantic comprehension, context and syntax (Morrow, 2012). Dickinson and colleagues (2003) assessed four year old children on measures of vocabulary, phonological sensitivity and recognition of environmental print, as well as early phonological awareness. They found a significant correlation between the factors. Further analysis revealed that this interplay was different in children with low vocabulary or low phonological sensitivity (found in their low income participants) where each factor appeared to reply upon each other to strengthen the effect on literacy growth. These authors used this data to present the comprehensive language approach where emergent literacy and the subsequent reading achievement rely on a complex mix of earlier oral-language abilities. A

second paper based their research on a similar premise while investigating the relationship between early language delay and later difficulties in literacy (Larney, 2002). They report on a range of studies exploring the continuity between language delay in the early years and later literacy difficulties. These longitudinal studies all present a strong case for this continuity as well as evidence that poor literacy developing from delayed language is dependent on the age at which the language difficulty persists, the severity of the difficulty and the relevance of the difficulty to the specific literacy measures assessed (Larney, 2002).

Given the role that early language plays in supporting early literacy development and the dearth of literature specifically referring to school age language, there are a number of language based studies with children with OM and HL that are pertinent to the current study. For example, a nine year longitudinal analysis of children with and without OM with effusion and the accompanying reduced auditory acuity (measured with auditory brainstem response) analysed language abilities at age two, four and six years. At two years of age, the OM positive group produced more phonological errors and had a reduced consonant inventory (Abraham, Wallace, & Gravel, 1996). At age four, the receptive, expressive and global language scores of both the OM positive and OM negative children appeared at par, though the OM positive group had reduced speech intelligibility (Gravel & Wallace, 1992). By the time the cohort reached school, aged six years, no difference was found in the reading skills of the two groups (Gravel, Wallace, & Ruben, 1995). This progress indicates that children with OM and early reduced auditory input may be able to compensate for the initial language struggles associated with their HL. A Dutch study also concludes that any negative

consequences of OM and HL on language comprehension and production appear to resolve by seven years of age (Zumach, Gerrits, Chenault, & Anteunis, 2007). These studies must be interpreted with caution as the relevance to the current participants is dependent on the assumption that the children did endure language difficulties because of possible early OM and HL. This is not necessarily the case, though in the current study preschool language difficulties of OM and HL history are unknown. Reasons for this absence are outlined in section 7.4 on limitations of the study. The following sections specifically discuss school age literacy skills and school age OM and HL.

One study, also concerned with OM and HL in early school aged children, narrowed the theoretical cause of later language difficulties to reduced temporal processing. Johnston and Green (2002) summarised the early relationship between auditory deprivation and HL associated with OM and then conducted their own study comparing the temporal processing of children with and without a history of OM. They compared measures of temporal processing in 14 six and seven year old children with a history of ongoing OM, classified as evidence of effusion by the presence of a tymponstomy tube (grommet) with mild to moderate HL and 14 age-matched children without exposure to the disease. They concluded that temporal processing development is dependent on continuous, consistent, normal auditory stimuli, and that temporal processing difficulties may increase the child's vulnerability to problems interpreting speech in environments with competing noise, such as the background noise in the classroom (J. Johnston & Green, 2002). The authors were surprised to find no difference between the groups on a word repetition task with continuous and interrupted noise. This result indicates that perhaps there

are no temporal processing difficulties resulting from OM and HL, a supposition that further supports the non-significant differences between the two groups in the current study. With a comparable ability to isolate language from background noise in a classroom setting, all students are provided with equal opportunity to absorb literacy instruction as well as attend to other classroom activities. The authors conclude that ongoing OM may not necessarily result in long-term auditory processing effects and that normal development can continue to occur (J. Johnston & Green, 2002).

Studies presented to date are indirectly relevant to the current study. The early language literature provides evidence for an early childhood relationship with OM and HL with equivocal evidence of this relationship continuing into school. Research specific to temporal processing and auditory deprivation in school indicate a small non-significant effect on a child's ability to attend to and listen in the classroom. Despite this indirect support of a weak relationship between OM, HL and school aged literacy, there is one study that focuses specifically on the literacy of Indigenous Australian school aged children. This study, conducted within an urban Indigenous Australian population, investigated outcomes of phonological awareness, reading and spelling in school age children with concurrent and recurring OM (Walker & Wigglesworth, 2001). Their results contrast with the current findings. Walker and Wigglesworth (2001) found evidence of a relationship between the presence of OM and concurrent HL and the literacy measures. They compared the literacy outcomes of nine grade two Indigenous children from urban Sydney who were recorded with type B tympanograms and a hearing threshold greater than 25dB in both the year of assessment and the previous year, with ten Indigenous students with normal ear health and hearing (the control group). The small sample size

required analysis to be conducted with non-parametric tests. The control group presented better phonological awareness, reading and spelling skills than the children with OM and HL. The differences were significant on all comparisons. The current study was designed to be partially comparable to these results. The timing and literacy outcomes are similar as are the participant characteristics. The definition of OM is slightly different and this may be part of an explanation of the discrepancy. The current hearing data was collected independent of the research project which did not allow for criteria as stringent as the Sydney study. Both studies identified OM as a type B tympanogram and both included students with this type B plus failure to meet a hearing limit of 25dB (the Sydney study allowed this for any of the frequencies 500, 1000 and 4000hz, the current studied allowed for 1000 and 4000hz). The Sydney study, however, required participants to meet these criteria at both the time of screening and in the year previous. It is possible that the stricter criteria of recurring OM lead to a greater likelihood of detecting literacy difficulty. However, results in the previous research question do not indicate difference in the scores between participants with a single episode or repeated episode of OM in this population.

There is an additional possible reason for the discrepancy between Walker and Wigglesworth's (2001) study and the current results that warrants discussion. It is understood that it may not be possible to generalise results from one group of Indigenous students to another given the uniqueness of the populations (DiGiacomo et al., 2013), especially with small sample sizes. The current study population is almost three times the size of the Sydney study, however, represents a small percentage of urban Indigenous Western Australian children. The interpretation of

the results when compared to other urban Indigenous studies and even more so to international or non-Indigenous Australian studies must be made with caution (Mellor & Corrigan, 2004).

A more general explanation for the non-significant differences could include the following biological information about OM and HL. First, the prevalence of OM typically reduces as the child ages (Paden, 1994). This suggestion must be interpreted with caution in this paper as Indigenous Australian children do not show the same recovery trend, and rates of OM remain high well into school years (Timms et al., 2012; C. Williams et al., 2009). This may be an explanation for the apparent reduced or absent negative impact of OM and HL in older children but is unlikely to be applicable in the current study.

Second, HL associated with OM fluctuates (Roberts, 2002). It is difficult to ascertain how long HL continues during or after an episode of OM (Marieb, 2007). This may help to explain the findings of the current study. While HL was tested up to five times during the screening period, simultaneous with the ear health screens, it is unknown how long or to what degree this HL was occurring. Of the 27 Indigenous children with OM, two thirds (n=18) also had HL. The students with OM only were not included in the analysis for this research question but their ear health condition (OM without HL) demonstrates that HL does not necessarily occur for every episode or for the entire duration of the episode of OM. The fluctuating nature of conductive HL may allow for extended periods of normal hearing and therefore adequate language input. This applies to both the recovery noticed in the longitudinal study (Abraham et al., 1996; Gravel & Wallace, 1992; Gravel et al., 1995) and in the absence of significant group differences in the current study. Perhaps the sporadic

occurrence of mild or moderate HL in the participants was not extensive enough to contribute to reduced quality input in the classroom and therefore significantly different literacy scores than their peers.

The current results suggest that OM with HL as an isolated factor in early school years does not play a role in determining literacy outcomes for urban Indigenous Australian children. It may be, however, that it is one of a number of variables which, when combined, have an impact. Many studies reported to date rely on the premise that HL related to episodes of OM is a causal variable and directly impacts language skills in early years and at school age (Vernon-Feagans et al., 2002).What is evident from the plethora of research in the area is that there is not a clear causal relationship across studies (Casby, 2001). The question still remains as to why some studies find connections (Walker & Wigglesworth, 2001) and that theory suggests that fluctuating mild to moderate conductive HL during school years may be detrimental to learning and development (Roberts, 2002; Shriberg et al., 2000), yet other studies, including the current one, did not support the premise (J. Johnston & Green, 2002). Vernon-Feagans et al. (2002) suggest a model of accumulative risks. The presence of OM may possibly affect the mother and child relationship or difficulties with sustained attention which in turn may impact on the learning efficiency of the child, their ability to focus on or comprehend instructions or language discourse or reduced engagement in learning activities(Vernon-Feagans et al., 2002). These factors become negative moderators where the effects of OM are exacerbated. On the other hand, if positive moderators, such as quality day care, are present then they may buffer against the adversity of OM and HL(Vernon-Feagans et al., 2002). The authors also attribute discrepancies in study outcomes to confounding

variables such as socioeconomic status (SES) or diagnosis of OM. Other studies agree, suggesting that the variety of developmental outcomes of children with OM may be due to other risk factors such as quality of pre-school day care or amount of adult interaction (Stenton, 2007). Further, children with greater vocabularies in early years, reported by one author as more common in higher SES families, are able to compensate any other language difficulties with greater success (Dickinson et al., 2003). These variables could precipitate the effect of OM or be a buffer that prevents an effect on educational outcomes. These discussions suggest that OM and HL may or may not affect language ability *because* of related factors. Another perspective is that OM and HL may not affect language ability *despite* related factors. It is possible that children compensate for significant variation in their language learning environment (Menyuk, 1986). If the quality of language input in the early years is high, and their literacy training well supported then perhaps the presence of episodes of OM and HL, even recurring episodes, do not disadvantage the child. OM and the associated HL by itself may not play an independent role in determining literacy outcomes however it is highly likely that the Indigenous participants are subject to a number of factors that, when accumulated (Vernon-Feagans et al., 2002), cause them as a group to perform more poorly on the literacy outcomes than their non-Indigenous peers.

Chapter Six: Intervention Interpretations and Discussion

This chapter addresses the assessment post intervention and follow-up assessment results of 34 of the Indigenous participants. The intervention program followed the activities and goals provided in the Gail Gillon Phonological Awareness Program (Gillon, 2008) with additional strategies as outlined by principles of best practice for working with Indigenous Australian children (Education Department of Western Australia, 1999). The post-intervention assessments complied with the same structure as the initial assessment and tested the same early literacy skills; letter knowledge, spelling, reading and phonological awareness. Children who participated in 11 or more of the 15 intervention sessions were included in the analyses for research questions four, five and six. Question four asked if participants displayed improvement immediately following their block of intervention and at the follow-up assessments, and if this improvement was also shown when statistically controlling for usual classroom literacy curriculum in the same school term. The affirmative answer was supported by the results. Research questions five and six grouped participants according to ear health and hearing status. Students with no otitis media (OM) were compared with those with at least one episode of OM for question five and students without OM or hearing loss (HL) were compared with those with both OM and HL for question six. The groups were compared on their improvement from immediately before to immediately after their intervention block. A greater improvement in children with OM was not supported by the data. This was not expected following the non-significant differences between the students with and without OM or HL in research questions two and three. Before deliberating on each

outcome, this section outlines two potential barriers to the success of the intervention provided and their influence on the current outcomes.

6.1 Barriers to Successful Intervention

The process to ameliorate Indigenous Australian children's literacy levels has been widely discussed although evidence is rarely provided (V. Johnston, 2009; Western Australian Department of Education, 2002). There are considerable barriers to a successful literacy intervention program, not least of which are practical barriers such as attendance, participant attrition, behaviour and attention (Helme & Lamb, 2011). The researcher in the current study faced all of these challenges. The researcher was advised by the project's cultural consultant team which consisted of Indigenous researchers, participating school teachers, Aboriginal and Islander Education Officers (AIEOs) and a speech pathologist experienced in working with Indigenous Australian Populations. These meetings enabled sufficient preparation to reduce the likelihood of each of the barriers and to lessen their impact on the intervention. The barriers are discussed below.

