A developmental study of the effects of aircraft noise exposure on primary school learners' Reading Comprehension

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Declaration

I hereby declare that this research is my own independent work, and had not been presented for any other degree at any academic institution, or published in any form.

It is submitted in partial fulfilment of the requirements for the degree of Master of Educational Psychology by Coursework and Research Report at the University of the Witwatersrand, Johannesburg

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Glossary of Terms

dBA (**D**eci**B**el **A**-weighted filter): The filtering of sound that replicates the human hearing frequency response. The human ear is most sensitive to sound at mid frequencies (500 to 4000 Hz) and is progressively less sensitive to sound at frequencies above and below this range. A-weighted sound level is the most commonly used descriptor to quantify the relative loudness of various types of sounds.

Leq : Measure used to express the average sound level (typically expressed in dBA) over a given period of time.

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Abstract

Considerable research has been conducted regarding the impact of aircraft noise on children's cognitive performance. Little has been carried out in developing countries however, particularly on the African continent. This study, which was conducted over a three year period, aimed to determine whether the reading comprehension of primary school learners in South Africa was affected by exposure to aircraft noise. The sample comprised 737 learners aged between 8-14 years (mean age = 11.3) in 2009; 650 learners aged between 11-15 years (mean age = 12.3) in 2010; and 178 learners aged between 12-16 years (mean age = 13.1) in 2011. The reading comprehensions of participants from two public schools in KwaZulu Natal in a high aircraft noise area (16h outdoor Leq> 63dBA) were compared with those of participants attending three matched public schools exposed to lower levels of aircraft noise (16h outdoor Leq <56). Reading comprehension was assessed through the use of the Suffolk Reading Scale 2 (SRS2), which was group administered. A univariate General Linear Model was used to investigate the effects of aircraft noise exposure, language and socio-economic status on reading comprehension, while observing for the possible impact of gender and noise sensitivity on the results. The first question aimed to establish whether aircraft noise negatively affects learners' reading comprehension. The results showed no significant differences between the experimental and control group (F_{713}=0.33, P=<0.8651). The second question sought to determine whether the removal of aircraft noise would lead to improved reading comprehension scores. No significant difference (P>0.05) was observed in interactions between time and the experimental and control groups, in relation to reading comprehension. Establishing whether having a different language to English as one's home language negatively affects reading comprehension, was the third question that was explored. Significant differences were observed between English first language speakers and English additional language speakers in the favour of the former (F_{713}=19.97, P<.001). The final research question looked at whether low socio-economic status negatively affects reading comprehension performance. The results showed no statistical difference regarding the impact of a low socio-economic status on reading comprehension (F_{713}=1.69, P>0.197). The overall results of this study suggest that chronic noise exposure does not affect children's reading comprehension, but that language plays a large role in reading comprehension

performance. Furthermore, it would indicate that the removal of aircraft noise does not result in improved performance on reading comprehension.

Chapter 1

Introduction

In South Africa, the Bill of Rights (1996) enshrines education as a basic right for all children. It is thus important to ensure that it is not compromised in any way. This means the educational context and environment must be conducive to learning taking place and it is therefore vital to identify and eliminate any distracting factors. Exposure to noise is one such factor and has been seen to affect children's reading abilities, cognitive development, health and motivation. The noise to which children are most commonly exposed, originates from modes of transport, such as cars, trains and aeroplanes as well as from music and other people (Kopko, 2008).

Whilst there has been extensive research done over the past 30 years on the effects of noise, particularly on children, little attention has been paid to this issue on the African continent (Shield & Dockrell, 2003). The research that has been undertaken internationally in this area, suggests that the noise to which children are exposed, might harm their initial developmental stages, as well as hamper their education. This may potentially lead to long-term negative effects (Haines, Stansfeld, Job, Berglund et al., 2001a). Furthermore, research shows that children may be more adversely affected by noise and environmental stressors in comparison to adults. This is proposed as being due to a reduced cognitive ability to comprehend environmental issues, along with reduced strategies to assist them to cope (Haines et al., 2001a).

Mixed results have been obtained however, particularly with reference to the effects of aircraft noise on reading comprehension, with some studies suggesting that it can delay the development of this skill in children by up to six months and others suggesting the impact to be negligible (Clark & Stansfeld, 2005; FICAN, 2000; Haines, Stansfeld, Brentnall, Head et al., 2001b; Matheson, Stansfeld & Haines, 2003). There has been further suggestion that when the chronic noise is removed, the detrimental effects incurred can be rectified (FICAN, 2000). This finding does warrant further exploration. Other bodies of research have also examined the influence of language on reading comprehension and the extent to which socio-

economic status is linked to academic performance with once again conflicting results being obtained (Brainard, Jones, Bateman & Lovett, 2004; Cummins, 1981; Havard, Reich, Bean & Chaix, 2011). A study was also conducted on classroom acoustics and the role that the design and insulation of educational facilities can play on the quality of learning received (Maxwell & Evans, 2000). Therefore, additional research into the effects of noise on reading comprehension, as well as further exploration into the role that language, socio-economic variables and classroom acoustics play on reading comprehension, would prove valuable to teacher's instruction. It would also assist with decisions made regarding the geographical location of schools.

1.1 Rationale

Much research has been conducted in first world countries, investigating the effects of aircraft noise on children's cognitive performance as well as their psychological and physiological well-being (Shield & Dockrell, 2003). Limited research has been conducted in developing countries, like South Africa (Seabi, Goldschagg & Cockcroft, 2010). Noise levels are considered to be on the rise, especially with an increase in people using aircraft as their preferred mode of transport (Franssen, van Wiechen, Nagelkerke & Lebret, 2004). The impact of aircraft noise exposure on the population however, especially children who are still in the process of developing, has been shown to be contradictory (Haines et al., 2001a; Shield & Dockrell, 2003).

Some studies have suggested the impact of aircraft noise to be extremely detrimental to reading comprehension, whilst others have suggested its effects to be insignificant (Clark & Stansfeld, 2005; FICAN, 2000; Matheson et al., 2003). Additionally, one study found evidence alluding to the fact that detrimental effects incurred whilst exposed to noise, could in fact be reversed if the noise source was removed (FICAN, 2000). It is therefore important that the effects of this noise, particularly on cognitive performance are fully understood, so that children's education is not hampered or negatively affected by environmental factors.

1.2 Overview of Chapters

In summary, this chapter explored the rationale behind research being conducted into aircraft noise and its impact on reading comprehension.

Chapter Two focuses on the effects of aircraft noise on children's cognitive performance as well as theories explaining why noise impacts on cognitive performance through an exploration of relevant literature on the subject. Further information pertaining to reading comprehension and the various components of reading comprehension, as well as the effects of social disadvantage in relation to geographical position and education, are discussed. Lastly language and the impact of language on reading comprehension and the role that acoustics play, are reviewed.

Chapter Three discusses the methodology utilised during the current study as well as information regarding the participants, procedure employed and data analysis used on the obtained data.

Chapter Four discusses the results obtained from the collected data, with Chapter Five discussing the results, the limitations of the study and future recommendations for research in this area, ending with a conclusion.

Chapter 2

Literature Review

2.1 Overview of the Chapter

As noted earlier, the effects of aircraft noise on children's cognitive performance, in particular that of reading comprehension, will be examined. Furthermore, the influence of language, social disadvantage and acoustics on reading comprehension, both internationally and within the South African context will subsequently be discussed. However, first and foremost, an understanding on the present theories as to why noise affects a learner's cognitive performance, needs to be obtained in order to interpret the findings of studies conducted on this topic.

2.2 Theories on how noise affects cognitive performance

Different views regarding the impact of noise on cognitive performance have been upheld with many believing the connection to be complex. A common finding in research conducted, suggests that noise only negatively interferes when the level of the task is cognitively demanding and difficult. In contrast, when tasks are simplistic or repetitive in nature, noise has even been seen to assist and improve performance (Hygge, 2003).

One explanation for the impact of chronic noise exposure on cognitive performance, proposes that the noise to which children are exposed, inhibits their ability to pay attention to important cues during difficult tasks that have a language base (Haines et al., 2001b). This is known as Broadbent's "Filter" Theory, which describes the nervous system as constituting a single channel which only has a restricted capacity to transmit information. Before information enters into the channel, a selective device or filter is employed to select only certain stimuli for processing or storage (Suter, 1989). Noise is seen to impact negatively on the processing of language (Woolner & Hall, 2010). In an attempt to cope with the environmental noise, children 'filter out' sound stimuli that are both relevant and irrelevant (Shield & Dockrell, 2003).

Noise increases the tendency to select information that is probable at the expense of information that is improbable. Therefore, in instances where noise is extreme, often stimuli from only one source is reviewed (Suter, 1989). As noise is chronic, it becomes an automatic reaction that then can be seen to occur in situations where relevant noise is filtered out without the individual realising (Haines et al., 2001b). This in turn may lead to children who are chronically exposed to high noise having difficulty with sustained attention and as a result, learning is effected, even when the noise is not apparent (Haines et al., 2001b; Maxwell & Evans, 2000). More simplistic tasks relating to recognition and short term memory appear not to be as affected by noise, suggesting that tasks that are cognitively easier, require less attention and are not as influenced by chronic noise exposure (Haines et al., 2001b). It is thus the volume of the noise, not the presence of the noise that seems to have the greatest impact on cognition (Kopko, 2008).

Another theory proposes that aircraft noise exposure leads to increased levels of arousal. The noise is said to increase the organism's level of arousal through stimulating the reticular formation (Suter, 1989). It is suggested that this could lead to improved performance on tasks where unrelated material is screened out, especially when the task is routine and monotonous. If the individual is already optimally aroused for the task at hand however, the addition of noise exposure can bring on a state of over-arousal and as a result, performance levels will suffer (Suter, 1989). Therefore, if the individual is exposed to continually high levels of noise, it may result in an inability to concentrate on the task at hand (Shield & Dockrell, 2003).

It would therefore appear that from a theoretical perspective, there are numerous components linked to the processing of information in the presence of noise, that could negatively affect one's cognitive performance. Various studies have been undertaken to examine this topic further.

2.3 Cognitive Performance

One such study that was conducted to better understand the effects of high levels of noise, particularly aircraft noise, on cognitive performance, was the Los Angeles Airport study, conducted in the early 1980's. This was the first, large study that looked into the effects of aircraft noise on children's cognition and health. Seven different schools were used with four schools being classified as high noise exposure schools and three as low noise exposure

schools (Cohen, Evans, Frantz & Stokols, 1980). Children were matched for scholastic performance, socio-economic and racial factors as well as additional confounding aspects (Cohen et al., 1980; Cohen, Evans, Frantz & Stokols, 1981). A sound-attenuated trailer was taken to the respective schools and testing of the children's reading comprehension, among other variables, was conducted in this. The results from this study demonstrated no differences between the high and low noise-exposed groups with regards to reading comprehension, (Cohen et al., 1980; 1981).

Another study, known as the Classroom Noise Study, conducted in the 1990's, aimed to analyse the impact of different transportation noises that children regularly encounter, whilst in their schooling environment, on their ability to recall information. Approximately 1 500 children in Sweden were exposed to different types of tape recorded noises: aircraft noise; rail noise; road traffic and a combination of the three (FICAN, 2000). All children were exposed to the same total noise level, for the same duration and at the same time of day. Furthermore, this included three tests, with learners in either noisy or silent conditions, with the student's exposure being reversed on the second test wave. The results indicated that learners' recall abilities were affected the most when exposed to aircraft and road traffic noises, but appeared to be relatively unaffected by rail noise (FICAN, 2000). When the noise levels were dropped to below Leq 55 dBA however, the impact of road traffic on the students' recall was negligible, though aircraft noise remained detrimental at this level. The study has been critiqued for the small sample chosen and subsequent difficulties in generalising results to the broader population. A larger sample would need to be used in order to see the true impact of the different noise sources on student's recall ability (FICAN, 2000).

The Schools Environment and Health Study was also conducted in the 1990's, prior to Heathrow building a fifth terminal, in an attempt to determine the effects that the new terminal would have on the public (FICAN, 2000). Both health and cognitive performance were examined. In terms of the cognitive elements, researchers were interested in seeing whether decreased attention was a factor in reduced cognitive performance. Results indicated that this was not the case, but that the aircraft noise was delaying children's reading comprehension by up to 6 months (FICAN, 2000). The evidence initially suggested that the effects increased negatively over time, but when these were adjusted for confounding variables, the effect was eliminated which was proposed as being due to the sample size

(FICAN, 2000). This once again demonstrates the importance of having enough people in a study to allow for accurate and not skewed results to be obtained.

Further research in this area was conducted by Haines et al. (2001b), seen in the West London School study, which examined the effects of aircraft noise on children's cognition. The study tested 451 children's reading comprehension, immediate/delayed recall, sustained attention and health from 10 primary schools around Heathrow Airport (Haines et al., 2001b). The sample size was chosen in an attempt to be able to account for confounding variables such as: socio-economic group distribution; unemployment rate; the age of the children; and the proportion of ethnic groups in the area (Haines et al., 2001b). The results suggested that there was a dose-response relationship between the noise levels at their homes and the number of children who scored lower on their delayed and immediate recall. The study found that, amongst numerous other variables measured, children's reading comprehension appeared not to be hugely influenced by the aircraft noise to which children were exposed (Haines et al., 2001b). A further finding however, highlighted that children from high noise exposure schools reported higher levels of annoyance than children from low noise exposure schools (FICAN, 2000). This study has been critiqued as not being longitudinal and therefore unable to take into account the effects of noise over time (Matheson et al., 2003).

The Munich Airport Study also aimed to examine the effects of chronic aircraft noise exposure on children's cognition and additionally looked at its impact on children's health (Matheson et al., 2003). In this instance, the main major airport in Munich, was relocated from an urban environment to that of a rural environment and three different opportunities for collecting data were carried out, one shortly before the airport closed, the second a year later, with the third being two years later (Matheson et al., 2003). In this study children from third and fourth grades were identified from schools in high and low noise exposure areas and were matched for socio-demographic characteristics. The testing was conducted in a sound-attenuated trailer which was transported from school to school. Amongst the variables measured, reading comprehension was seen to be a component with which the children in the noise environment struggled (Matheson et al., 2003). Furthermore, the results showed that children who were at the initial location of the airport were negatively affected the most, but that this negative impact disappeared over time once the airport was shut down, leading to a reduction in impairment. In contrast, children at the site of the new airport started to show signs of impairment, noticed in their poorer cognitive performance (FICAN, 2000). This

finding has led to recognition of the negative impact of aircraft noise on cognitive performance. One of the limitations of the study however, was the size of the sample and the extent to which it was large enough to control for confounding variables, thus a larger sample would need to be utilised (Matheson et al., 2003).

Funded by European Union, the RANCH project (Road Traffic and Aircraft Noise Exposure and Children's Cognition and Health) has been the most recent study carried out on this topic. It was specifically designed to address cognitive performance and children's health by looking at exposure-effect relationships in terms of aircraft and traffic noise and how children performed at school (Stansfeld, Clark, Cameron, Alfred et al., 2009). The study comprised a sample of 2 844 children, between the ages of 9-10 from 89 primary schools that were situated near to three main airports in the Netherlands (Schipol), Spain (Barajas) and the United Kingdom (Heathrow) (Stansfeld et al., 2009). In the different countries, schools were sampled to determine high aircraft and road noise exposure to low aircraft and road noise exposure. The noise levels surrounding the schools were measured and these in turn were examined in relation to cognitive tests and health questionnaires to establish if there was any correlation between them. Additionally, factors such as education, ethnicity and socio-economic status were also taken into account (Stansfeld et al., 2009). Results on learners' reading comprehension indicated that noise exposure did affect this particular skill. The delay in reading comprehension varied between one month in the Netherlands, to two months in the United Kingdom, for a 5 dB change in aircraft noise (Stansfeld et al., 2009). Interestingly, road traffic noise was seen not to detrimentally impact on cognitive performance, but instead was seen to be associated with improved performance on certain activities (Stansfeld et al., 2009). The researchers ascribed this effect to elevated levels of arousal which assisted in their execution of the task (Stansfeld et al., 2009). The findings suggest the need for policies and guidelines to be implemented to ensure that the high noise exposure environments that children are learning in are healthy educational settings (Stansfeld et al., 2009). There were however limitations to the study regarding the cross-sectional nature, the lack of classroom acoustic assessment and additionally the bias or inaccuracies that may have resulted from use of parental reports on mental health (Stansfeld et al., 2009). This highlights the importance of trying to control for as many extraneous variables as possible.

2.4 Additional Impacts of Noise

Noise levels can also be seen to impact on children's cognitive performance indirectly. This is due to the effect that the noise has on the teachers who interact with the children (Kopko, 2008). Research has shown that teachers in noisy environments often experience greater fatigue and annoyance, proving to be less patient with learners than those teachers placed in quieter areas (Woolner & Hall, 2010). Time spent on instruction is also compromised due to noise, as teachers stop teaching during loud bursts of external noise (Kopko, 2008; Woolner & Hall, 2010).

It is equally important to look at the role that noise plays on individuals from a psychological point of view. Research has been conducted highlighting the importance of individuals being able to predict aversive stimulus, which is largely dependent on the presence or absence of perceived control (Suter, 1989). Often an inability to control the noise stimuli or the uncertainty of when aversive noises will arise, leads to profound levels of annoyance, which can also be seen to negatively impact performance (Clark & Stansfeld, 2005; Evans, Hygge & Bullinger, 1995; Haines et al., 2001b; Matheson et al., 2003; Schreckenberg & Meis, 2007).

As can be seen numerous and conflicting results have emerged regarding the impact of chronic noise exposure on learners, suggesting it needs to be further investigated. One cognitive task however, that appears to be repeatedly affected by environmental noise, is that of reading comprehension.

2.5 Reading Comprehension

2.5.1 What Reading Comprehension Entails

Brown, Marsh, Craven and Cassar (2006) identified four key components to reading, namely, phonetic skills, vocabulary, reading fluency and comprehension. Reading comprehension is said to be reliant on a variety of basic language and cognitive skills and is viewed as a crucial skill, necessary to our everyday lives (Brown et al., 2006; Cain & Oakhill, 2006). Individuals exercise literacy skills as a means of communicating affiliations and connections between intricate concepts and knowledge (Brown et al., 2006). Explaining the importance of reading comprehension Hall, White and Guthrie (1986) state that:

> "moving from printed text to comprehension involves a) knowledge of the world; b) cognitive processes, including perceptual discrimination, short term memory, serial order encoding, attention allocation and direction, and inferential processing; and c) language comprehension processes that include retrieval and integration of word meaning, syntactic parsing of sentences, determination of anaphoric references, and analysis of discourse structures" (p. 90).

Previously, reading comprehension was believed to be based on the 'alphabetic principle' whereby letters would represent different sounds and these sounds could in turn be employed to construct words (Orasanu & Penney, 1986). New insights into comprehension now propose that people find a purpose for reading a particular text and then search their memory base for anything linked to the topic (Orasanu & Penney, 1986). This is then followed by the identification of familiar words and those that have similar letter groupings to words they know (Orasanu & Penney, 1986). Our recognition of the words is predisposed by our expectations of what words will emerge based on our knowledge of the language and the topic at hand. This ultimately leads to the reader creating meaning from the text and their prior knowledge (Orasanu & Penney, 1986). The unique and varied expectations of the reader, comprehension of the varied structures of the text, and the objective that learners incorporate in their reading, thus interact and influence comprehension (Knott, 1986).

Some would argue that the acquisition of reading comprehension is merely learning to understand writing to the same extent that one understands spoken language (Perfetti, Landi & Oakhill, 2005).When initially learning to read, it is proposed that the correlations between reading and spoken language comprehension are small, due to children learning to decode and identify words (Perfetti et al., 2005). It is these word-reading processes that reduce comprehension. However, as children's reading abilities progress, the relationship between reading comprehension and spoken language comprehension increases and in turn evens out by high school (Sticht & James, 1984).