6.1.1 Attendance and attrition.

The Australian Curriculum, Assessment and Reporting Authority (ACARA) documented an attendance rate of 81% for year one Indigenous Australian children in Western Australian government schools in 2010 (ACARA, 2010). This percentage indicates the proportion of school days attended. Note that the data does not disaggregate attendance for metropolitan or regional students though it is expected that absentee rates will be higher in remote schools (Bourke, Rigby, & Burden, 2000). For comparison, non-Indigenous year one students in Western Australian government schools attended 93% of school days in 2010. To present this in

perspective, there are approximately 50 school days in a school term and the ACARA average attendance rates predicts that students might be absent for 10 of these days. There are an extensive number of reasons suggested to cause the absenteeism including cultural events (e.g. attending funerals), undervaluing education, poor teacher/parent relationships, reduced engagement in school activities, transient home location (Reid, 2008) and illness such as OM (Mc Turk et al., 2008). This was discussed previously in section 2.4.6 on the relationship of OM and language in Indigenous Australian populations.

The cultural consultant team advising the current project speculated on possible days where attendance would be highest although this is unpredictable. This was discussed further with the classroom teachers and integrated into the intervention schedule. Suggested influences on attendance ranged from specific (e.g. students were more likely to attend on days where they were involved in sporting activities) to general (e.g. Indigenous Australian children are less likely to attend school on their parents 'pay-days').

Each participating school had strategies to combat absenteeism in the Indigenous students. One of the roles of either an AIEO or Aboriginal Attendance Officer is to work with families of children presenting with high absenteeism and to implement strategies to improve rates. Such initiatives include a pick-up/drop-off service or a reminder to families that school attendance is a legal requirement and of the importance of attendance for successful education (Mellor & Corrigan, 2004). Despite these expectations, session attendance, which is attendance at school on the day of the session, was above the average reported by ACARA. On average across the two blocks of intervention, participants attended 85% of sessions. Participants

who attended less than 11 of the 15 sessions were excluded from the analysis so the average attendance rates of the remaining participants increased to 89%. Attendance of less than 11 sessions reduces a participant's intervention time to less than half of the 20 session time frame recommended by Gillon (2008) and less than 70% of the current intervention. Of the four students excluded for this criterion, one moved to a different school and one stopped attending school for unknown reasons. Both were classified as attrition. Of the remaining two students excluded from analysis, one was a sporadic attender for whom the AIEO reported non-compliance from the caregivers and one spent approximately six weeks visiting family in rural Western Australia. Wolgemuth and colleagues (2013), while analysing the success of a literacy intervention in northern Australia, concluded that students who are not included in the analysis because of attrition or poor attendance are more likely to be students facing educational difficulties. Although not evidenced, this is possibly true for the small proportion of students (4/38) excluded from the current study. Literature suggests that their extremely high rate of absenteeism is likely to negatively impact their educational outcomes (Mc Turk et al., 2008).

Particularly important for the current research is an understanding that the implementation of a school based literacy intervention program may not be effective for students attending a limited number of sessions. The results indicate that while attendance was not a barrier to implementation of a successful program in general, it is concerning that 10% (4/38) of participants did not have the advantage of a full program due to their poor attendance. Attendance and attrition may be a barrier to successful completion of a literacy intervention and will have implications for future

planning of intervention programs. Further strategies to overcome absenteeism are required.

6.1.2 Behaviour and attention.

Social and emotional behavioural difficulties are listed as key factors in the academic outcomes of Indigenous Australian children in the Western Australian Aboriginal and Child Health Survey (Zubrick et al., 2006). The Australian Bureau of Statistics reports an indication by teachers that 17% of school aged Indigenous students in Western Australia are at high risk for clinically significant emotional or behavioural difficulties, the most common indication being hyperactivity (Australian Bureau of Statistics, 2007). This report must be interpreted with caution by first considering the experience and understanding of teachers working with Indigenous students, the definition and tolerance level of behaviour and the behaviour management skills of the teacher and policies of the school.

The researcher has considerable experience working with a school aged client base, including a number of years with a focus on Indigenous Australian children. This experience, coupled with expert advice from the cultural consultant team, allowed for adequate preparation for any possible barrier to intervention caused by poor behaviour. It would appear that the cultural adaptations to the intervention approach, such as establishing mutual respect, active play based tasks and peer on peer accountability plus an understanding of Indigenous children's communication style assisted, in general, to maintain facilitatory behaviour within the intervention groups. Behaviour was not a measured outcome however there are a number of factors that provide affirmation for the intervention approach. For example, a number of the students were known for disruptive behaviour within their classroom but were

compliant throughout the sessions, responding positively to the active and peer led tasks. Teachers reported an eagerness for students to participate in each session. Further, an education assistant accompanied the researcher for sessions with one group attended by a poorly behaving student (on recommendation of a behaviour specialist working with the child). The assistant did not participate in the intervention tasks but did demonstrate well established rapport with the child who was able to continue with the intervention. While facilitatory to the study, this also provides an example of the benefits of Indigenous staff, with long term rapport, working within this population, a strategy encouraged in literature on best practice in the education of Indigenous Australian children (Education Department of Western Australia, 1999). Despite the overall positive response, two students presented with behaviour that interrupted the efficiency of the sessions and, despite further adaptations and input from the school, were both excluded from the intervention program (see attempts to mitigate the behaviour in section 3.3.5.4). Because these students were removed from their respective groups, it is unlikely that poor behaviour will have impacted on the intervention program. Nevertheless, it is important to consider the possibility of this barrier to efficient and successful intervention. This is particularly pertinent because, as with attendance, there is literature indicating a relationship between the presence of OM and poor behaviour (Burrow, Galloway, & Weissofner, 2009; Otto, 2010) as discussed in section 2.4.1.3.

6.2 Comparing Change in Literacy Outcomes Following a Targeted Literacy Intervention Program

Participants performed significantly better at spelling, reading, letter knowledge and phonological awareness following a block of targeted intervention.

This analysis was complicated and strengthened by a number of factors. Firstly, participants were divided into two groups and were each presented with a block of intervention, one group received the intervention in term three (T3) and the other group in term four (T4). The staggered start to the interventions was planned to provide greater confidence that any improvement demonstrated was likely due to the intervention and not only classroom instruction. Second, assessment data was collected at four time points; initial assessment in term two (Ax1), an assessment at the end of term three immediately following T3 intervention block (Ax2), an assessment at the end of term four immediately following T4 intervention block (Ax3) and a follow-up assessment in term two the following year (Ax4). This provided data regarding the longer term impact of the intervention, determining if results were maintained throughout another term of typical classroom instruction. On all four outcomes students performed significantly better following the intervention and the outcomes remained high at the final assessment. It is part of Western Australian education curriculum to include daily literacy intensive sessions both within a dedicated literacy session and incorporated into mathematics, science and history components of the classroom curriculum (School Curriculum Standards Authority, 2013). For this reason, it was imperative to include a statistical design strategy that allowed comparison of literacy outcomes before and after the intervention, independent of the progress expected from normal school activities.

Interaction analyses which cross referenced the progress in each intervention block with the assessment results immediately before and immediately after the intervention revealed inconsistent results. The outcomes of reading and phonological awareness showed significant interactions for both intervention blocks. The group

that received the intervention improved more than those not receiving the intervention. For both spelling and letter knowledge, the interaction of the difference between outcomes before and after term four was significant however improvements appear to be similar through term three for both the group receiving the intervention and the group receiving normal classroom activity. Although the staggered design was intended to strengthen the analyses by attributing results to the intervention rather than the usual classroom activity, there are two reasons why only interactions of the pre and post assessment results in term three are interpreted in this discussion (see Figures 3, 4, 5 and 6). Firstly, cross referencing these interactions to the outcomes at the end of term four is problematic given the group receiving normal classroom activity had already received the intervention the term before. Secondly, the significant interaction shown for T3 and T4 group between Ax2 and Ax3 for reading, letter knowledge and phonological awareness is likely attributable to the decrease in the T3 scores rather than the significant increase in outcomes presented by the T4 students. There are a number of important observations of the outcomes discussed below.

Phonological awareness was specifically targeted in the current intervention. It is not surprising, then, that it was this outcome that showed the greatest improvement. Although not directly targeted, the outcomes of spelling, reading and letter knowledge were incorporated in some tasks such as the book share or the sound tracking activities with added letter blocks. Extensive research has shown that phonological awareness intervention produces improvements in phonological awareness outcomes (Blachman et al., 1999; Gillon, 2000) and that the transfer to reading and spelling improvements is expected (Foulin, 2005; McLachlan & Alison,

2014; Rohl & Pratt, 1995). These improvements may be delayed as further practice to explicitly apply the learnt phonological awareness skills to spelling and reading activities may be required (National Reading Panel, 2000). The usual classroom environment is designed to provide these activities. The reading scores in the current study improved significantly for T3 students after their block of intervention, then decreased throughout term four, then showed further significant gains at the follow-up assessment. The T4 students improved during their intervention block, though not significantly, but did show significant gains at the follow-up assessment. This pattern suggests delayed transference of the targeted skills to their acquisition of reading. A similar pattern is shown with spelling outcomes with improvement shown for both groups immediately following their block of intervention and at the follow-up assessment. Both groups showed significant improvement in reading and spelling outcomes at Ax2 whether they had received the intervention or not. However, only the reading interaction was significant indicating a treatment effect for reading but not spelling. Reading skills may be particularly benefited by an increase in phonological awareness with more literature focusing on phonological awareness effectively aiding reading development over spelling development (National Reading Panel, 2000).

The outcomes of letter knowledge displayed a different pattern and plateaued after term three with no significant change in results for either group at Ax3 or Ax4. This was expected as letter knowledge is an early learnt skill. Students are expected to be familiar with the alphabet prior to school (Morrow, 2012), however, children from socially and economically disadvantaged communities, including Indigenous Australian children, are often first exposed to the English alphabet in kindergarten or

pre-primary. An Australian study of one such urban community reported that a third of participants in year one were unable to name 50% of the alphabet (Hay, Elias, Fielding-Barnsley, Homel, & Freiberg, 2007). The low letter knowledge score in the current study (an average of scores for each group) is likely to reflect the poor awareness of the pre-primary participants. They demonstrated rapid and significant increase in their letter knowledge, whether they received the intervention or not, and reached the level of their older peers by Ax2. This result is likely to be influenced by a ceiling effect with high scores and no significant increase between assessments two, three and four. The participants were consistently familiar with the vast majority of letter names or sounds (averaging close to 24/26) with the most common errors being incorrect identification of q (as p) or y (as u) or d (as b). These are common errors in alphabet knowledge. Letter learning is based on probability in languages (q is an uncommon letter) and letters are recognized against feature information (y/u and b/p share similar features) (Rummelhart, 1994). These errors are not likely to significantly impact on the spelling outcomes, especially as inverse letters were scored as correct in the current study (see section 3.3.4.1).

There are a large variety of phonological awareness interventions available with recent literature focusing on teacher led whole class programs or evaluation of the success of teacher professional development (Lane, Prokop, Johnson, Podhajski, & Nathan, 2013; McLachlan & Alison, 2014; Wolgemuth et al., 2013). Few address small group phonological awareness therapy presented in a similar style and to a similar age group as was the case in this study. One example, a U.S. study, investigated a phonemic awareness instruction program with 42 metropolitan kindergarten and year one students (Cunningham, 1990). While this study analysed

data from middle class families with a background of normal ear health, the results of the study provide insight into the general trends expected of literacy intervention programs. The first grade children aged 6;3 to 8;1 years (approximately equivalent to year two students in the current study) performed significantly better than the kindergarten children aged 5;4 to 6;5 years (approximately equivalent to year one students in the current study) on the phonemic awareness measures including tasks such as phonemic deletion (equivalent to phoneme detection in the current study) and phoneme oddity (equivalent to phoneme manipulation in the current study). This is not a novel concept given the literacy growth expected in these early years and is also shown in the current study where the older participants performed significantly better on all outcomes than the children in the years below.