2.5.2 The Importance of Reading Comprehension

Evershed states that "To read is to empower, to empower is to write, to write is to influence, to influence is to change, to change is to live" (Department of Education, 2008). This highlights the importance of reading and reading comprehension, which constitute a key

component to knowledge attainment. Without this skill, people are denied the opportunity to gain access to pertinent information regarding health, social, cultural and political issues, not to mention a source of great pleasure and enrichment (Baatjes, 2003).

Young children start by learning to read and then during their mid-elementary schooling, they start reading to learn (Gough, 1996). It is at this stage that some children may experience and become aware of difficulties understanding what they are reading. Comprehension of the material that is being read is crucial to a child's success in school. Children must be able to understand the context of the words in individual sentences and furthermore comprehend numerous concepts when reading and engaging in longer passages (Cain & Oakhill, 2006).

There are two types of basic reading comprehension skills, namely concrete and abstract. Concrete comprehension skills comprise the ability to answer questions when the information being asked is explicitly stated in the reading selection (Lipson, 2012). Concrete skills include vocabulary, main idea, fact or opinion, sequencing, following directions and reading for details. Abstract reasoning on the other hand, includes inference, analysis, evaluation, drawing conclusions, and establishing cause and effect (Lipson, 2012). It further necessitates the reader to draw on knowledge already obtained. Both types of comprehension require that the reader have adequate processing and working memory skills, which enable them to take in new information, identify and categorize it, merge it with previously learned information, and respond. Difficulties with reading comprehension could thus be related to challenges with any of the above skills, which are all linked to success in the classroom (Lipson, 2012).

2.5.3 Reading Comprehension and Literacy in the South African Context

Illiteracy in South Africa constitutes a deeply rooted social phenomenon that threatens true transformation and development from taking place (Baatjes, 2003). An inability to read inhibits countless people from entering into the workplace, which in turn adversely impacts the country's economy, as poverty rates increase (Møller, 2007). The consequences of high levels of illiteracy can thus be seen as far-reaching. In 1996, 32% of the population was found to be functionally illiterate, with a startling 3 million adults having had no access to any form of education (Baatjes, 2003). Almost, 5 years later, a national census found that the numbers had grown by a further 500 000 adults (Baatjes, 2003). These statistics provide an indication of the scope and scale of reading initiatives needed within the current education setting.

Government implemented the National Reading Strategy in an attempt to improve the reading level and comprehension of all learners (Department of Education, 2008). The stated benefits link to assisting learners move through the education system; improving matriculation pass rates; improving individual's ability to communicate in an ever-changing world; and bringing about economic benefits to the country through turning out workers who are capable in terms of their reading and writing skills (Department of Education, 2008). This they tried to achieve through building on six key components, "monitoring learner performance; teaching practice and methodology; teacher training, development and support; management of the teaching of reading; resources; and research, partnerships and advocacy (Department of Education, 2008, p. 13). In spite of this nationwide intervention, results obtained from progress reports would still suggest that South African school children continue to fall short in terms of acquiring reading and comprehension skills.

Pretorious and Naudé (2002) conducted a study that examined why South African learners tended to fare worse than other children from different countries with regards to their reading and literacy skills. Children aged between five and seven, from an informal settlement in South Africa were tested prior to their entry into the schooling system for their readiness for the school environment. It was found that these children experienced difficulties relating to literacy skills, sentence construction, syntax, sound development and basic alphabet knowledge (Pretorious & Naudé, 2002). This would suggest that while difficulties experienced with reading comprehension may be due to issues of under-developed literacy skills, there are additional factors that exist outside of the schooling environment, such as culture and particularly that of social disadvantage that are linked to competence in reading comprehension.

2.6 Social Disadvantage

"Social disadvantage" is a term that is hard to define due to the numerous components which constitute it (Ginsborg, 2006). Factors relating to family status; the type of housing; the level of education of the parents; unemployment and economic deprivation; and high usage of medical and social services can be seen to represent just some of the components used to define the term (Ginsborg, 2006). The implications of social disadvantage, however, are extensive and these will be looked at in terms of their relationship to geographical position and education.

2.6.1 In relation to geographical position

Factors relating to unfair environmental policy-making and prejudiced market components would appear to have influenced the type of population who live in areas that are seen as less environmentally desirable. A study done in Birmingham in the United Kingdom, aimed to establish the extent to which inequalities existed within the town in relation to noise exposure (Brainard et al., 2004). Demographic information provided by the 1991 United Kingdom census, as well as factors relating to age, ethnicity and indicators of poverty of residents living in the town, were all examined. Based on the results obtained, it would appear that certain ethnic groups tended to be concentrated in areas that were exposed to high noise levels. Moreover, these ethnic groups also tended to be socially deprived, making the ability to differentiate between the two difficult (Brainard et al., 2004). Some of the critique regarding the study, suggests that results are specific to Birmingham and may not be able to be generalised to other situations and settings, due to the participants not being reflective of the broader population (Brainard et al., 2004). Additionally, the data obtained from the census is fairly outdated (1991 for a 2001 study) and this may have meant that geographical distribution of the population did not in fact match the noise patterns that were measured in 2001 (Brainard et al., 2004). Using current data when conducting studies, and trying to use a population that is representative of the larger population, are thus key elements to a study.

These findings were further supported by evidence obtained in the Schools Environment and Health Study which found the population surrounding the Heathrow airport to comprise of a higher proportion of racially diverse and non-English speaking populations. There too appeared to be high numbers of families with socially deprived children (FICAN, 2000). It would appear that socio-economic status may also be closely associated with aircraft noise, with poorer communities more exposed to aircraft noise due to a lack of choice regarding housing.

To further explore this trend, a study conducted in Paris, France, assessed whether noise exposure generated from road traffic in particular, was correlated to any socio-economic variables (Havard et al., 2011). Data used from the RECORD Cohort study and modelled noise data was utilised. Associations were sought by means of estimating noise exposure in residential areas whilst also taking into account numerous socio-economic variables (Havard et al., 2011). In contrast to previous research conducted, results of this study suggest that the

more affluent and educated the neighbourhood, the higher the noise exposure but only in the case of non-French citizens. This study showed that more people in first-world countries were exposed to higher noise levels, with those coming from disadvantaged countries, being less exposed and affected by it (Havard et al., 2011). This was proposed as being due to noisier high-traffic arteries being mainly located in the vicinity of the more affluent business and tourist neighbourhoods. It is important to note, however that Havard et al. (2011) argue that the results obtained cannot be extended to other settings and that the utilisation of a cross-sectional design does not allow for the understanding of the timing of the causal mechanisms and how these in turn relate to the inequalities. The use of a longitudinal study would help to overcome this issue.

2.6.2 In relation to Education

It is widely accepted that exposure and access to reading material at a young age assists children in acquiring reading skills (Noble, Farah & McCandliss, 2006). A lack of this exposure and access, which is often associated with a lower socio-economic status, often negatively impacts on the development of this skill (Noble et al., 2006). Furthermore, as Cunningham & Stanovich (2001) argue, a lack of practice and exposure can affect the fluency and speed at which reading is done and the slowness which results, can often be seen as a factor that makes the experience less enjoyable, or even avoided. The authors also propose that the volume of reading done can also be seen to improve an individual's vocabulary and that one acquires greater understanding through exposure than through rote learning (Cunningham & Stanovich, 2001). Exposure to books is thus a particular factor that is affected by socio-economic variables.

Research conducted on the impact of an individual's socio-economic status on their reading capability, aimed to explain how socio-economic status influences the relationship between phonological awareness and reading ability. The sample comprised 168 first graders, with varying socio-economic statuses, from nine different, New York, public schools. Tests from the Woodcock Johnson III Tests of Achievement were used to obtain the children's reading ability and level of phonological awareness. The results of the study indicated that when a child's socio-economic background was lower, they struggled to decode words. A higher socio-economic status and more access to reading, on the other hand, assisted a child to overcome a weak phonological awareness far more readily. One limitation of the study

however, was its inability to distinguish between genetic and environmental factors for which socio-economic status may stand as a substitute. This highlights the importance of operationally defining one's terms. Results do however suggest that a good comprehension of the sound structure of a language, helps dramatically in grasping reading skills. It is therefore proposed that emphasis in reading needs to concentrate on the development of phonological awareness within children as it helps reduce socio-economic disadvantages that are faced (Noble et al., 2006).

South Africa is a country that is well known for its large discrepancies in income (Van der Berg, Burger, Burger, de Vos et al., 2011). Statistics have highlighted that the gap between the wealthiest decile per capita income differs by as much as 208% in comparison to the second wealthiest decile (Van der Berg, 2002). The large majority of the population lives on an income that makes daily survival very difficult. This invariably impacts on numerous components, including education.

The home environment into which a child is born can be seen as having a huge impact on their academic attainment (Van der Berg, 2002). Within the South African context, research has suggested that Black learners have a backlog on test scores that is almost equivalent to three years in education, compared to other racial groups (Van der Berg, 2002). This is proposed as being due to the poor quality of education received during the Apartheid era (Van der Berg, 2002). However, this difference ceased to exist when the Black child came from a higher socio-economic background and had more access to resources and support (Van der Berg, 2002). Timæus, Simelane and Letsoala (2011) also found evidence to suggest that Black learners are performing worse than children from other racial groups and suggest that the majority of educational disadvantages that African learners experience are due to household poverty and in particular the low education of the mother. Results obtained indicated that children from wealthier backgrounds were more likely to be enrolled into school on time, progress better through the educational system and were much more likely to have matriculated, than children from poorer households (Timæus et al., 2011). This can be seen as particularly detrimental as a low socio-economic status affects the education and performance of the learners, which in turn affects their ability to change their social position (Van der Berg et al., 2011).

Results obtained from the Monitoring Learner Achievement (MLA) Survey would also seem to support the above. The survey indicated that about 40% of the parents who were interviewed had not completed primary education and a further 60% of the parents in all main provinces, had either failed to successfully complete primary school, or alternatively had not achieved education levels higher than primary school (South African Book Development Council, 2007). As highlighted previously, the educational background of a child's parents has a huge effect on their achievement within the school environment. Uneducated parents, or parents with little education, often find assisting their child with their school work problematic, due to a lack of understanding of what the child is required to do (South African Book Development Council, 2007). The MLA survey also revealed that most of the households interviewed had no access to books and that approximately a quarter of the parents were members of a library, and over half of all of those interviewed, had access to fewer than 10 books. This scenario is detrimental to children, as environments where printed materials are lacking, often result in difficulties with reading and spelling (South African Book Development Council, 2007).

Research conducted in 2010 by the Southern and Eastern Consortium for Monitoring Educational Quality (SACMEQ III), highlighted the very poor cognitive performance and low skill level particularly of reading, mathematics and science (Van der Berg et al., 2011). The consortium consisted of "education ministries, policy-makers and researchers who, in conjunction with UNESCO's International Institute for Educational Planning (IIEP), aimed to improve the research capacity and technical skills of educational planners," (Spaull, 2011, p. 4). In an effort to achieve this, data was collected via school surveys, examining a huge number of variables (socio-economic status, quality of education, access, and equity). Detailed information on mathematics and reading from 2 800 schools, 70 000 learners, 6 000 teachers and 2 800 principals from 15 different countries was obtained. The results of this study suggest that South African children from a lower socio-economic status performed worse on reading tests, in comparison to children from an equally poor background, but from a different country (Spaull, 2011). Thus whilst it is evident that socio-economic background impacts on education due to location, educational quality, parental education, exposure to resources and support, other factors are at work. One such factor that has been particularly reviewed in this context is the impact of language.

2.7 Language

Language continues to be an important factor, especially in the assessment of cognitive performance and particularly reading comprehension. Much research has indicated that children whose first language differs to that of the language in which they are taught or tested, often experience difficulties during testing. It was found that scores incurred, were often not representative of the individual's actual abilities (Brisk, 1998).

Cummins (1981) investigated factors that lead to learners' academic failure, with the suggestion that tuition in a language other than one's home language creates difficulties, as full comprehension is not always achieved. This proposition is in line with his 'linguistic mismatch hypothesis' which suggests that "a home-school language switch will almost inevitably result in academic retardation unless initial content is taught through their first language whilst they are still learning," (Cummins, 1981, p. 161). This effect is attributed, in part, to children who are bilingual or exposed to two languages, having to master two different language systems. This means that the bilingual child is expected to interpret considerably more language, than the monolingual child who only has to make sense of one language system. Difficulties experienced by the learners are thus due to a mismatch between their language spoken at home and that of their school (Cummins, 1981).

Others have argued the point that when children are not tutored in their first language, their second language is adversely affected as the basics of their primary language are not firmly in place (August, Calerón, Carlo & Nuttall, 2006). It can thus be concluded that the use of both the child's first and second language should be encouraged. This notion is further supported by a meta-analysis on the effectiveness of bilingual education conducted by Greene (1998) which would also appear to suggest the need for a combination between exposure and use of first language. Eleven different studies were conducted in the United States of America, between 1992 and 1996, that included standardized score results from 2 719 learners of whom 1 562 were being taught bilingually. Results obtained suggested that children who were not proficient in English, performed considerably better on standardized tests when taught to some extent in their first language. This was in comparison to children whose first language was also not English, but received their education only in English (Greene, 1998).

An alternative theory to that espoused by Greene (1998) and August et al. (2006) known as the 'exposure hypothesis' is proposed by Lopez and Greenfield (2004), which argues for the

need for increased immersion as the best way to learn a language. It suggests that if increased amounts of time were spent teaching in the learners' first language as opposed to English, comprehension of English would be further reduced, due to limited exposure (Lopez & Greenfield, 2004).

Cummins (1981) argues that when testing comprehension in a second or additional language, even if the individual appeared fluent superficially, the results of the scores obtained would not be a true reflection of their ability. Studies conducted suggest that it takes up to five years for a second language learner to catch up academically to a first language speaker (Cummins, 1999). It has thus been observed that children who are not taught in their first language and are somewhat bilingual, encounter problems in school and perform worse than children who are monolingual. This is specifically the case on IQ tests and on activities that measure literacy development (Cummins, 1981).

August et al. (2006) investigated the effect of language of instruction on reading outcomes for three, different, groups of Spanish speaking learners. The differences and benefits between all the three different conditions proposed above were analysed. Out of the three groups, there were those who only received instruction in English, those who were taught bilingually and those instructed only in Spanish (August et al., 2006). Over a period of four years, 269 children were tested, with interesting findings emerging. It would appear that in environments where there were enough people who spoke the same first language and in which educators were adequately trained to teach in it, bilingual instruction was seen as beneficial. This would suggest the importance of taking into account the context when looking at the impact of bilingual instruction (August et al., 2006).

The impact of noise has also been investigated as a factor that, in the case of bilingual children, may impact on comprehension. When the language spoken at school is an additional language and as a result differs from the language spoken at home, noise in the classroom can be seen to be even more detrimental (Evans & Hygge, 2007). Nelson, Soli and Seltz (2002) reviewed research evidence with findings suggesting that second language speakers do not perform as well as native speakers on tests of speech comprehension against noise. This however, can be contrasted by work done by Shield and Dockrell (2003), which looked at the performance pattern on written tasks of children with English as an additional language (EAL), when exposed to high levels of noise, which did not suggest that these learners

suffered additional difficulties. This was thought to be attributed to the fact that the tasks did not depend on speech intelligibility (Shield & Dockrell, 2003). The above, would strongly support further research being conducted into the relationship between language and noise.

2.7.1 Language in the South African Context

In South Africa there are 11 official languages, which means for many, English-based assessments lead to numerous challenges for the majority of individuals (Foxcroft & Roodt, 2009). Statistics suggest that as much as 74 % of the population speak an African language with only 9% stating English to be their primary language (Ramaahlo, 2010). Despite these overwhelming numbers, most educational instruction is in English and Afrikaans (Alexander, 2003).

This is the ongoing legacy of the Apartheid regime whereby children in schools were required by law, seen in the Bantu Education Policy of 1953, to be taught in English and Afrikaans in an attempt by the government to exert dominance (Henrard, 2002). This transpired despite the research at that time suggesting that being taught in one's mother tongue was the most effective way of teaching a child (Alexander, 2003). Huge opposition to this policy eventually led to the 1976 Soweto uprising which led, amongst other things, to changes in language policies (Alexander, 2003).

More recently, the Language-in-Education Policy of 1997 in post-Apartheid South Africa specifies that learners, particularly in the Foundation Phase (Grade R- Grade 3), should be taught in their mother tongue. However, despite this policy, investigations by the Department of Education have produced evidence to suggest that most learners in South Africa do not learn in their first language, especially those in the Foundation Phase. The majority of schools have inadequate language policies which do not adequately attend to the needs of the learners. Furthermore, it has been found that teachers in the Foundation Phase, on the whole have not been equipped to teach reading in the home language of African learners (Department of Education, 2008).

While huge changes have been made to education and language policies in South Africa, there still remains a large gap between what is occurring in reality and what is stipulated in the policies (Henrard, 2002). Language barriers with a lack of inter-group communication and understanding, which ultimately hinder children's academic progress and comprehension

in the classroom, continue to impact on children's education in South Africa (Alexander, 2003). It is evident that there is still a great need to address the problem of language within the classroom to ensure that learners are provided with the best means to achieve their academic potential. An additional factor that should also be taken into account, is that of acoustics which can additionally be seen to impact on reading performance in the classroom.

2.8 Acoustics

Originally acoustics constituted the study of small pressure waves in the air which were able to be detected by the ear; in other words 'sound'. This notion has expanded over time to incorporate higher and lower frequencies namely ultrasound and infrasound, as well as structural vibrations (Rienstra & Hirschberg, 2001). Acoustics can therefore be seen to represent a broad and complex term, comprising numerous components.

Maxwell and Evans (2000) conducted a study which examined the effects of noise on pre-school children's reading skills as an effect of acoustical design. Researchers wanted to establish if high noise levels experienced in the classroom would, as shown in previous studies, impact on children's reading performance. Children were exposed to noise levels of up to 75 dBA. Results indicated that children performed better on the recognition of numbers, letters and simple words (as this was seen as the first reading skill that they grasped) in quieter areas that had been acoustically treated (Maxwell & Evans, 2000).

The challenge is the fact that large noise does not solely derive from sources external to the school environment, but can also be seen to permeate from internal noise factors. Background noises within the classroom from heating and ventilation systems, as well as computers, or projectors, add to the noise levels experienced in the classroom. This is coupled with the noise that children make in the room which is often dependent on the task with which they are engaging. These noise levels are often said to be exacerbated by high reverberation levels which increase noise levels and additionally make hearing speech more difficult (Woolner & Hall, 2010). Consistent findings in both field and laboratory studies that indicate noise to be detrimental in tasks that are language based, have led some to suggest the need to control reverberation in an attempt to diminish both internal and external noise levels (Knecht, Nelson, Whitelaw, & Feth, 2002; Nelson et al., 2002). Whilst this finding is supported by numerous others, there are still some in the field, who remain undecided about the impact of reverberation. They place more emphasis on noise levels and signal to noise levels with

regards to speech intelligibility, as well as the standards adopted for school buildings (Shield & Dockrell, 2003).

In numerous English secondary schools that are currently awaiting rebuilding work, problems with acoustics are considered by over three-quarters of head teachers to be the primary factor negatively impacting on the provision of education (Price Waterhouse & Coopers, 2008). The majority of these schools were built prior to the development of stringent regulations and guidelines, which legally obligate schools to build according to certain specifications due to external noise levels (Shield & Dockrell, 2003). As a result, many of these schools were built utilising lightweight construction materials with inadequate sound insulation that can be seen to have a substantively negative impact on children's learning (Price Waterhouse & Coopers, 2008). This emphasises the adverse influence that poorly conceptualised building and acoustical design can have on school environments and education.