The same study found a significant effect of intervention indicating a highly effective facilitative role of phonemic awareness training in the participants reading performance. The participants were divided into two experimental groups receiving either a ‘skill and drill’ treatment approach or a ‘metalevel’ treatment approach and a third control group receiving usual classroom story book exposure. The treatment approaches are addressed individually in the third point below but both resulted in significantly improved phonemic awareness. This corresponds with outcomes of the current study where the participants showed significant improvement in phonological awareness following the phonological awareness targeted treatment program. A post-hoc comparison in the U.S. study showed that both treatment groups in both grades performed significantly better at the reading assessment than the control group. This analysis supports the premise of a strong positive association between reading and phonemic awareness, an association that is also shown in the current study.

A third parallel between Cunningham's (1990) investigation and the current study lies in the different treatment approaches. It was concluded that, following the treatment phase, the kindergarten students in both experimental groups achieved a similarly high improvement in reading outcomes. However, the reading results for grade one students after the block of 'metalevel' analysis were significantly higher than the reading results of the experimental group provided with the 'skill and drill' treatment approach. Both treatments involved twice weekly small group sessions for 10 weeks. Both treatment approaches explicitly taught skills of blending and phonemic segmentation, justified by their close association with reading. However, in the first treatment approach, 'skill and drill' students received this teaching in a decontextualized manner focusing purely on the skills while in the second treatment approach, 'metalevel', students were led to apply the skill by generating further examples or contextualising the task in a story. This second treatment method was shown, by a three way interaction of treatment analysis, to improve reading achievement to a significantly greater level than the improvement shown following 'skill and drill'. The intervention presented in the current study also includes a holistic approach focusing not only on specific skills of phonological awareness but also on how these can be applied to tasks of early reading and spelling. For example, each session was introduced with a book share or similar activity where skills learnt in the previous session were reiterated and integrated, and activities that taught a 'big picture' approach (see Table 5) were included to explain the role of sounds in syllables, syllables in words and words in discourse. In this sense, there are considerable similarities between the 'metalevel' approach described in the U.S. study and the current intervention. The results provide confirmation of the treatment choice in the current study. However, while all students in the current study showed

significant improvement in phonological awareness at all assessments, reading results did not show significant improvement immediately following intervention in the students receiving the intervention in term four. The question arises as to why Cunninghams's (1990) 'metalevel' approach resulted in significant improvement in phonemic awareness which related to significantly improved reading while in the current study reading improvement was only significant immediately following intervention for one group of participants; the group which received intervention in term three. Cunningham (1990) highlights the fact that the kindergarten students did not show the same treatment effect, suggesting that their reduced exposure to reading in an earlier stage classroom may have reduced their ability to apply their new found skills. The participants of the current study were at least a year younger than those reported in the U.S. study. This may be one explanation for the less marked transfer of skills to reading outcomes. It is also possible that the age of the current participants, and the fact that they entered school with already reduced pre-literacy skills, did not allow for adequate opportunity to apply their newly learnt phonological awareness skills in the classroom or at home, resulting in reduced transference of these skills to reading abilities.

All participants in the current study showed an overall significant increase in reading scores. Discussion within the U.S. study (Cunningham, 1990) revealed a second possibility that could be applied to the current results. The transfer from phonological awareness to reading outcomes may be delayed rather than displayed immediately following the intervention therefore indicating the need for opportunity to apply and consolidate.

A third reason for the slight discrepancy between reading outcomes of the U.S. study and those of the current study likely lies in the differences between participants that may affect their pre-school learning such as socioeconomic status (SES) or cultural differences of the participants. It is possible that given the significantly delayed phonological awareness and reading skills of the current participants before intervention, they may require further instruction to apply the targeted skills to outcomes of reading and spelling. Similarly, the current participants received the phonological awareness instruction and exposure within a culturally supportive environment. They may also need this support when learning to transfer these skills to reading. Comparison to a study conducted with Indigenous Australian school aged children is needed.

Interventions targeting literacy in Indigenous Australian school aged children are scarce and studies rigorously investigating the success of these programs are even less frequent. In 2000, the Australian Commonwealth Government launched the National Indigenous English Literacy and Numeracy Strategy (NIELNS). This initiative aimed to ensure Indigenous students were reaching the literacy and numeracy levels of their non-Indigenous peers (Mellor & Corrigan, 2004). The NIELNS worked towards the following six key issues; attendance, hearing health and nutrition problems, preschool experience, good teachers, best teaching methods and measuring success and accountability. These issues were to be addressed by cooperation between the Commonwealth and education providers who were to be empowered to implement best practice with existing resources. Using these resources and a provision of recurrent funding, educators were encouraged to establish strategies to reach the common goal of improved literacy and numeracy and to implement clearly articulated plans (Mellor & Corrigan, 2004). This empowerment

of health professionals appeared to be limited to monetary support. However, a number of relevant resources were produced and are described below. An executive summary of NIELNS lists the projects funded by the initiative that reported to a national survey. Eighty eight percent of providers reported that their projects had a moderate to major impact on literacy and numeracy skills (Hugh Watson Consulting & Department of Education Science and Training, 2003). The survey compiled a list of how this impact was achieved and what factors contributed to the success. While these factors are general, there are some direct applications to the current study, for example; *"the community supported and was involved in the education of their children", "the teachers expect that the Indigenous children will be successful", "the development of materials that support, value and represent Aboriginal culture is leading to greater interest and involvement by Indigenous students, improved attendance and improved literacy and numeracy results"* and *"testing is helping to improve the recognition of health problems and their earlier treatment"* (p.g. 9-10). Beyond the reporting of survey data, each initiative under NIELNS was to conduct their own evaluation. Importantly, the NIELNS, labelled a readiness for learning program, indicates positive outcomes. Improvement was reported by 75% of individual initiatives. However, the authors observe that overall improvement is a long process and requires the extensive collaboration of multiple providers (Hugh Watson Consulting & Department of Education Science and Training, 2003).

One resource available at the time of NIELNS and relevant to the current study is the 'Time for Talk' initiative aimed at increasing oral language in Indigenous Australian children in the classroom (Department of Education Western Australia, 1998) This was introduced two years prior to the NIELNS, but has not

been evaluated for success or implementation. Another resource that was available to educators of Indigenous Australian children is a literacy resource book published by the Catholic Education office called ‘Making The Jump’ which was targeted at schools in rural and remote Western Australia where Standard Australian English is often a second or third dialect for the students entering school (Berry & Hudson, 1997).

Despite these valuable resources, albeit with limited evidence of their efficacy, none of the six NIELNS outcomes, with the possible exception of *Good Teaching*, encompass an explicitly taught, targeted literacy intervention. Although the most recent mention of NIELNS by the Commonwealth Department of Education stated that responsibility for this program was transferred to the Department of the Prime Minister and Cabinet on 18 September 2013, there does not appear to be an evaluation of the success, or otherwise, of the strategy. The only nation-wide evaluation of Indigenous Literacy appears to be NAPLAN (Australian Curriculum Assessment and Reporting Authority, 2011), a national level benchmarking scheme in years three, five, seven and nine (MCEETYA, 2006).

There is one smaller scale program introduced to schools in Australia’s Northern Territory to address inequitable literacy outcomes. ABRACADABRA (ABRA), mentioned in more detail in section 2.1.2.2, is a web based tool supporting teachers to address foundational literacy skills (Wolgemuth et al., 2013). This involved four 30-45 minute teacher led sessions per week for a school term focusing on activities of letter knowledge, reading and phonological awareness using a computer program. The participants were 312 pre-primary, year one and year two students. Of these, 28% identified as Indigenous or Torres Strait Islander. The paper

by Wolgemuth and colleagues (2013) was the first to report a rigorous analysis of any school based literacy intervention with Indigenous Australian children which included an Indigenous and non-Indigenous control. Unlike the state and national level strategies, ABRA had undergone rigorous evaluation using a multi-site randomised control trial design. A significant improvement in phonological awareness skills following the term of intervention was shown, with particularly strong progress shown by the Indigenous cohort.

There are a number of similarities to the intervention in the current study. First, ABRA was designed to complement the classroom literacy curriculum. In both interventions, sessions were scheduled outside of normal classroom literacy lessons and were tailored to the level of the particular group. ABRA was advantaged by using classroom teachers to conduct the intervention who were then encouraged to continue with the strategies beyond the allocated intervention sessions. Second, the sessions of both interventions were structured with a general whole group activity that reviewed the skills learnt and introduced the context of the new targets. In both cases, these targets were within the categories of letter knowledge and phonological awareness. Third, while the analysis design for the interventions differed, both compared the intervention progress to a control group of students receiving normal classroom activities such as phonics and group reading. Fourth, both interventions resulted in significant overall improvement in phonological awareness when compared to the control and the results were not as conclusive with reading outcomes. In the ABRA evaluation, it is suggested that this indicates that the overall improvement following the program was driven by phonological awareness outcomes, a conclusion also likely in the current targeted intervention. A final

comparison between the two intervention programs lies in the population focus. While non-Indigenous students were included in the class based ABRA intervention, the focus of the study was to improve literacy outcomes in Indigenous students. Analysis of co-variance and logistic regression comparing the Indigenous and non-Indigenous students revealed particular improvement in measure of phonological awareness and phoneme-grapheme correspondences for the Indigenous children when compared to the progress of both the Indigenous control and the non-Indigenous children receiving the intervention. Results of both studies therefore show promise in the use of phonological awareness interventions as a "learning accelerant" for early literacy growth of Indigenous participants, aiming towards equal performance with their peers (Wolgemuth et al., 2013, p. 261).

It is widely understood that in the first years of school (which in Western Australia are pre-primary, year one and year two) children are exposed to explicit literacy training, sometimes for the first time, and their skills develop significantly in these early years (Clay, 2001). Yet for children with delayed phonological awareness or who are inhibited from receiving the full benefits of this time period, explicit intervention is necessary to maintain relative equality throughout these early years. The participants of this study have been shown, on the whole, to benefit from the intervention provided.

6.3 Comparing Change in Literacy Outcomes of Indigenous Children With and Without Otitis Media and Hearing Loss

In addressing research questions five and six, the improvements, following a block of intervention, of children with one or more episodes of OM in the year prior to the assessment period were compared to participants with normal ear health. In a

more specific comparison, children with both OM and HL were compared to their peers without prior OM or HL to the intervention. These questions were constructed on the assumption that significant differences would be demonstrated for research questions two and three and OM and HL would be shown to have an impact on school aged literacy learning. Given that no significant difference between the participants with and without OM or HL was found at the initial assessment, it is not surprising that the progress of the Indigenous participants was fairly uniform, regardless of their ear health and hearing status.

This study is particularly concerned with the Indigenous Australian children with OM during the testing period of their early school years. Concerns about this population are also documented in a small body of literature aiming to provide these children with further literacy learning. These concerns have resulted in a number of strategies working on the presumption that their literacy is delayed due, in part, to their poor ear health. Examples of strategies and programs are described in more detail in section 2.1.2.2 on addressing literacy deficits. As with the literacy interventions targeted to Indigenous Australian school age children more generally, there do not appear to be any publications addressing the outcomes. The report published for the Commonwealth NIELNS provided a summary entitled Intervention Strategies for Aboriginal Children with Conductive Hearing Loss (Western Australian Department of Education, 2002). The project was an initiative aimed to contribute to the outcome *Overcoming hearing health and nutrition problems.* The strategies were developed in consultation with parents, teachers, elders and Indigenous children in an urban primary school in 1999. The authors acknowledge that evaluating the effectiveness of the strategies as they are generalized to different

school communities is challenging. However there is also no apparent documentation of the success within the original school, nor information regarding the number of schools which have since implemented the strategies.