It is however argued that improving acoustical designs may in turn affect other factors and worsen the problems. Particular reference is made of the tension between air quality and noise. Certain items used to assist with acoustics in building such as carpets and ceiling hangers may collect dust and in doing so worsen the air quality. Furthermore, while ventilation systems have been argued as adding to noise levels in educational settings, research on the effects of poor air quality on health, suggest that maintaining good air ventilation is imperative (Woolner & Hall, 2010).

The findings above would suggest the importance of further research being conducted. Acoustic features such as ceiling height and the shape of classrooms need to be considered. It is believed that these may assist in reducing noise levels experienced in the classroom (Maxwell & Evans, 2000).

Chapter 3

Methods

3.1 Overview of the Chapter

This chapter commences with a description of the context of the study and the research design. This is followed by the hypotheses, research questions, information pertaining to the participants, the procedure followed and instruments utilised (biographical questionnaire, Suffolk Reading Scale and noise instrument). Finally, the chapter concludes with descriptions on threats to validity, ethical considerations and data analysis.

3.2 Context of the Study

This study constitutes a part of a larger, longitudinal, South African based study, namely The Road and Aircraft Noise Exposure on Children's Cognition and Health (RANCH- South Africa) study. RANCH SA is based on the original RANCH project that primarily investigated the effects of aircraft and road traffic noise on children's cognitive performance. The RANCH-SA project is attempting to determine the effects that aircraft noise has on South African primary school children's reading comprehension, attention, working memory and episodic memory in KwaZulu Natal (Seabi et al., 2010). For the purpose of this dissertation, archival records were utilised, whereby only the effects on reading comprehension were investigated.

3.3 Research Design

This quantitative, developmental study uses a longitudinal design whereby repeated observations of the same variables over long periods of time have been made. The development of children's reading comprehension, has been tracked over a period of time (2009-2011). Quantitative research aims to quantify constructs as well as take into account variables when explaining and analysing data (Babbie & Mouton, 2001). Additionally it aims to control for sources of error either through experimental or statistical controls (Howell, 1998). Both descriptive and inferential statistics were utilised in this study.

Inferential statistics refer to the type of statistical computations used in order to make inferences from the data that has been analysed and is based on sample observations to a larger population (Babbie & Mouton, 2001). On the other hand, descriptive statistics can be seen to comprise statistical computations that describe the characteristics of a sample, or describe the relationship between variables of the sample (Howell, 1998). This, in comparison to inferential statistics, just summarizes the sample observations as opposed to making inferences (Babbie & Mouton 2001). In this study, inferential statistics were employed to examine the proposed hypotheses, whilst descriptive statistics focused on the sample's characteristics relating to gender, age, language and socio-economic status.

There were three phases in which data was collected. In the first phase, the learners' reading comprehension was measured prior to the closure of the Durban International Airport (relocation to the new King Shaka International Airport site), where noise levels were high (16 hours outdoor Leq <63dBA) for the experimental group, but low (16 hours outdoor Leq <56 dBA) for the control group. In phase two, the airport had been relocated to the new site, thus noise levels were the same (16 hours outdoor Leq <40 dBA) for both groups. Lastly, in the third phase, noise levels were once again the same for both the experimental group and the control group.

3.4 Research Questions

On the basis of the aforementioned hypotheses, the following research questions were formulated.

1) Does aircraft noise negatively affect primary school children's reading comprehension?

2) Does the removal of high aircraft noise lead to improved reading comprehension for noise-exposed children?

3) Does having a different language to English as your first language negatively affect primary school children's reading comprehension?

4) Does a low socio-economic status negatively affect primary school children's reading comprehension?

3.5 Hypotheses

Babbie and Mouton (2001, p. 643) describe a hypothesis as "essentially a statement that postulates that a certain relationship (correlation or causality) exists between two or more variables." The hypotheses that were tested in this research were:

(Ho1) Aircraft noise does not negatively affect primary school children's reading comprehension.

(Ha1) Aircraft noise negatively affects primary school children's reading comprehension. Such a hypothesis has arisen as a result of numerous studies conducted overseas, which have found evidence to suggest that children exposed to high levels of aircraft noise perform worse on reading comprehension measures, in comparison to children exposed to lower levels of aircraft noise (Clark & Stansfeld, 2005; FICAN, 2000; Haines et al., 2001a).

(Ho2) The removal of high aircraft noise does not lead to improved reading comprehension for primary school children

(Ha2) The removal of high aircraft noise leads to improved reading comprehension for primary school children. This notion has emerged due to results that were obtained from the Munich study that also took advantage of the natural occurrence of an airport relocating. It was this study that found evidence to suggest that when the noise exposure from aircraft was removed, any negative effects that resulted disappeared over time (FICAN, 2000).

(Ho3) Having English as an additional language, does not negatively affect primary school children's reading comprehension.

(Ha3) Having English as an additional language negatively affects primary school children's reading comprehension. The impact of language on school performance has been widely looked at and literature written by Cummins (1981) suggests that children taught in a language other than their home

language, do not perform as well at school as those taught in their home language. This is proposed as being due to their having to master not only one, but two languages (Cummins, 1981).

(Ho4) A low-socio-economic status does not negatively affect primary school children's reading comprehension.

(Ha4) A low socio-economic status negatively affects primary school children's reading comprehension. Research has shown that children who come from lower-socio-economic homes have less exposure to books and cognitively developing stimuli; are more inclined to live in areas that are exposed to high levels of transportation noise; and have parents with lower education levels (Brainard et al., 2004; FICAN, 2000; Noble et al., 2006; Van der Berg, 2002). These factors that emerge due to a low socio-economic status, in turn have been seen to negatively affect children's academic performance in schools (Timæus et al., 2011; Van der Berg, 2002).

3.6 Participants

The sample comprised 737 learners between the ages of 8 and 14, with a mean age of 11.3 in 2009. Of the 737 participants, 50.3% (n=370) were females and 49.7% (n=366) were males. In 2010, the sample was made up of 650 learners between the ages of 11 and 15 (mean age = 12.3), with 49.9 % (n=321) females and 50.1% (n=322) males. Finally in 2011, the sample comprised 178 learners of whom 48% (n=84) were females and 52% (n=91) were males with age ranges from 12 to 16 (mean age = 13.1). The additional variables of English as a First Language (EFL), English as an additional language (EAL), deprived learners and not deprived learners were looked at. The numbers of the respective variables do not always add up to the total participants (N) of the control and experimental groups, as there was data missing. A further detailed breakdown of the socio-demographic characteristics of the sample is presented in Table 1.

Table 1

The socio-demographic characteristics of the experimental and control groups

	2009		2010		2011	
Variables	**Experimental N=438**	**Control N=298**	**Experimental N=299**	**Control N=297**	**Experimental N=96**	**Control N=82**
Males	195	171	173	148	40	42
Females	191	178	172	149	56	40
EFL	228	188	194	166	37	34
EAL	153	157	120	121	26	23
Deprived	154	103	209	209	30	36
Not Deprived	233	251	43	108	54	44
Mean age	11.2	11.3	12.2	12.4	13.0	13.2
Age Range	8-14		11-15		12-16	

The participants were from five public schools in KwaZulu Natal Province. Two of the schools were originally situated in a high aircraft noise area (16h outdoor Leq>63dBA) near the old Durban International Airport, with the other three schools being situated in a low noise area (16h outdoor Leq<56dBA). The schools were selected based on their proximity to, and distance from, the airport. The socio-demographic characteristics of the learners were matched using the questionnaire for children developed by the RANCH SA team which learners filled out. Additionally, parents completed a questionnaire comprising questions that established their income, their socio-economic status and home language.

A non-probability, purposive sampling method was utilised, whereby participants were selected or asked to participate due to criteria of relevance to the research question (Willig, 2001). Criteria for participating in this study thus included primary school children in a high and low noise area, with similar socio-economic backgrounds and no perceived hearing difficulties as alleged by parents and teachers. Although there was the risk that a biased selection would be obtained, due to the selection not being random, efforts were made to ensure that the sample utilised was representative, by the questionnaires being distributed to children who signified the target population.

3.7 Procedure

Learners had their reading comprehension tested between 08.00a.m and 10:30a.m in April 2009, before the Durban International Airport shut down, again a year later in 2010 and then a third time a year later, in 2011. These times were agreed upon by the principal and staff members. Information regarding any hearing difficulties experienced by the participants was gathered from the children's parents. All testing was conducted during the week, when air traffic movements were normal. Furthermore, when the Suffolk Reading Scale 2 (SRS2) was administered to learners, RANCH-SA protocol was followed. This ensured that all testing was preceded by practice items to certify that all participants understood what was required of them during the assessment. All tests that were fully completed, were placed in coded envelopes once the assessment came to an end.

3.8 Instruments

Whilst numerous instruments were administered as a part of the RANCH-SA study, only three different instruments were employed during this study. A biographical questionnaire was utilised to obtain biographical data relevant to the study; the Suffolk Reading Scale 2 was used to obtain reading comprehension levels; and a SVAN 955 Type 1 sound lever meter and a Rion NC74 acoustic calibrator, were both used to measure the noise levels.

3.8.1 Biographical Questionnaire

The biographical questionnaire was devised by the RANCH SA team to gain information pertaining to the noise levels to which the participants were exposed (See Appendix 3 for biographical questionnaire). The questionnaire was administered in English, to all the participants in print form and was completed prior to the assessment taking place. It further aimed to gather information regarding the participant's home language, age, gender, health, support at home and school work. Socio-economic status was also ascertained from the questionnaire and was determined by whether or not the child was entitled to receive free meals at school. Research has shown that there is a "significant correlation between the free school meal ratio and a range of census indicators representative of socio-economic status" (Seabi, 2012, p. 8). Receiving a free school meal was thus linked to whether the child's caregiver was receiving a government social grant.

3.8.2 Reading Comprehension

Reading comprehension was measured using the Suffolk Reading Scale 2 (SRS2) (See Appendix 4 for front page of Suffolk Reading Scale 2 (SRS2)). The instrument comprises 86 multiple-choice questions, each with five possible answers. The scale's multiple choice format allowed for it to be group administered. The scale was standardized in the United Kingdom, using a sample of primary school children that was representative and primarily randomly selected. It was devised as a means of measuring children's reading abilities from the ages of 6 years 4 months to 13 years 11 months and in doing so, establishing the standard of their reading (Matsui, Stansfeld, Haines & Head, 2004). Whilst some of the ages of participants in the current sample fell out of the age category mentioned above, it is important to remain cognizant of the South African context and its impact on performance. When looking at international studies that utilised the SRS2 as an assessment instrument, it can be noted that their mean scores are significantly higher than that of the sample used in this study. The mean reading comprehension score obtained by learners in the West London Schools Study was 96.8 with a minimum of 69 and a maximum of 128, after adjusting for ethnicity, main language and age (Matsui et al., 2004). Further studies conducted around Heathrow Airport, also reported participants obtaining a mean reading comprehension score of 98.48 in high noise conditions and between 100.01 and 102.66 in low noise conditions after adjusting for the same socio-demographic characteristics discussed above (Haines et al., 2001a).

When comparing these studies, to the mean reading comprehension score obtained in this sample, it becomes evident that the South African learners are performing at a far lower level. In this study, the mean reading comprehension score obtained at high noise levels (63.5 dBA and 69.9 dBA) at time 1 (2009) was 37.23, with the mean reading comprehension score obtained at low noise levels (54.4 dBA and 55.3 dBA) at time 1 (2009) being 30.17. This can be seen to be significantly lower than the mean reading comprehension scores obtained by children in other international studies, as highlighted above.

For children in England and Wales, the school going age for the majority of them is four years. This aims to admit them into the reception class at the beginning of the year in which they turn five (Sharp, 1998). Studies conducted on reading performance in both the United States of America and England found evidence to suggest that the earlier children go to school and start learning to read, the better they perform later (Sharp, 1998). Although the

SRS2 is normed for children between the ages 6 years 4 months to 13 years 11 months, the English standard is thus significantly higher than that of South African learners due to increased schooling exposure as a result of attending school earlier on. This factor was therefore taken into account when administering the SRS2 to the participants in the current study, whose ages did not all fit into the standardised age bracket.

Research was also done to determine whether this test would yield reliable results as it is not normalised for the South African population. Results indicated that the test was a reliable measure of reading comprehension in the South African context despite it having been developed in the United Kingdom. This was demonstrated in the Suffolk Reading Scale 2 obtaining a Cronbach alpha coefficient of 0.93 (Ramaahlo, 2010). On the standardization sample, it was furthermore found to have a test-retest co-efficient of 0.88 (Seabi, Cockcroft, Goldschagg & Greyling, 2012).

3.8.3 Noise Measurements

In order to measure the external noise surrounding the five schools, a SVAN 955 Type 1 sound lever meter was utilised. To further test the instruments, calibration prior and after the measurements were taken; a Rion NC74 acoustic calibrator was used. The measurement of the noise was taken between 08:00 a.m. and 10:30 a.m., which was during the period when testing took place.

3.9 Threats to Validity

One of the biggest concerns regarding the validity of the test, rests in the fact that the Suffolk Reading Scale 2 was administered as one of the last tests in the battery as part of the RANCH-SA protocol. As a result, issues relating to fatigue and boredom may have affected the children's performance and completion of the questionnaires as not all of the children managed to complete their questionnaires. The results obtained may thus not have been truly reflective of their abilities. Cloze comprehension tasks are often designed however to get progressively more difficult and therefore, failure to complete certain questions may not have been as a result of boredom or fatigue, but instead due to a genuine inability to answer the posed questions (Cain & Oakhill, 2006).

3.10 Ethical Considerations

Ethical clearance for the carrying out of this study was granted (MEDP/12/002IH). Ethical procedures adhered to involved obtaining ethical permission from the Educational Department prior to the study being conducted. The researcher also obtained written permission from the Faculty of Humanities Post-Graduate Committee to conduct the study. Furthermore, no data pertaining to any child was utilised unless parental consent and the child's informed assent, had been gained (See Appendix 1 for parental consent & Appendix 2 for child's informed assent). Before the testing was carried out, the headmasters of the schools selected, were informed about the purpose and details of the study. This ensured that the heads were knowledgeable before providing consent to conduct research in their schools. Each of the participants and their parents were informed as to what the nature of the research was, with no means of deception being utilised. They were also informed that participation was voluntary and that they were free to withdraw at any time, if they so wished.

In the biographical questionnaire and Suffolk Reading Scale 2, questions relating to the child's age, race, gender, grade and his/her name were asked as a means of coding, as well as in order to obtain demographical information. For this reason, anonymity could not be guaranteed due to the personally identifying information, however confidentiality was adhered to at all times. Commitments were made to participants and their parents that when the researcher was reporting the results, all participants would remain anonymous. Additionally it was conveyed to them that they would have access to the final report which would be in an electronic format at the University of the Witwatersrand library. Whilst archival data was utilised in this study, the above procedures were followed during the collection of data to ensure ethical adherence.

3.11 Data Analysis

Based on the research hypothesis, the general purpose of the study was to determine the effects of aircraft noise exposure on primary school children's reading comprehension. The data analysis conducted on this research topic was performed using the Statistical Analysis Software (SAS). Descriptive statistics (mean and standard deviation) were used as well as inferential statistics. The independent variables of language, socio-economic status and chronic noise exposure were looked at in relation to the dependent variable, being that of reading comprehension.

To test whether the results obtained from the Suffolk Reading Scale 2 were normally distributed, as well as assessing whether the conditions of homogeneity were met, a univariate analysis was performed. Furthermore, a one way Analysis of Covariance (ANCOVA) was conducted to test whether the dependent variable of reading comprehension differed across the noise levels and groups, whilst controlling for gender, language and socio-economic status. A one way Analysis of Variance (ANOVA) was also used to test whether the mean reading comprehension score at time 1 (2009) differed at different levels of noise.

A Repeated measures ANOVA was conducted in order to look at the reading comprehension as well as the level of noise, gender and language at the different times of testing, simultaneously, to establish whether interactions were taking place. Furthermore, a two independent sample T-Test was performed to establish whether there was a statistical difference in reading comprehension between learners for whom English constituted their first language (EFL) and those for whom English constituted an additional language (EAL). A second, two independent sample T-Test was also run to establish whether there was a significant difference between learners who came from a low socio-economic status and were thus offered a free school meal, in comparison to those who came from a higher socio-economic status and were not offered a free school meal. Multiple Analyses of Variance (MANOVA) were also conducted to establish whether the impact of language and social deprivation on reading comprehension performance, was significant over the three year testing period.

The effect sizes were also calculated, providing an indication of how much variance in reading comprehension was influenced by language or socio-economic status. Cohen's *d* effect sizes were calculated as these were not influenced by sample size, which may have proved problematic due to the different sample sizes seen over the three testing times.

Chapter 4

Results

4.1 Overview of the Chapter

The aim of this study was to determine whether aircraft noise impacts on children's reading comprehension. The impact of the noise on the participant's reading comprehension was established through repeated measures ANOVA and a one-way ANCOVA. These findings are presented below, followed by the further reporting of the results of the hypotheses that were postulated in Chapter 3.

4.2 Normality of the Data

Statistical methods are based on numerous underlying assumptions. A common assumption that is upheld is that a random variable is normally distributed (Park, 2008). During statistical analyses, normality is often conveniently assumed, without conducting tests or obtaining empirical evidence. Normality is crucial however and when this assumption is incorrectly presumed, interpretations and inferences can be unreliable and invalid (Park, 2008).

When looking at the histograms presented in Figure 1 and Figure 2 below, it becomes evident that the distribution of raw scores resemble that of the bell shape curve, depicting normally distributed results. However, when looking at the results obtained in Figure 3, the data is slightly negatively skewed signifying that the majority of the participants performed better when tested at time 3 (2011).

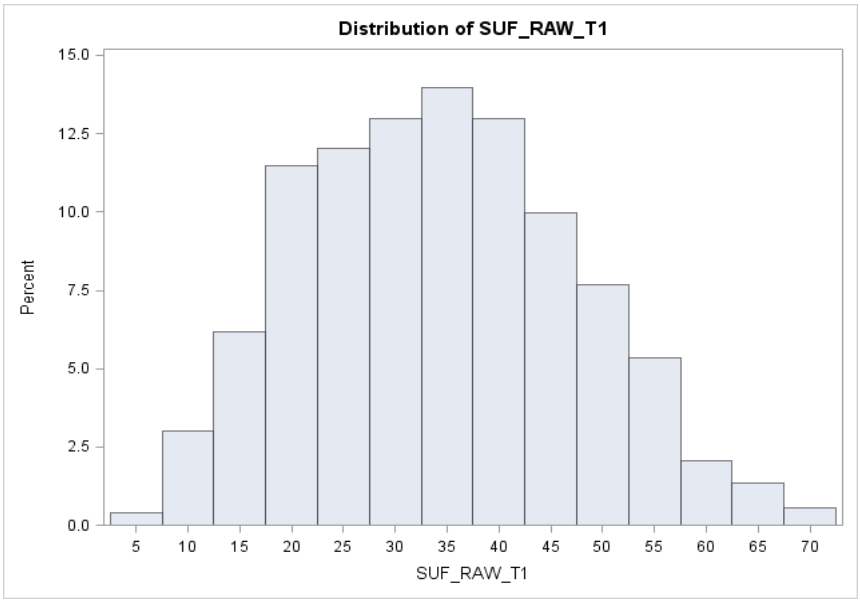

Figure 1: Histogram: Raw scores obtained on the Suffolk Reading Scale 2 at time 1 (2009)