The report introduces a number of reasons for adopting the strategy in this particular population with a focus on the children suffering from chronic conductive HL arising from OM. These purposes include difficulty transitioning from oral language to the literate language style expected in school, reduced experience with oral language and vocabulary, avoidance of engagement in reading and other classroom activities and absence of a strong auditory processing platform on which to build their Standard Australian English. These are not strongly supported by literature in the report. However, the current project arose from similar observations of the struggles of this populations reported in the literature and supporting evidence has been gathered and reported in detail in chapter two on the appraisal of existing knowledge. There are further similarities between the appraisal of current knowledge presented in the current paper and the literature presented in the justification of purpose for the strategies report. Both include the low-achievement scores on the literacy benchmarks provided by MCEETYA (2000). Both summarise the phonological awareness program for Indigenous EFL students with hearing disabilities (PA-EFL) by Yonovitz and Yonovitz (2000) as a key, if not the only, intervention designed specifically for Indigenous Australian children. These similarities in literature despite a time period of over a decade between the two documents indicate how poorly the issue has been addressed. The PA-EFL program was evaluated and students made significant gains in measures of phonological awareness, reading and spelling. Although the title suggests a program targeted to

children with poor ear health, there is no indication of the number of participants with HL and therefore no comparison between groups. This is likely due to the location of the study, in very remote north Australia, where HL is extremely prevalent and may have been assumed to be present. Instead, Yonovitz and Yonovitz (2000) record their efforts to support the students and education staff in the literacy learning by providing amplification sound systems and hearing aids, hearing testing and referral to the appropriate medical personal and in-service education on hearing testing, disabilities and their possible effect on classroom learning. Although successful, seen in the significant increase post intervention in the current study, the authors did not analyse their data for any differences in results for their participants with and without OM and HL. Although both the current study and the PA-EFL study demonstrate success following a targeted phonological awareness intervention, neither provides a strong indication that this success is influenced by the presence of OM or HL in the population.

Chapter Seven: Conclusions

The purpose of this study was to determine whether Indigenous Australian children with otitis media (OM) in their first two years of school demonstrated particularly poor outcomes on measures of early literacy when compared to their Indigenous peers with normal ear health during this time. High rates of OM are well documented in many Indigenous Australian Communities (Coates, 2002; Gunasekera et al., 2007; Kong & Coates, 2009; Latzel & Hunter, 2002; Morris et al., 2007; C. Williams, 2003) with significant repercussions for hearing loss (HL) (Nienhuys et al., 1994). This high prevalence is also documented specifically in school aged children in Perth (Timms et al., 2012; C. Williams et al., 2009). The generally poor academic outcomes of Indigenous Australian children are also well documented (Anderson, 2014; Australian Bureau of Statistics, 2007; Dockett et al., 2006; MCEETYA, 2006; Zubrick et al., 2006) and also apply to the Indigenous children in Perth (C. Williams & Masterson, 2010). Many international studies, including two meta-analyses, have attempted to address a connection between the disease and poor educational outcomes in low socioeconomic and ethnic minority groups (Bowd, 2004; Casby, 2001; Roberts, Hunter, et al., 2004; Roberts, Rosenfeld, et al., 2004; Shriberg et al., 2000) with equivocal results. In Australia, the relationship is far less analysed with only one study reporting literacy outcomes of Indigenous Australian children who presented with OM and HL in primary school (Walker & Wigglesworth, 2001). Nevertheless, many publications make the suggestion that OM and the subsequent HL play a significant role in the reduced educational outcomes of Indigenous Australian school children (Couzos et al., 2001; Mc Turk et al., 2008; Partington & Galloway, 2005). A secondary purpose of this study was to address the

literacy deficits in the participants and determine if a targeted phonological awareness program impacted students' achievement in spelling, reading and phonological awareness, particularly if they had been recorded with OM in the prior school years. Phonological awareness training has been shown to positively impact school aged literacy outcomes for children with increased risk of literacy learning difficulties (Blachman et al., 1999; Gillon, 2002; Nancollis et al., 2005) but has never been documented in a culturally appropriate program for Indigenous Australian children.

This study implemented quantitative analyses, using a method that is robust to group differences, to assess both the between group differences on the initial assessment and the effectiveness of the intervention. It was anticipated that ehe results of these analyses would contribute to the field of Indigenous Australian health and education, firstly, by advancing the research on the impact of OM and the reasons for poor literacy outcomes and, secondly, by documenting an effective method to improve these literacy outcomes.

This final chapter begins with a brief summary of the study outcomes. It includes discussion on the implications for future research, Indigenous communities and education and health providers. The limitations of this study will be presented to provide insight regarding the scope of the study followed by concluding statements.

7.1 Addressing the Research Questions

In responding to the first research question, the current study provided further evidence for the significantly poorer literacy outcomes in Indigenous Australian pre-

primary, year one and year two students when compared to their non-Indigenous peers.

In response to research questions two and three, there was no significant difference between the literacy outcomes of students with and without OM or HL.

The analyses for research question four revealed significant improvement in the literacy outcomes of Indigenous children following a targeted phonological awareness program. For both reading and phonological awareness outcomes, interaction analysis demonstrated significantly greater improvement in the children receiving the first intervention compared to those receiving normal classroom curriculum. For both spelling and letter knowledge, this interaction was only apparent following the second intervention block. The outcome of this is less clear because the T3 students receiving normal classroom curriculum had received the intervention in the previous term and demonstrated a decrease in score for these two outcomes. While the interaction is likely due to this decrease, it does still indicate a positive impact of the intervention on the children's spelling and letter knowledge scores.

In response to research questions five and six, results did not reveal significant differences. Neither the children with OM or OM and HL performed significantly better than their Indigenous peers with no episodes of OM or neither OM nor HL.

The results answering the first and last three research questions provide strong support for the need to address literacy deficits and for the effectiveness of one way of doing so in the target population. Research questions two and three

suggest that the presence of OM is not a key contributor to the literacy difficulties seen in the participants; instead, a holistic analysis of the multi-factorial nature of social, health and educational influences is considered to interact with literacy abilities in Indigenous Australian children, of which OM may be one factor. Reasons for these results as supported, or otherwise, by recent literature were discussed in chapters five and six. The following section addresses implications of the outcomes on the practice of health and education providers in Australia.

7.2 Implications for Best Health and Education Practice

7.2.1 Ear health screening.

Given the lack of significant difference on literacy outcomes of the participants with and without OM and HL, the importance of ear health screening for educational purposes is put into question. There is no doubt that OM and HL are highly prevalent in Indigenous Australian children and that rates continue to be high in early school years (Timms et al., 2012). It is therefore imperative that regular ear health screening continues to target a primary health issue and provide, if necessary, medical and social intervention. However, the integration of the ear health screen into a language assessment for all Indigenous children may not be worth the cost. Results of the current study show reduced literacy outcomes for all Indigenous Australian children despite their ear health status. Therefore this status cannot be used as a predictor or indicator of poor literacy outcomes. Introduction of a state wide screening program that provides regular ear health checks for Indigenous Australian children from birth remains valuable for a host of other reasons but cannot be definitively associated with literacy. There remains, however, an inadequate understanding of the impact of early OM and HL on later language in Indigenous

Australian children. Testing younger children for fluctuating conductive hearing loss may ensure that any deficit that develops is given a chance to resolve prior to school entry (J. Johnston & Green, 2002).

7.2.2 Literacy assessment.

The significantly low literacy outcomes of the Indigenous Australian children in pre-primary may indicate the children's lack of preparedness for school. This has implications for pre-school language and literacy exposure. Indigenous Australian children have been reported to find the transition to school particularly difficult with 75% of Indigenous children not attending a formal early education service (Rosier & McDonald, 2011).

There are serious implications arising from the continued poor literacy results into year three. The literacy assessment, carefully designed to test literacy skills without the influence of cultural or language differences, indicates that the participants continue to remain behind their peers into the third year of schooling. This poor performance in early school is said to directly impact retention into high school, confidence in educational abilities, trust in the school system, secondary education success and employment prospects(Mellor & Corrigan, 2004).

7.2.3 Intervention.

The current study presented an overall improvement following the phonological awareness intervention. However, scrutiny of the individual data is warranted to determine individual patterns of improvement following the intervention. This may indicate a need for a more individualized program to encourage growth in students who showed little or no improvement. Additionally, it

was observed that the intervention style, carefully planned for the population, fostered self-esteem and cultural values. Students demonstrated group identity and most sessions involved discussion about their culture and their language while learning. This has positive implications for students' confidence in their Indigenous identity within the expectations of the school system (Western Australian Department of Education, 2002).

The success of the intervention in the current study has implications for the planning and structure of future phonological awareness interventions in Indigenous Australian populations. Training of teachers, although proven to promote early literacy, is difficult given the vast differences in cultural groups across Australia and the very varied needs within one classroom. Therefore, training other education workers to work with these children in small groups in addition to regular classroom activities appears to be an effective and efficient option. This has implications for time allocation of education support workers in classrooms with Indigenous Australian children who demonstrate reduced literacy.

There is a hope that this study will serve as the springboard for schools and districts to consider the individual needs of their Indigenous Australian students and then provide evidence based, culturally appropriate assistance as needed.

7.3 Future Research

Based on the results of this study, there are a number of recommendations that would assist in furthering positive outcomes in ear health and educational outcomes for Indigenous Australian children. The researcher of the current quantitative study was presented with a challenge to avoid a problem-based attitude.

This was made particularly difficult when much of the underlying evidence focuses on problem statistics. It is important that all ongoing research remains strength based (Centre for Child Well-Being, 2011). The following suggestions are accompanied with encouragement to maintain positive, inclusive and respectful forward thinking when contributing to the growing Indigenous research discourse.

The most pertinent need for research following this study is to address the equivocal data on early OM and later literacy results and the dearth of this research with Indigenous Australian children. The current study only questioned the relationship of OM in the first years of school with literacy in the same period. Despite a non-significant result, there is still sufficient evidence to warrant a longitudinal study analysing the ongoing history of OM and HL from birth as a predictor for school age literacy learning difficulties (Hall, Grose, Drake, & Pillsbury, 2000). These longitudinal studies could also provide analysis of the long term impact of interventions on language and literacy outcomes.

The Earbus data from Telethon Speech and Hearing is an invaluable resource. Currently, assessment of the data is limited and there are vast opportunities to track the ear health of a large number of Indigenous Australian children throughout Western Australia. For example, research could contribute to discussion regarding the following three aspects: the effectiveness of the screen and medical referral system on reducing ear health problems, the integration of a language or literacy element to the implementation of the program or the change in prevalence rates since the program's inception.

Future research elaborating on the current study would ideally plan for participation from a larger group of children from a wide variety of Indigenous Australian cultural language groups. This will allow for generalizability beyond a single community and encourage respectful engagement from a greater number of health and education providers. A report on school aged Indigenous students highlights the benefit of a larger scale study for advancement of sound policy and generalised practice (Australian Institute of Health and Welfare, 2010).

Another suggested line of research arose following the discussion presented in 6.2. The programs used as a comparison to the intervention of the current study such as National Indigenous English Literacy and Numeracy Strategy (Mellor & Corrigan, 2004) and the associated resources have not been well evaluated. State wide distribution of *Do You Hear What I Hear?* (Department of Education, 2002) and *Time for Talk* (Department of Education Western Australia, 1998) have also not resulted in any rigorous analysis of implementation or success. It is likely too late to begin the evaluation for these studies but it would be valuable to review programs and strategies currently provided by government and private organisations to provide a rigorous evidence base on which to continue their implementation. A number of these current plans are listed in section 7.5 below.

A final possible field of research to be addressed following this study is an efficacy study of the culturally modified literacy assessment and intervention assessment tools. Although relevant and appropriate for the current study, more general implementation of the tools within a school setting would require rigorous testing of validity and reliability within a variety of Indigenous Australian cultural language groups.

7.4 Limitations of the Study

The current study has investigated the complex interaction between health and education in one Indigenous Australian community. It should therefore be understood that there are a number of topics, analyses and expansions that would benefit the project but were not possible in the constraints of this project. These are considered below.