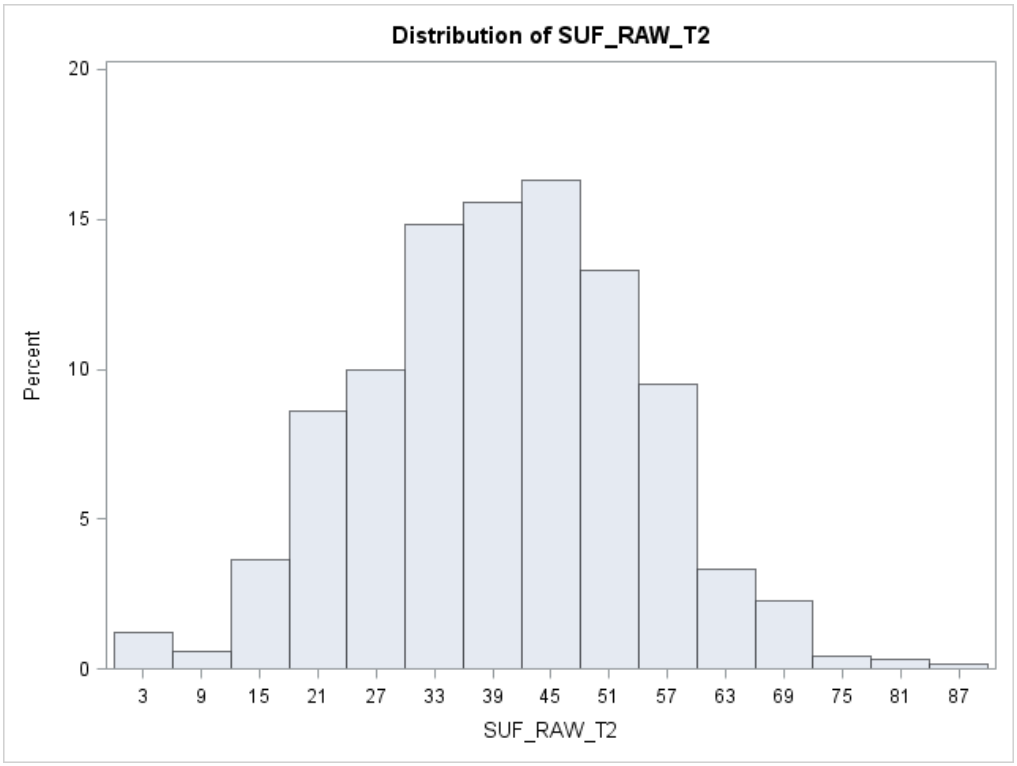

Figure 2: Histogram: Raw scores obtained on the Suffolk Reading Scale 2 at time 2 (2010)

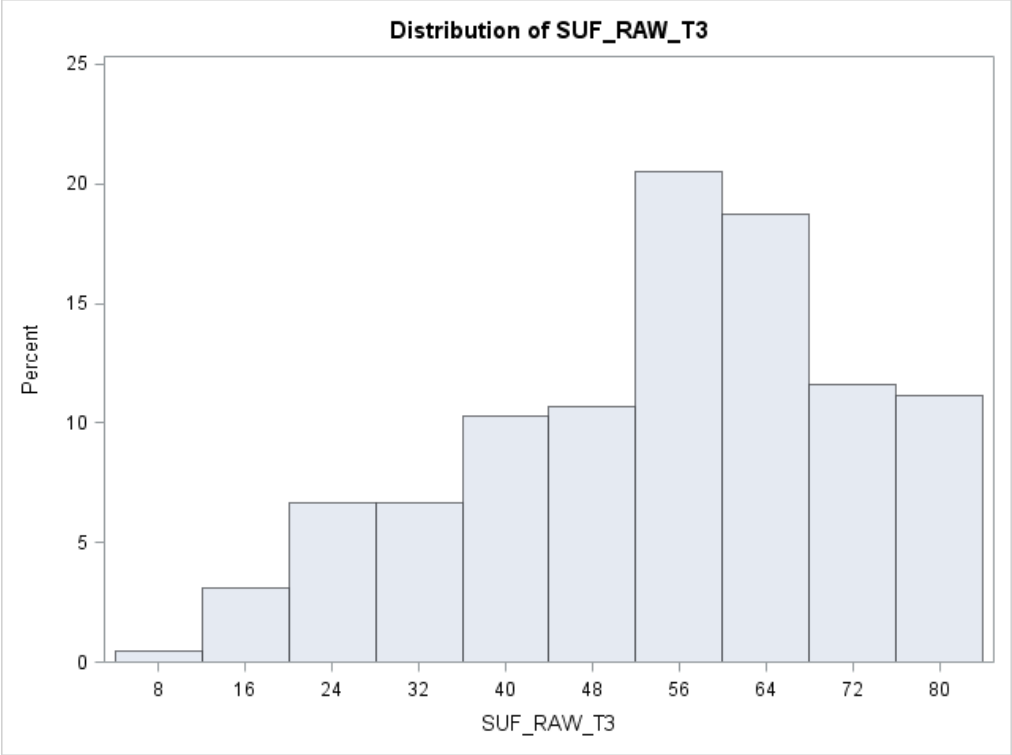

Figure 3: Histogram: Raw scores obtained on the Suffolk Reading Scale 2 at time 3 (2011)

4.3 The effect of aircraft noise on reading comprehension

The first question aimed to examine the effect, if any, of aircraft noise on reading comprehension. Illustrated in Table 2 are the means, standard deviations and p-values obtained across the different testing times. In 2009 there was no statistical difference ($p>0.05$) at the 5% significance level between the experimental group ($M=37.23$, $SD=11.9$) and the control group ($M=30.17$, $SD=14.3$). Again in 2010, the experimental group's ($M=43.52$, $SD=12.4$) reading comprehension scores did not differ significantly at the 5% significance level ($p>0.05$) from the control group ($M=35.41$, $SD=15.7$). Lastly, in 2011, there was no statistical difference ($p>0.05$) between the experimental ($M=58.78$, $SD=17.2$) and control group ($M=46.29$, $SD=16.8$) at the 5% significance level. It can however, be seen that each year the children's reading comprehension scores were tested, the experimental group performed better, seen in their higher mean, when compared to the control group. This was an unexpected finding, seeing as the experimental group was exposed to higher aircraft noise levels than that of the control group. As the results are not statistically significant, however (p value is not less than 5%) these results cannot be extrapolated to the general

population. This would imply that learner's reading comprehension performance in the five schools tested in KwaZulu Natal, were not significantly affected by the level of aircraft noise to which they were exposed.

Table 2

Reading Comprehension scores of aircraft noise exposure groups

	2009			2010			2011		
Group	**Mean**	**SD**	***P***	**Mean**	**SD**	***P***	**Mean**	**SD**	***P***
Experimental	37.23	11.9	0.197	43.52	12.4	0.161	58.78	17.2	0.063
Control	30.17	14.3		35.42	15.7		46.29	16.8	

A one way analysis of covariance (ANCOVA) was also conducted to test whether there was a significant difference between the groups and noise levels on the dependent variable (reading comprehension) whilst controlling for gender, language and socio-economic status. As demonstrated in Table 3, when looking specifically at the impact that the noise levels had on reading comprehension at time 1 (2009), there was a statistical difference at the 5% level ($p<0.05$), highlighting its impact on the reading comprehension scores. With regards to time 2 (2010), there was a statistical difference ($p<0.05$) at a 5 % level. Again, with time 3 (2011), there was a statistical difference ($p<0.05$) in terms of the impact of the noise level on the reading comprehension scores obtained. When looking at the groups (experimental and control groups) however and their impact on reading comprehension, no significant differences ($p>0.05$) across all three times of testing were observed. This is not a surprising result, as the participants in both the control and experimental groups were matched prior to the study being conducted. When looking at the r-square, at time 1 it was 0.215 indicating that all the variables can only explain 21% of the variance of the dependent variable. At time 2 and time 3, the r-square was 0.114 and 0.110 respectively, again highlighting the small percentage of the variance explained.

Table 3

ANCOVA Results

Source	DF	Mean Square	F	*P*	R-Square
		2009			
Groups	1	302.54	1.75	0.191	
Noise Levels	3	962.54	5.58	0.019	
Gender	1	623.21	3.61	0.059	0.215030
Language	1	3256.72	18.87	<.0001	
Meal	1	295.94	1.71	0.192	
		2010			
Groups	1	398.30	1.98	0.161	
Noise Levels	3	972.79	4.84	0.029	
Gender	1	92.13	0.46	0.499	0.114496
Language	1	1804.26	8.97	0.003	
Meal	1	147.41	0.73	0.393	
		2011			
Groups	1	945.86	3.51	0.062	
Noise Levels	3	1579.07	5.86	0.017	
Gender	1	50.99	0.19	0.664	0.110473
Language	1	2743.72	10.19	0.002	
Meal	1	24.10	0.09	0.765	

A one way-ANOVA, was subsequently run to establish whether the mean of the reading comprehension scores differed at the different levels of noise to which the children were exposed. The ANOVA was just run for time 1 (2009) as this was the only time during which the noise levels differed between the control and experimental groups. As presented in Table 4, the reading comprehension mean at noise level 1 (16h outdoor Leq<55 dBA) was 31.0, at noise level 2 (16h outdoor Leq<56 dBA) the mean was 39.11, at noise level 3 (16h outdoor Leq>63 dBA), the mean was 34.58 and at noise level 4 (16h outdoor Leq>69 dBA) it was 31.99. Pairwise comparisons, demonstrated in Table 5, show there was a statistical difference ($p<0.001$) between the reading comprehension scores at the air condition of 54.4 dBA and 55.3 dBA, as well as a statistical difference ($p<0.001$) between the reading comprehension scores when air conditions were at 55.3 dBA and 69.9 dBA. This would indicate that the worst reading comprehension scores were obtained at the lowest and highest aircraft noise levels and the best reading scores were obtained at the second lowest aircraft noise levels. Significant differences between reading comprehension scores obtained and aircraft noise levels, were thus seen to exist between the lowest (54.4 dBA) and the second lowest noise levels (55.3 dBA), as well as the highest (69.9 dBA) noise levels and second lowest noise levels, an unexpected finding.