First, the researcher had planned to engage participants' caregivers to a greater extent. Data collection and analysis was undertaken by a non-Indigenous researcher albeit with some experience working within Indigenous Australian communities. Every attempt was made to ensure a positive learning experience for the students and to avoid the faux pas of previous 'Western research' by following suggestions of Indigenous Australian Researchers and guidelines for researchers working in Indigenous communities (Aboriginal Rural and Remote Interest Group for the Audiological Society of Australia, 2001; Fredericks, 2008; Humphery, 2001; Mellor & Corrigan, 2004). Inclusion of the cultural consultant group, Aboriginal and Islander Education Officers and interested parents, and rigorous cultural modifications to the assessment and intervention learning environment, resulted in relationships built on trust and confidence between the researcher and the health (Telethon Speech and Hearing Centre staff and Earbus Screeners) and education (Schools staff) providers and with the participants. However, interaction between the researcher and the participants' wider community was limited. This was a concern both in recruitment and feedback. The researcher met with a number of the parents in the presence of the Aboriginal and Islander Education Officers at two schools, with two parents at a BBQ at one school, with three parents at an information session at

one school and with one parent at a feedback session at one school. It is likely that the remainder of the parents are unfamiliar with the outcomes of the study or the significance of their child's involvement beyond the plain language information sheet provided at the time of consent (See Appendix G). This has been considered a failure of other similar research impacting on the children's educational attainment and ongoing engagement in education (Higgins & Morley, 2014). The critical nature of parent involvement in Indigenous children's education is discussed in detail in a resource sheet developed by the Australian Institute of Health and Welfare and the Australian Institute of Family Studies (Higgins & Morley, 2014). Another two publications released after the recruitment and data collection phases of this study also highlight the importance of consulting with significant family members for recruitment and retention (Rae et al., 2013) and forming productive partnerships between the researchers and parents when teaching reading (Johnson, Dempster, & McKenzie, 2013). The lack of strong relationships between the researcher and families and the limited feedback provided to parents will decrease the likelihood of integration of the skills learnt in the intervention into home life or into the literacy learning or ear health of the participants' siblings. Future research must plan for and implement dialogue with parents throughout, and perhaps beyond, the life of the project.

A second limitation to the current study lies in the small number of participants provided with intervention. While initially a large cohort of participants was recruited, time restraints and limits on age and OM and HL criteria reduced the intervention group to 34 participants. The findings should be seen as an introduction to the success of using targeted phonological awareness intervention rather than be

generalized to a larger context. Generalization of results is further limited by cultural difference between Indigenous Australian communities not represented in the Perth cohort (Taylor et al., 2009).

A third and final major limitation of the current study is likely a result of the complexity of OM. Authors of a study also analysing a relationship between OM and language outcomes highlight the need to take into account the presence, degree, extent and duration of HL accompanying OM and also lethargy or malaise related to the disease. Additional variables extrinsic to the child need to be noted, such as adult interaction, social-economic status and nutrition (Shriberg et al., 2000). The current study lacks the methodological rigour of some other studies when it comes to the definition of OM and HL. For example, a U.S. study defined OM based on the results from an average of 33.3 ear examinations in the 18 months prior to language assessment (Roberts et al., 1998). The current study was unable to address these extrinsic factors or provide information on HL beyond a pass or fail status up to 5 times in the screening period. Ongoing research may benefit from a multifactor risk model approach, accounting for these extrinsic factors and the actual hours spent with HL (Shriberg et al., 2000). This also includes any medical management of the disease throughout the assessment or intervention periods. The authors of a meta-analysis of international OM and language studies presume that the participants were being medically managed throughout the research though the compliance or success of the treatment is not extensively documented (Casby, 2001). The participants of the current study may have undergone treatment as the Telethon Speech and Hearing Centre Earbus does refer participants to a GP whose most likely response is to prescribe antibiotics. This may mitigate an effect of OM if the disease was dealt with

promptly. It is not known if the participants followed through with the referrals or complied with any antibiotic prescription. If medical management does play a role in reducing the length or severity of an episode of OM and subsequent impact on literacy learning then this lends credence to referral programs such as the Earbus. Further research on treatment fidelity and the extent to which healthcare management has a positive impact on OM occurrence, will assist in clarifying the relationship between health and education.

7.5 Summary

The current study has provided valuable insight into the early school literacy outcomes of a specific group of Indigenous Australian children in Perth who are known to suffer from high rates of OM. It has compared these outcomes to a control group of non-Indigenous participants, highlighting a disparity between the two groups, although irrespective of presence of OM. The study has investigated the effect that the presence of OM and HL, during a year of ear health screens, has on literacy and concluded minimal difference in the participants with and without the disease. Finally, the study presents the positive results of an intervention targeting the literacy skills found to be deficit in the participants.

The current study did not provide evidence, as predicted, that OM and HL would provide a significant contribution towards these poor literacy outcomes. The results did support the need for ongoing, evidence based and community driven investigation into literacy improvement strategies in this population. Without a clear indication of the independent role that OM plays in literacy outcomes, intervention for this population requires a multi-factorial approach as suggested by Lyons and Janca (2012): *"the implications of treating each area of Indigenous disparity as a*

stand-alone problem ignores the complexity, interrelated nature and spectrum of overall disadvantage experienced by a high proportion of Indigenous peoples" (p. 17).

Literacy is a particularly important focus in this population and requires ongoing investment. Literacy skills factor significantly in a young person's perception of school. If they are successful, children are more likely to continue and thrive in a school environment. If they are unsuccessful, then children are more likely to truant and become involved in antisocial behaviour (Snow & Powell, 2004). Mellor and Corrigan (2004) summarise this well: *"developing Standard Australian English literacy is of primary importance to Indigenous students, since it provides them with the necessary skills to interact within mainstream society and avail themselves of the broadest range of civic, social, educational and employment possibilities" (p. 39).*

Health and education providers are responsible for addressing the needs of the children in their care. This research could be used as a catalyst for change, encouraging a broader perspective, integrating the currently separate health and education sectors and moving towards an effective process simultaneously alleviating health stressors and encouraging education gains. Though small and lacking generalization possibilities, this study does provide important insight into the current status of Indigenous ear health and education and is encouraging for health and education providers. Current programs addressing management of OM in Indigenous Australian children are frequently updated and evaluated. For example, the Kalgoorlie Otitis Media Research Project (Lehmann et al., 2014), the Review of Ear Health and Hearing among Indigenous Australians (Burns & Thomson, 2013)

and the Boab Health Services Otitis Media Program (Boab Health Services, 2014) have all been released in the past 12 months. Similarly programs addressing Indigenous education are also being developed and implemented. For example, the Aboriginal and Torres Strait Islander Education Action Plan in the Northern Territory, (Northern Territory Department of Education, 2014), the Solid partners Solid futures plan in Queensland (Queensland Government Department of Education Training and Employment, 2014) and the $56.4 million commitment by the Australian Government Department of Social Services towards expansion of intensive literacy and numeracy programs and individual learning plans for Indigenous Australians (Department of Education Employment and Workplace Relations, 2014) are all promising initiatives. A strong evidence based evaluation of the implementation and success of these programs is essential to continue to see positive change in Indigenous Australian school children and their communities.

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Appendix A Letter of Ethical Approval from the Department of Education

Government of **Western Australia**
Department of **Education**

Your ref :
Our ref : D12/0100860
Enquiries :

Associate Professor Cori Williams
School of Psychology & Speech Pathology
Curtin University
GPO Box U1987
PERTH WA 6845

Dear Associate Professor Williams

Thank you for your completed application received 20 January 2012 to conduct research on Department of Education sites.

The focus and outcomes of your research project, *The Relationship between Otitis Media and Literacy Outcomes of Urban Indigenous Australian School Children,* are of interest to the Department. I give permission for you to approach site managers to invite their participation in the project as outlined in your application. It is a condition of approval, however, that upon conclusion the results of this study are forwarded to the Department at the email address below.

Consistent with Department policy, participation in your research project will be the decision of the schools invited to participate, individual staff members, the children in those schools and their parents. A copy of this letter must be provided to site managers when requesting their participation in the research. Researchers are required to sign a confidential declaration and provide a current Working with Children Check upon arrival at the Department of Education site.

Responsibility for quality control of ethics and methodology of the proposed research resides with the institution supervising the research. The Department notes a copy of a letter confirming that you have received ethical approval of your research protocol from the Curtin University Human Research Ethics Committee.

Any proposed changes to the research project will need to be submitted for Department approval prior to implementation.

Please contact Ms Allison McLaren, A/Evaluation Officer, on (08) 9264 5512 or researchandpolicy@det.wa.edu.au if you have further enquiries.

Very best wishes for the successful completion of your project.

Yours sincerely

ALAN DODSON
DIRECTOR
EVALUATION AND ACCOUNTABILITY

16 February 2012

151 Royal Street, East Perth Western Australia 6004

Appendix B Letter of Ethical Approval from the Western Australian Aboriginal Health Ethics Committee

Western Australian Aboriginal Health Ethics Committee
2 Bulwer Street, PERTH WA 6000
PO Box 8493, Stirling Street, PERTH WA 6849

Dear A/Professor Williams,

RE: HREC Reference number: 386-01/2012

Project title: The relationship between Otitis media and Literacy Outcomes of Urban Indigenous Australian School Children

Thank you for submitting the additional documentation as requested by the WAAHEC for the above research project. Your response was considered by the committee at the meeting held on the 12th March 2012.

I am pleased to advise that the WAAHEC has now granted approval of this research project. Approval is granted from 12 March 2012 pending your agreement of the following conditions:

1. Conditions

- The WAAHEC will be notified, giving reasons, if the project is discontinued before the expected date of completion.
- The Coordinating Investigator will provide an annual report to the WAAHEC and at completion of the study in the specified format. This form can be found on the AHCWA website (www.ahcwa.org).
- The approval for studies is for three years and the research should be commenced and completed within that period of time. Projects must be resubmitted if an extension of time is required.
- That the Aboriginal and Torres Strait Islander community are formally acknowledged for their contribution to this research project.
- Copies of any publications that arise from this research are to be given to the WAAHEC prior to release.

2. Amendments

If there is an event requiring amendments to be submitted you should immediately contact ethics@ahcwa.org for advice.

Should you have any queries about the WAAHEC's consideration of your project please contact ethics@ahcwa.org.

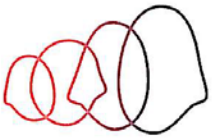
The WAAHEC wishes you every success in your research.

Kind regards

Chelsea Bell
For
Tammy Prouse
Chair, WAAHEC
14/3/12

This HREC is constituted and operates in accordance with the National Health and Medical Research Council's (NHMRC) *National Statement on Ethical Conduct in Human Research (2007), NHMRC and Universities Australia Australian Code for the Responsible Conduct of Research (2007) and the CPMP/ICH Note for Guidance on Good Clinical Practice.* The process this HREC uses to review multi-centre research proposals has been certified by the NHMRC.

Appendix C Letter of Support from Telethon Speech and Hearing



Telethon Speech & Hearing
Releasing children's potential

5 December 2011

WAAHEC
Aboriginal Health Council of WA
Dilhorn House
2 Bulwer Street
PERTH WA 6000
Phone - 08 9227 1631
Email – ethics@ahcwa.org

Letter of support for PhD project "The Relationship between Otitis Media and Literacy Outcomes of Urban Indigenous Australian School Children"

To whom it may concern,

We would like to indicate our support for this research project proposed by Curtin University PhD candidate Lydia Timms under the supervision of Associate Professor Cori Williams.

It is anticipated that the participants and their local and extended community network will benefit from this project as outlined in the ethics application. These benefits include immediate outcomes such as ear health screening, local GP referral, literacy assessment and literacy intervention. Benefits are also expected to include improved education outcomes for the participants and increased awareness and positivity surrounding ear health and literacy skills. The project will make a valuable contribution to the literature about Aboriginal health and education, and has the potential to inform policy development.

The project has been designed in line with values and aims of the Telethon Speech & Hearing Centre and we are pleased that the Earbus screening data is being used in such a positive manner. Procedures are culturally appropriate and appear to have been developed with the best intentions of advancing the participants and their community.

With this letter we formally recognize the value of the project in helping develop ongoing solutions for improved Aboriginal health outcomes.

Yours sincerely,

Lara Shur
Manager Audiology Services

36 Dodd Street Wembley WA • PO Box 186 Wembley WA 6913
T +61 8 9387 9888 F +61 8 9387 9889 E speech@tsh.org.au www.tsh.org.au ABN 73 885 107 614

Appendix D Letter of Support from Derbarl Yerrigan Health Service Inc.

DERBARL YERRIGAN HEALTH SERVICE INC.
ABN 60 824 221 416
156 Wittenoom Street, East Perth W.A. 6004
Phone: (08) 9421 3888 Fax: (08) 9421 3884
Email: dyhs@dyhs.org.au Website: www.dyhs.org.au

03/01/2012

WAAHEC
Aboriginal Health Council of WA
Dilhorn House
2 Bulwer Street
PERTH WA 6000
Phone - 08 9227 1631
Email – ethics@ahcwa.org

Letter of support for PhD project "The Relationship between Otitis Media and Literacy Outcomes of Urban Indigenous Australian School Children"

To whom it may concern,

We would like to indicate our support for this research project proposed by Curtin University PhD candidate Lydia Timms under the supervision of Associate Professor Cori Williams.

It is anticipated that the participants and their local and extended community network will benefit from this project as outlined in the ethics application. These benefits include immediate outcomes such as ear health screening, local GP referral, literacy assessment and literacy intervention. Benefits are also expected to include improved education outcomes for the participants and increased awareness and positivity surrounding ear health and literacy skills. The project will make a valuable contribution to the literature about Aboriginal health and education, and has the potential to inform policy development.

Following discussion with Lydia, we are looking forward to contributing to the project as part of the cultural reference group and anticipate positive outcomes. The project has been designed in line with values and aims of Derbarl Yerrigan health service. Procedures are culturally appropriate and appear to have been developed with the best intentions of advancing the participants and their community.

With this letter we formally recognize the value of the project in helping develop ongoing solutions for improved Aboriginal health outcomes.

Yours sincerely,
BRETT WALLEY.
Ear Health Co-ordinator

Appendix E Information Letter for Department of Education Site Managers

Assessment and Intervention Involvement

LydiaTimms
Doctoral Student
School of Psychology & Speech Pathology
CurtinUniversity of Technology
GPO Box U 1987,
Perth, WA 6845

Dear Principal

Does the ear health of children affect their literacy?

My name is Lydia Timms and I am undertaking a doctoral research project, under the supervision of Associate Professor Cori Williams, at Curtin University. My project aims to determine if there is a relationship between the presence of otitis media (OM), an ear infection often causing hearing loss, and poor literacy skills in Aboriginal children.

Aboriginal students at your school have been screened by Telethon Speech and Hearing Centre Earbus. I have the pleasure of working in conjunction with their staff.

In my project I will assess the literacy of the children with OM at a number of primary schools in Perth and compare them with a group of Aboriginal children without OM and with a group of non-Aboriginal children from the same schools. I will then provide relevant and culturally appropriate literacy intervention to a smaller group of the Aboriginal children assessed and determine if their literacy outcomes improve.

I would like to invite your school to take part in the project.

What does participation in the research project involve? I seek access to pre-primary, year 1 and 2 students at your school who, along with their caregivers, have given consent. For the initial assessment phase, involving Indigenous and non-Indigenous participants, I will take each participating child out of class (to a quiet room or space in your school) for a 40 min session in term 2. This session involves assessment of indicators of phonological awareness, early spelling and early reading skills from the Queensland University Inventory of Literacy. This is a well-established language assessment and is widely used in Australia. For the intervention phase, involving pre-primary and year 1 Indigenous participants only, I will take each participating child out of class for two 60minute sessions a week for a block of 8 weeks in term 4. These sessions will take place in small groups and be play based. The intervention involves games and activities that encourage the children to complete language based tasks from the Gail Gillon Phonological Awareness Program (these include rhyme, phoneme identity and manipulation and

letter to sound knowledge). These participants will be required for one assessment at the end of term 3, one immediately following the intervention block and one follow-up assessment early 2013. I may video record a selection of these sessions to ensure that assessment and intervention is consistent for all participants. This video will only be seen by me and my supervisors and will be destroyed following data collection. I will ask for separate consent from the children prior to recording.

We will keep school's involvement in the administration of the research procedures to a minimum. However, we ask for your school's advice and assistance for the optimum method of gaining consent from Indigenous caregivers. We would also like to meet with the Aboriginal/ Islander Education Officer/s at your school to discuss the project.

How can this project benefit the participants, your school and the wider community? The children involved in the intervention program will be provided with additional pre-literacy skills essential for reading and spelling success. Student and family increased awareness of OM may also mean a reduction of the disease in your school. I wish to consult with your AIEO and participant families to ensure the benefits remain beyond the project. Theory and some previous research indicates that OM has a negative impact on language and literacy development. Proving such a connection will enhance knowledge in the area of Aboriginal ear health and education and will allow us to advocate for improvement in both areas.

To what extent is participation voluntary, and what are the implications of withdrawing that participation? Participation in this research project is entirely voluntary. We require written consent from both the participant and their caregiver. Participants are able to withdraw their involvement at any time without adverse consequences.

What will happen to the information collected, and is privacy and confidentiality assured?
Information that identifies anyone will be removed from the data collected. The information will be kept in a secure cabinet at Curtin University and on a password protected external hard drive for a minimum of 5 years and will only be accessible to those directly involved in the project. Consistent with Department of Education policy, your school will receive a summary of the research findings.

Is this research approved? This study has been approved by the Curtin University Human Research Ethics Committee (Approval Number 167/2011)). The Committee is comprised of members of the public, academics, lawyers, doctors and pastoral carers. Its main role is to protect participants. If needed, verification of approval can be obtained either by writing to the Curtin University Human Research Ethics Committee, c/- Office of Research and Development, Curtin University, GPO Box U1987, Perth, 6845 or by telephoning 9266 2784 or by emailing hrec@curtin.edu.au. The research has met the policy requirements of the Department of Education (Reference D12/0100860 a copy of this letter is also attached) and Western Australian Aboriginal Health and Ethics Committee.

Do all members of the research team who will be having contact with children have their Working with Children Check? Yes. Please find evidence of my Working with Children Check attached to this letter.

Who do I contact if I wish to discuss the project further? If you would like to discuss any aspect of this study with a member of the research team, please contact my supervisor using the details provided below. If you wish to speak with an independent person for verification of ethics approval, please contact the Curtin University Ethics Committee (see details below).

How do I indicate my willingness for the school to be involved? If you have had all questions about the project answered to your satisfaction, and are willing for the school to participate, please complete the **Consent Form** on the following page.

This information letter is for you to keep.
Thank you

Lydia Timms
lydia.timms@postgrad.curtin.edu.au

Associate Professor Cori Williams

CurtinUniversity
Tel: 9266 7865

Email: c.j.williams@curtin.edu.au

Human Research
EthicsCommittee
CurtinUniversity
Tel: 9266 2784

Email: hrec@curtin.edu.a

Appendix F Consent Form for Department of Education Site Managers

Consent Form

- I have read this document and understand project, as described within it.
- I am satisfied with the answers I received for any questions I may have had.
- I am willing for this school to become involved in the research project, as described.
- I understand that participation in the project is entirely voluntarily.
- I understand that the school is free to withdraw its participation at any time, without consequence.
- I understand that this research may be published in a journal or presented at a conference, provided that the participants or the school are not identified in any way.
- I understand that the school will be provided with a copy of the findings from this research upon its completion.

Name of Site Manager (printed): _____

Signature: _____ Date: / /

Appendix G Plain Language Information Letter for Caregivers of participants receiving assessment and intervention

Curtin University

Dear Parent/Carer

- I am doing a project to see whether otitis media (ear infection often causing poor hearing) causes children to have poor reading and spelling.

- I need to assess the skills needed for spelling and reading in term 2.

- I will compare the results of Aboriginal children with the infection, Aboriginal children without the infection and Non-Aboriginal children without the infection.

- I will then spend time with your child in term 4 to help your child with their reading and spelling in a fun way.

- Your child's school has agreed to participate as it will provide them with useful information and help in the development of spelling and reading and better ear health in their students.

- All information will be confidential

- The procedure is designed to help your child and your community and will not hurt them or delay their education.

Are you willing to take part? If so please read more detailed information below and sign the attached form and return it to your school. Appendix H Consent Form for Caregiver/s

Appendix H Consent Form for Caregivers

- I understand the information about the project.
- I have asked any questions I may have had and I am happy with the answers.
- I understand that it is up to me whether or not my child takes part.
- I am happy for my child to take part in the project.
- I have talked about this project with my child and he/she wants to take part.
- I understand that we can pull out of the project at any time.
- I am happy for the project to be presented at a conference and possibly published in a journal. I know that my child and school will not be identified in any way.
- I understand that I will be given a summary of the findings after the project is finished.

Name of Child (printed): _____

Name of Parent/Carer (printed): _____

Signature of Parent: _____ Date: / /

Appendix I Information Letter for Caregiver of participants receiving assessment and intervention

Assessment and Intervention Involvement

Lydia Timms
Doctoral Student
School of Psychology & Speech Pathology
Curtin University of Technology

Does the ear health of children affect their literacy?

Your Primary School is one of a number of schools in Western Australia we have asked to take part. We ask that you to talk to your child about the project as we will also be asking them to agree to participate. A simplified information sheet for your child is attached.

What does participation in the research project involve?
If your child takes part in the project I will take him/her out of class for a 40min session in term two. In this session I will assess skills that indicate how well your child is learning to read and spell. These include rhyming, splitting words into sounds and telling me the first or last sound of a word. The assessment is based on the Queensland Inventory of Literacy. Then, in term 4 (or term 1 next year) your child will participate in a twice-weekly 60 minute session each week for 8 weeks with a small group of other children from their class. These sessions are based on a program that has been used many times in Australia and they are designed to be enjoyable for your child. This means I will use games and activities to encourage your child to complete language based tasks which focus on the skills needed for reading and spelling.
I may video record some of the sessions to make sure I am providing the same assessment and intervention to every child. This video will only be seen by me and my supervisors and will be destroyed once I have finished all assessments. I will ask for separate consent from your child before I record.
Throughout the project I would like to discuss with you how you think your child is going and how we can make sure the benefits of the project can continue into the future for your child and other children in the school.

Does my child have to take part?
No, it is you and your child's choice whether you want your child to take part or not. Your decision will not affect your family's relationship with your child's teacher or the school and you or your child can still change your mind at any time. Even after taking part, we can destroy any information we have collected on your child, unless we have already published a paper or report on the study. Please discuss this with your child, they will also be required to provide their own consent before participating.

Why should I take part in this project?

This project will be good for your child, your child's school and your community in a number of ways. Your child will receive a free literacy assessment, free help with learning literacy, and you will be given information on your child's progress. The project will help us to learn more about ear health and literacy and ways to improve these for children. There are no foreseeable risks to your child's health or education by being involved in this project.

What will happen to the information collected, and is privacy and confidentiality assured?
Your privacy is very important. We will remove your child's name and any information that could be used to identify him/her, or you, from the information we collect. We will safely store the information for 5 years so that only the researchers can see it, and then it will be destroyed.

I will record the projects results in my doctoral paper and they may be published in a journal, or presented at a conference but always without any identifying information. You and the school will be given a summary of the findings if you would like to know what the research found.

Is this research approved?
We have approval to do this project from the Curtin University Human Research Ethics Committee, Western Australian Aboriginal Health and Ethics Committee and the Education Department. All those involved have a Working with Children Check that you can ask your school Principal to see.

Who do I contact if I wish to discuss the project further?
If you would like to talk about this study please contact my supervisor or myself on the details provided below.

How does my child become involved?
If you and your child are both happy for him/her to take part, please complete the **Consent Form** on the following page.

This project information letter is for you to keep.

Thank you

Lydia Timms
Lydia.timms@postgrad.curtin.eud.au

Associate Professor Cori Williams
Curtin University
Tel: 9266 7865

Email: c.j.williams@curtin.edu.au

Human Research Ethics Committee
Curtin University
Tel: 9266 2784

Email: hrec@curtin.edu.au

Appendix J Information Letter for Caregiver of participants receiving assessment

Assessment Involvement

Lydia Timms
Doctoral Student
School of Psychology & Speech Pathology
Curtin University of Technology

Does the ear health of children affect their literacy?

Dear Parent/Carer

- I am doing a project to see whether otitis media (ear infection often causing poor hearing) causes children to have poor reading and spelling.
- I need to assess the skills needed for spelling and reading.
- I will compare the results of Aboriginal children with the infection, Aboriginal children without the infection and Non-Aboriginal children without the infection.
- Your child's school has agreed to participate as it will provide them with useful information and help in the development of spelling and reading and better ear health in their students.
- All information will be confidential
- The procedure is designed to help your child and your community and will not hurt them or delay their education.

Would you like to take part? If so please read more detailed information below and sign the attached form and return it to your school.

Your Primary School is one of a number of schools in Western Australia we have asked to take part. We ask that you to talk to your child about the project as we will also be asking them to agree to participate.

What does participation in the research project involve?
If your child takes part in the project I will take him/her out of class for a 40min session in term two. In this session I will assess skills that indicate how well your child is learning to read and spell. These include rhyming, splitting words into sounds and telling me the first or last sound of a word. The assessment is based on the Queensland Inventory of Literacy. This session is designed to be enjoyable for your child. I may video record some of the sessions to make sure I am providing the same assessment to every child. This video will only be seen by me and my supervisors. I will ask for separate consent from your child before I record. I may like to discuss with you how you think your child is going and how we can make sure the benefits of the project can continue into the future for your child and other children in the school.

Does my child have to take part?

No, it is you and your child's choice whether you want your child to take part or not. Your decision will not affect your family's relationship with your child's teacher or the school and you or your child can still change your mind at any time. Even after taking part, we can destroy any information we have collected on your child, unless we have already published a paper or report on the study. Please discuss this with your child, they will also be required to provide their own consent before participating.

Why should I take part in this project?
This project will be good for your child, your child's school and your community in a number of ways. Your child will receive a free literacy assessment and you will be given information on your child's progress. The project will help us to learn more about ear health and literacy and ways to improve these for children. There are no foreseeable risks to your child's health or education by being involved in this project.

What will happen to the information collected, and is privacy and confidentiality assured?
Your privacy is very important. We will remove your child's name and any information that could be used to identify him/her, or you, from the information we collect. We will safely store the information for 5 years so that only the researchers can see it, and then it will be destroyed.

I will record the projects results in my doctoral paper and they may be published in a journal, or presented at a conference but always without any identifying information. You and the school will be given a summary of the findings if you would like to know what the research found.

Is this research approved?
We have approval to do this project from the Curtin University Human Research Ethics Committee, Western Australian Aboriginal Health and Ethics Committee and the Education Department. All those involved have a Working with Children Check that you can ask your school Principal to see.

Who do I contact if I wish to discuss the project further?
If you would like to talk about this study please contact my supervisor or myself on the details provided below.

How does my child become involved?
If you and your child are both happy for him/her to take part, please complete the **Consent Form** on the following page and help your child fill in the Consent Form attached to his/her letter.

This project information letter is for you to keep.

Thank you

Lydia Timms

Lydia.timms@postgrad.curtin.eud.au

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Committee
Curtin University
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Human Research Ethics

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Tel: 9266 2784

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Appendix K Information Letter for Child Participant

Assessment and Intervention Involvement

Hello

My name is Lydia. I have a project that I would like your help with.

The project is about how sore ears can cause reading and spelling to be hard.

I want you to help me a two times a week for about an hour.

If you want to stop at anytime, that's OK, you can.

The first time we meet I will ask you some questions and we will look at some pictures. The other times we meet we will play some games that teach you about words.

I won't tell anyone what you say while helping me with the project, unless I need to tell someone like your teacher.

Your parents, or the person who looks after you, has talked with you about helping with the project.

If you would like to help with the project, please draw a circle around the smiley face on the next page.

If you don't want to help with the project – that's OK too.

Lydia Timms

Speech Pathology Student

Curtin University

Appendix L Consent Form for Child Participant

- I know that I can say ‘yes’ or ‘no’ to doing this project.
- I know that I can stop whenever I want.
- I know that I will be answering questions and doing word games as part of the project.
- I know that I need to draw a circle around the smiley face on this page before I can help with the project.

YES

I would like to help with the project

NO

I do not want to help with the project

Name of child: _____ Today’s Date: / /

Appendix M Score Sheets for Literacy Assessments One to Four

Literacy Assessment One

Participant Code: _____

Date of assessment: _____

REAL WORD SPELLING

Stimuli	Spelling	Score	
/glu/ (glue)		1	0
/tʃɪn/ (chin)		1	0
/lɪps/ (lips)		1	0
/noʊs/ (nose)		1	0
/brɛd/ (bread)		1	0
		Total:	

NON WORD SPELLING

Stimuli	Spelling	Score	
/dɔd/		1	0
/lɒnt/		1	0
/ʃik/		1	0
/wʌmp/		1	0
/sʌts/		1	0
		Total:	

REAL WORD READING

Stimuli	Pronunciation	Score	
coffee		1	0
egg		1	0
food		1	0
sock		1	0
bunny		1	0
		Total:	

NON WORD READING

Stimuli	Pronunciation	Score	
acked		1	0
slet		1	0
bocks		1	0
sord		1	0
sed		1	0
		Total:	

SYLLABLE SEGMENTATION

Stimuli		Number of claps	Score	
trainer	2		1	0
constellation	4		1	0
memorize	3		1	0
minus	2		1	0
responsible	4		1	0
astronomer	4		1	0
proving	2		1	0
possibly	3		1	0
telescope	3		1	0
			Total:	

SPOKEN RHYME RECOGNITION

Stimuli		Response	Score	
hen/men	Y		1	0
said/paid	N		1	0
wait/wet	N		1	0
drew/new	Y		1	0
bar/car	Y		1	0
hat/fall	N		1	0
			Total:	

PHONEME DETECTION

Position	Stimuli				Score	
First	bed	bag	MOP	bus	1	0
	mug	mad	moth	TEN	1	0
	ROD	pin	peg	pat	1	0
Subtotal:						

Last	mop	hip	SUN	keep	1	0
	rug	HOT	wig	tag	1	0
	RAN	dot	let	cut	1	0
Subtotal:						

PHONEME SEGMENTATION

Stimuli		Sounds	Score	
itch	2		1	0
frog	4		1	0
big	3		1	0
og	2		1	0
plate	4		1	0
lek	3		1	0
Total:				

PHONEME MANIPULATION

Stimuli	Without	Sounds like	Response	Score	
told	/t/	old		1	0
spin	/s/	Pin		1	0
caught	/t/	Caw		1	0
brow	/r/	Bow		1	0
clean	/l/	Keen		1	0
trim	/t/	Rim		1	0
Total:					

Notes:

_____
_____
_____
_____
_____
_____

Literacy Assessment Two
Participant Code: _____
Date of assessment: _____

REAL WORD SPELLING

Stimuli	Spelling	Score	
/dʌk/ (duck)		1	0
/bɜd/ (bird)		1	0
/pɛn/ (pen)		1	0
/prɛzənt/ (present)		1	0
/dʒɛli/ (jelly)		1	0
		Total:	

NON WORD SPELLING

Stimuli	Spelling	Score	
/dap/		1	0
/sɒnt/		1	0
/tʃeɪk/		1	0
/gɪmp/		1	0
/lʌts/		1	0
		Total:	

REAL WORD READING

Stimuli	Pronunciation	Score	
cake		1	0
frog		1	0
hen		1	0
ball		1	0
drink		1	0
		Total:	

NON WORD READING

Stimuli	Pronunciation	Score	
sicked		1	0
blat		1	0
tocks		1	0
pord		1	0
mard		1	0
		Total:	

SYLLABLE SEGMENTATION

Stimuli		Number of claps	Score	
protest	2		1	0
mathematics	4		1	0
operate	3		1	0
dozen	2		1	0
advertisement	4		1	0
scientific	4		1	0
pavement	2		1	0
crocodile	3		1	0
gravity	3		1	0
			Total:	

SPOKEN RHYME RECOGNITION

Stimuli		Response	Score	
jump/bump	Y		1	0
card/pad	N		1	0
rack/ring	N		1	0
say/may	Y		1	0
date/mate	Y		1	0
face/run	N		1	0
			Total:	

PHONEME DETECTION

Position	Stimuli				Score
First	said	sag	TOP	suss	
	bug	dad	boat	MEN	
	COD	lone	leg	lit	
Subtotal:					

Last	bop	tip	FUN	sleep	
	tug	GOT	fig	wag	
	TAN	moat	Bet	hut	
Subtotal:					

PHONEME SEGMENTATION

Stimuli		Sounds	Score	
ash	2		1	0
blog	4		1	0
tag	3		1	0
bee	2		1	0
crane	4		1	0
pek	3		1	0
Total:				

PHONEME MANIPULATION

Stimuli	Without	Sounds like	Response	Score	
bold	/b/	old		1	0
spun	/s/	pun		1	0
Sought	/t/	saw		1	0
grow	/r/	go		1	0
blake	/l/	bake		1	0
cram	/k/	ram		1	0
Total:					

Notes:

_____
_____
_____
_____
_____
_____

Literacy Assessment Three
Participant Code: _____
Date of assessment: _____

REAL WORD SPELLING

Stimuli	Spelling	Score	
/pʌpi/ (puppy)		1	0
/dɪə/ (deer)		1	0
/greɪps/ (grapes)		1	0
/lɛg/ (leg)		1	0
/hænd/ (hand)		1	0
		Total:	

NON WORD SPELLING

Stimuli	Spelling	Score	
/pan/		1	0
/lænt/		1	0
/doʊk/		1	0
/grɪsh/		1	0
/mʌb/		1	0
		Total:	

REAL WORD READING

Stimuli	Pronunciation	Score	
fish		1	0
toe		1	0
bat		1	0
face		1	0
bread		1	0
		Total:	

NON WORD READING

Stimuli	Pronunciation	Score	
tacken		1	0
clab		1	0
mots		1	0
tord		1	0
mird		1	0
		Total:	

SYLLABLE SEGMENTATION

Stimuli		Number of claps	Score	
survive	2		1	0
prehistoric	4		1	0
majesty	3		1	0
flower	2		1	0
community	4		1	0
centimetre	4		1	0
safety	2		1	0
minimum	3		1	0
allergy	3		1	0
			Total:	

SPOKEN RHYME RECOGNITION

Stimuli		Response	Score	
mat/fat	Y		1	0
will/hot	N		1	0
bite/fate	N		1	0
boys/toys	Y		1	0
mad/sad	Y		1	0
bear/rear	N		1	0
			Total:	

PHONEME DETECTION

Position	Stimuli				Score
First	ted	tag	COP	tease	
	sag	seed	seat	BEN	
	LOG	home	hug	hit	
Subtotal:					

Last	ban	tin	TOP	hen	
	gut	HILL	fit	hat	
	TAN	moat	bet	hut	
Subtotal:					

PHONEME SEGMENTATION

Stimuli		Sounds	Score	
am	2		1	0
plod	4		1	0
hag	3		1	0
for	2		1	0
crane	4		1	0
kep	3		1	0
Total:				

PHONEME MANIPULATION

Stimuli	Without	Sounds like	Response	Score	
tanned	/t/	and		1	0
spot	/s/	pot		1	0
bald	/d/	ball		1	0
blow	/l/	bow		1	0
brake	/r/	bake		1	0
prod	/p/	rod		1	0
Total:					

Notes:

_____
_____
_____
_____
_____
_____

Literacy Assessment Four
Participant Code: _____
Date of assessment: _____

REAL WORD SPELLING

Stimuli	Spelling	Score	
/taɪgʌ/ (tiger)		1	0
/ʃip/ (sheep)		1	0
/geɪm/ (game)		1	0
/dʒus/ (juice)		1	0
/mʌfɪn/ (muffin)		1	0
		Total:	

NON WORD SPELLING

Stimuli	Spelling	Score	
/gæm/		1	0
/læms/		1	0
/toʊn/		1	0
/krɒt/		1	0
/tɪgs/		1	0
		Total:	

REAL WORD READING

Stimuli	Pronunciation	Score	
sauce		1	0
bee		1	0
coat		1	0
slipper		1	0
tooth		1	0
		Total:	

NON WORD READING

Stimuli	Pronunciation	Score	
socken		1	0
clig		1	0
rots		1	0
yord		1	0
tid		1	0
		Total:	

SYLLABLE SEGMENTATION

Stimuli		Number of claps	Score	
unit	2		1	0
horizontal	4		1	0
battery	3		1	0
mayor	2		1	0
immunity	4		1	0
politician	4		1	0
figure	2		1	0
organic	3		1	0
container	3		1	0
			Total:	

SPOKEN RHYME RECOGNITION

Stimuli		Response	Score	
bit/kit	Y		1	0
bill/fall	N		1	0
bite/band	N		1	0
saw/core	Y		1	0
cog/log	Y		1	0
call/tear	N		1	0
			Total:	

PHONEME DETECTION

Position	Stimuli				Score
First	peg	pat	SIP	peas	
	sad	seep	soap	BIN	
	LOT	coat	cup	couch	
Subtotal:					

last	tan	sin	FLOP	fun	
	bat	FALL	sit	kite	
	MAN	hug	leg	frog	
Subtotal:					

PHONEME SEGMENTATION

Stimuli		Sounds	Score	
on	2		1	0
clot	4		1	0
sad	3		1	0
egg	2		1	0
plane	4		1	0
seat	3		1	0
Total:				

PHONEME MANIPULATION

Stimuli	Without	Sounds like	Response	Score	
pant	/p/	ant		1	0
cross	/k/	ross		1	0
felt	/t/	fell		1	0
breeze	/r/	bees		1	0
flake	/l/	fake		1	0
cloud	/k/	loud		1	0
Total:					

Notes:

_____
_____
_____
_____
_____
_____

Appendix N Video Recording Consent for Caregivers

A selection of sessions will be video recorded to make sure that tasks are consistent for all participants.

The video will only be viewed by the researcher and her supervisors. Your child's name, school or other identifying information will not be stored with the video.

The video will be destroyed following completion of the sessions at your school.

By signing this form, I am allowing the researcher to video tape a session including my child as part of this research. I understand that recordings will only be viewed by Lydia Timms and her supervisors and that the footage will be destroyed at the end of her time at the school.

Name of Child (printed): _____

Name of Parent/Carer (printed): _____

Signature of Parent: _____ Date: / /

Appendix O Video Recording Consent for Child Participant

For my project I need to make a video of what we are doing together. I will then show the video to someone who can help me check if what I am doing with you is the same as what I am doing with the other children.
I will not show the video to your teacher or your parents or anyone else.

- I know I do not have to be in the video
- I know that I can ask for the video to be stopped at any time
- I know that no one except Lydia and her helpers will see the video
- I know that I need to draw a circle around the smiley face on this page before I can be in the video

YES

I want to be in the video

NO

I do not want to be in the video

Name of child: _____ Today's Date: / /

Appendix P Word Lists from the MacArthur Communicative

Development Inventories for Real-word Spelling and Reading Targets

1	ant	30	milk
2	tiger	31	muffin
3	zebra	32	peas
4	bee	33	nuts
5	bunny	34	sauce
6	dog	35	toast
7	deer	36	water
8	goose	37	belt
9	lamb	38	boots
10	puppy	39	coat
11	sheep	40	hat
12	boat	41	jeans
13	bus	42	pants
14	car	43	shoe
15	train	44	shorts
16	truck	45	slipper
17	bat	46	sock
18	block	47	arm
19	book	48	eye
20	doll	49	face
21	game	50	feet
22	bread	51	hand
23	butter	52	knee
24	coffee	53	leg
25	egg	54	lips
26	fish	55	mouth
27	food	56	nose
28	grapes	57	tooth
29	juice	58	toe

(Fenson et al., 1993)

Appendix Q Intervention Schedule

Table Q1
Term 3 Intervention timetable

Monday	Tuesday	Wednesday	Thursday	Friday
9:55am School 1 Group 1			9:55am School 1 Group 2	8:40am School 3 Group 1
11:10am School 1 Group 2	12:00pm School 3 Group 1		11:10am School 1 Group 1	10:00am School 2 Group 1
1:00pm School 4 Group 1	1:30pm School 2 Group 1		1:00pm School 4 Group 2	
School 4 Group 2			2:00pm School 4 Group 1	

Table Q2
Term 4 Intervention timetable

Monday	Tuesday	Wednesday	Thursday	Friday
		9:00am School 3 Group 2		10:00am School 1 Group 5
9:50am School 3 Group 2		10:40am School 1 Group 3		11:00am School 1 Group 3
11:30am School 2 Group 2		11:40am School 1 Group 4		12:00pm School 1 Group 4
		1:30pm School 1 Group 5		1:30pm School 2 Group 2

Appendix R Example of a Session Outline at the Beginning of an Intervention Block

Daily chats **10 minutes**
Book share: 'Wonky-Donkey' by Craig Smith

Session re-cap and outlook
"Remember we look at a sentence in the ladder. A sentence is made up of words and we stepped out each word along the ladder."

"Well words are made up of big parts. We are going to break up words into their big parts today."

Segmenting syllables **10 minutes**
Fishing for compound words and identifying the first and last part.

Rhyme identification **10- 15minutes**
Remind children that rhyming means words sound the same at the end.
Label the pictures on each child's board, emphasising the onset and rime
Each child has a bingo board. Taken from The Gillon Phonological Awareness Training Program (Gillon, 2008, p. 9)
A volunteer is to select a yellow card (pictures of rhyming pairs to the pictures on the bingo board) and place a coloured block on the word that rhymes on each child's card.
Each child to help the others sound out the names of the pictures to determine if they rhyme with the target word.

Break
5minutes
Toilet, drink, walk, snack

Phoneme analysis **10-15 minutes**
Early phoneme manipulation activity taken from The Gillon Phonological Awareness Training Program (Gillon, 2008, p. 12). Place coloured blocks in the large box. Demonstrate how sounds are represented by the block by moving two of the same coloured blocks into the smaller boxes when saying/repeating a sound.

Appendix S Example of a Session Outline at the End of an Intervention Block

Daily chats **10 minutes**
Book share: 'Hound Bee' by TIME-LIFE early learning program

Session re-cap and outlook

Lower performing groups
Initial sound identification **10 minutes**
Present the group with pictures starting with one of six phonemes. Clarify the name of each picture.
Have a volunteer roll a letter die and match it to the corresponding pictures.

OR

Higher performing groups
Cluster segmentation **10 minutes**
Present the group with pictures of words starting with /Sc/, /St/ or /Sp/ clusters. Each picture is numbered which corresponds to a number on a mat.
Have a volunteer roll a marble onto the map. The child is required to segment the phonemes in the picture of the corresponding number.

Extend further by encouraging blending

Rhyming identification **10 minutes**
Play a game of memory with the group. Words which were previously represented with pictures are now presented with words.
Children are required to read the words out loud and determine if they rhyme. If so, the child keeps the rhyming pair.

Extend by generating additional rhyming words

Break **5minutes**
Toilet, drink, walk, snack

Sound tracking **10 minutes**
Advanced phoneme manipulation activity taken from The Gillon Phonological Awareness Training Program (Gillon, 2008, p. 12).
Children are provided with letter blocks from the Gillon resource kit. They commence by spelling a word e.g. /pit/. They are then asked to change one phoneme to make a new word e.g. /pin/.

Extend by increasing to CVCC and CCVCC words.
Extend further by covering and writing the word.

Appendix T Acronyms used within this Dissertation

Acronym	Title
OM	Otitis media
HL	Hearing loss
MLD	Masking level difference
QUIL	Queensland University Inventory of Literacy
SES	Socioeconomic status
AIEO	Aboriginal and Islander Education Officer
UK	The United Kingdom
U.S.	The United States of America
GLMM	Generalised linear mixed model
ANOVA	Analysis of Variance
NAPLAN	The National Assessment Program – Literacy and Numeracy
ARACY	The Australian Research Alliance for Children and Youth
AIATSIS	Australian Institute of Aboriginal and Torres Strait Islander Studies

Appendix U Copyright Clearance for Figure 1

Mar 24, 2015
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Appendix V Histograms for Literacy Outcomes

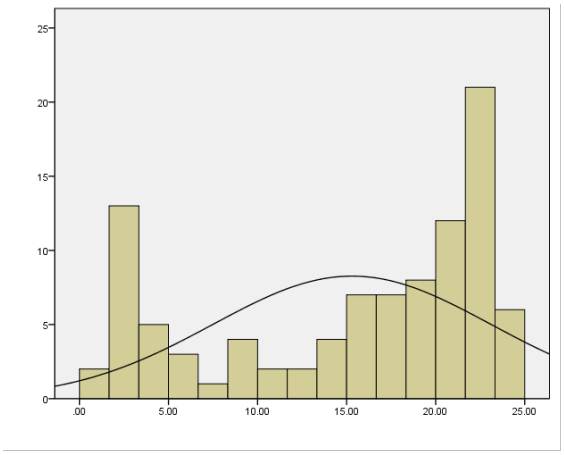

Figure 1. Histogram of participants' spelling scores at assessment one

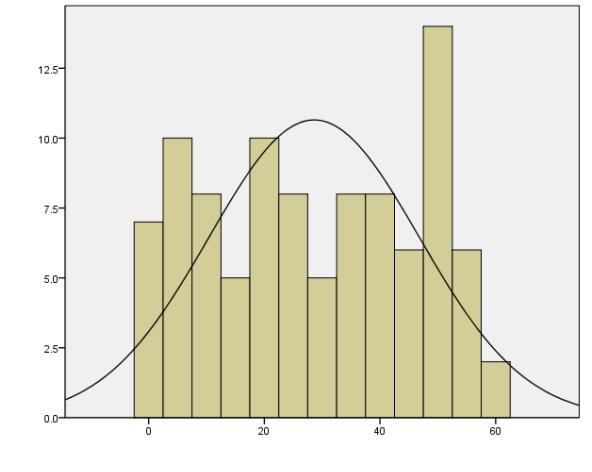

Figure 2. Histogram of participants' reading scores at assessment one

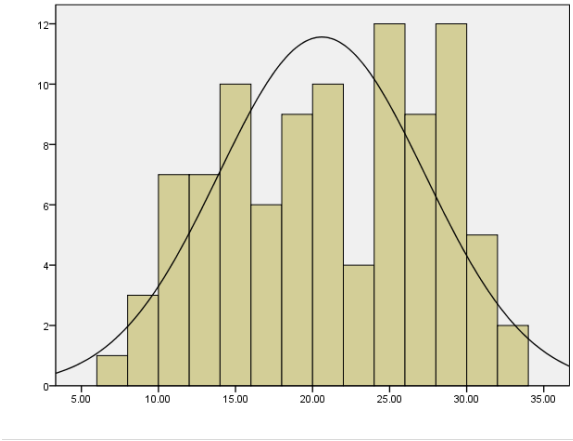

Figure 3. Histogram of participants' phonological awareness scores at assessment one