Table 4

Mean reading comprehension scores and confidence levels at the different noise levels at time 1 (2009)

Noise Levels (2009)	**Mean reading comprehension scores in 2009**	**95% CL**
54.4	31.0	29.0 to 32.9
55.3	39.1	37.4 to 40.8
63.5	34.6	32.8 to 36.4
69.9	31.9	30.2 to 33.7

Table 5

Noise Levels at time one (2009) in relation to reading comprehension scores

P values for reading comprehension scores across different noise levels at time 1 (2009)				
dBA	**54.4**	**55.3**	**63.5**	**69.9**
54.4		<.0001	0.011	0.456
55.3	<.0001		0.0003	<.0001
63.5	0.011	0.0003		0.048
69.9	0.456	<.0001	0.048	

Due the fact that the running of a 3 way ANOVA produced such a low r-square, repeated measures ANOVA were run in an attempt to simultaneously look at the numerous dependent variables, over the three testing times. As highlighted in Table 6, when time was controlled and the impact of the experimental and control group in relation to the reading comprehension scores were looked at, no statistically significant difference F (713)= 0.15, p> 0.05 was observed. Furthermore when controlling for time again and looking at the impact of noise levels (2009) in relation to children's reading comprehension, no significant difference F (713) =0.33, p>0.05 was seen. This further supports results obtained above, which suggest that aircraft noise does not negatively affect reading comprehension performance.

Table 6

Repeated Measures Analysis of Variance Results

	Value	**F**	***P***
Noise Levels	0.998	0.15	0.865
Groups	0.996	0.33	0.719

4.4 The effect of the removal of high aircraft noise on reading comprehension

The second question aimed to determine whether the removal of high aircraft noise leads to increased performance on reading comprehension. In order to determine whether children's reading comprehension scores improved once the noise levels were reduced over time, the means for both the experimental and control groups were conducted across all three time frames and graphically represented by a mean plot graph (2009, 2010 & 2011) in Figure 4. When looking at this in conjunction with Table 1, it is noted that the reading scores increased over time, for both the experimental (M = 37.23 (2009); M = 43.52 (2010); M= 58.78 (2011) and control groups (M= 30.17 (2009); M= 35.41 (2010); M= 46.29 (2011)). It is therefore evident that the increase in scores was incremental, with reading comprehension marks improving each year the Suffolk Reading Scale 2 was administered. A repeated measures analysis of variance was conducted to ascertain whether the increase in means was statistically significant or not. As seen from Table 7, there was no statistical difference ($p>0.05$) regarding the interaction between time (2009, 2010 and 2011) and reading comprehension scores. Furthermore, no statistical difference ($p>0.05$) was found in the interaction between time and group on reading comprehension scores obtained. This would indicate that whilst reading comprehension scores improved over time, the difference in the interaction between time and the control and experimental groups, was not significant. This would indicate that the removal of high aircraft noise did not lead to improved reading comprehension.

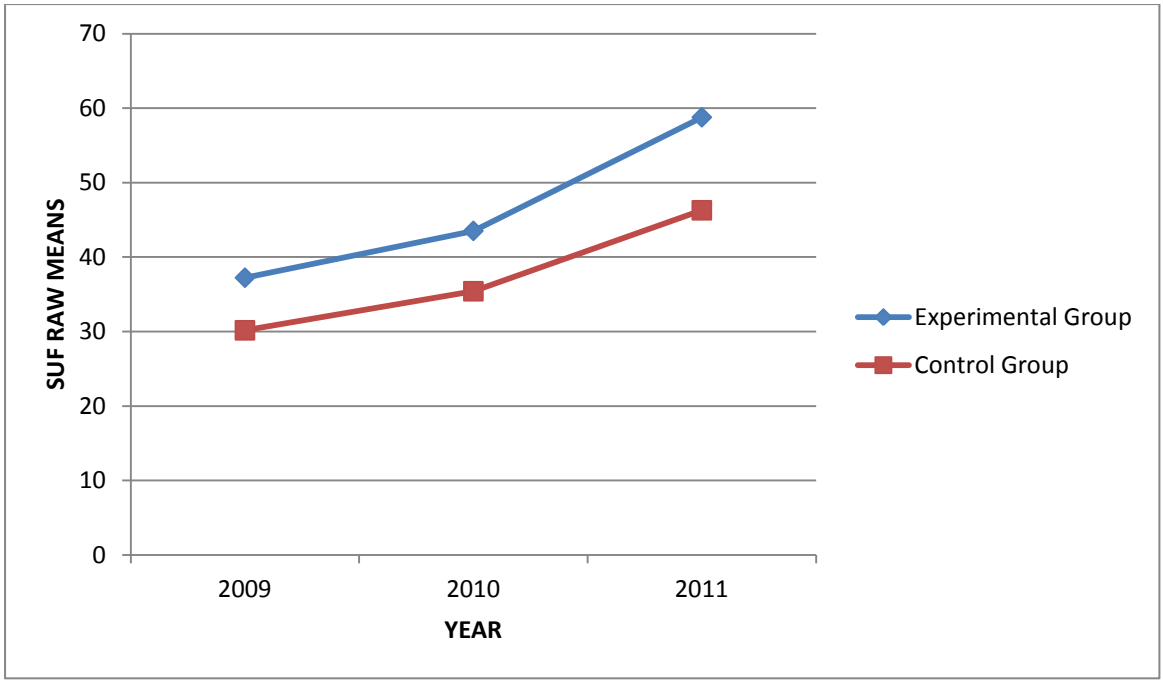

Figure 4: Line Chart depicting the means of the Reading Comprehension from 2009-2011

Table 7

Interactions between time, and time and group, in relation to reading comprehension

	DF	**F**	***P***
Time	2	0.89	0.41
Time*Groups	5	0.39	0.68

4.5 The effects of home language on reading comprehension

The third question investigated whether language spoken at home negatively impacts on reading comprehension. It was postulated that English first language (EFL) speakers would perform significantly better than learners who spoke English as an additional language (EAL), due to the SRS2, being an English-based assessment. As demonstrated in Table 8, in 2009, at time 1, there was a statistically significant difference in scores between EFL participants (M= 38.63, SD =13.12) and EAL participants (M=28.68, SD= 10.85); t(713) =10.75, p<0.001, in favour of the EFL group. A year later in 2010, once again there was a statistical difference in scores between EFL participants (M=42.52, SD= 14.46) and EAL participants (M=35.71, SD=12.49); t(619) =6.07, p<0.001. Lastly, in 2011 once again there

was a statistical difference in scores between EFL participants (M=58.7, SD=14.09) and EAL participants (M=49.53, SD=18.89); t(211) =4.06, p<0.001. This suggests that a learner's primary language impacts on their reading performance, particularly when the assessment instrument utilised is not in their home language. In 2009, a large effect size (*d*=0.83) for language on reading comprehension was determined with moderate effect sizes (*d*=0.50; *d*=0.55) during 2010 and 2011 respectively being recorded. This would suggest the relatively large influence that language has on reading comprehension performance, particularly when noise levels are elevated.

Table 8

Comparison of language groups by year

	2009		**2010**		**2011**	
	EFL	**EAL**	**EFL**	**EAL**	**EFL**	**EAL**
Mean	38.63	28.68	42.52	35.71	58.7	49.53
SD	13.12	10.85	14.46	12.49	14.09	18.89
T	10.75		6.07		4.06	
p	<0.0001		<0.0001		<0.0001	

A MANOVA was additionally conducted over the three time periods to test the hypothesis that reading comprehension negatively impacts participants when they are tested in a different language to that of their home language. The results seen in Table 9 indicated that there was a statistical difference (p<0.001) in terms of the effect of language on the reading comprehension scores obtained by the children. This supports the results obtained above, which suggest that language has a large influence on reading comprehension. Again, a type three error was accounted for, due to the unbalanced design and unequal numbers in the groups.

Table 9

Summary of the main effects on reading comprehension with specific reference to language

Source	**DF**	**Mean Square**	**F**	***P***
Groups	1	1546.15	4.01	0.047
Noise Levels	3	3464.73	8.99	0.003
Language	1	7693.71	19.97	<.0001

4.6 The effects of socio-economic status on reading comprehension

The fourth question sought to examine whether having a low socio-economic status negatively affects a learner's reading comprehension. A two independent sample T-Test was conducted to compare the reading comprehension scores for participants who received free school meals in comparison to those who did not. As illustrated in Table 10, there was a statistical difference between those participants that had a low socio-economic status (M=37.07, SD=13.75) compared to those who had a higher socio-economic status (M=32.95, SD=12.61); t(719) = 4.08, p<0.001, in favour of the former group. In 2010 however, there was no statistical difference between those participants that had a low socio-economic status (M=39.60, SD=14.33) compared to those that did not (M= 39.67, SD=13.98); t(602) =-0.05, p>0.05. Furthermore, in 2011, there once again was no statistical difference between those participants who had a low socio-economic status (M=55.71, SD=15.75) and those who did not (M=53.69, SD=18.06); t(210) =0.86, p>0.05. It would appear therefore that there was no difference in reading comprehension for those children who came from a low socio-economic status and those who did not in 2010 and 2011. However, in 2009 there did appear to be a difference in reading comprehension scores obtained between those who were socially deprived and those who were not. This suggested that children who were socially deprived performed better in high noise levels, than those children who were not socially deprived. In 2009 a small effect size (*d*=0.31) for socio-economic status on reading comprehension was determined. In 2010, no effect size (d= -0.0001) was determined and in 2011 a minimal effect size (*d*=0.12) for socio-economic status on reading comprehension was determined. This

would suggest that socio-economic status has a very minimal impact on reading comprehension performance.

Table 10

Comparison of Social Deprivation groups by year

	2009		**2010**		**2011**	
	Deprived	**No Deprivation**	**Deprived**	**No Deprivation**	**Deprived**	**No Deprivation**
Mean	37.07	32.95	39.60	39.67	55.71	53.69
SD	13.75	12.61	14.33	13.98	15.75	18.06
T		4.08		-0.05		0.86
P		<0.0001		0.958		0.389

A MANOVA over the three time periods, was additionally conducted to get a better understanding of the impact of socio-economic status on reading comprehension over the three years the study was conducted. As presented in Table 11, the results indicated that there was no statistical difference ($p > 0.05$) in terms of the effect of socio-economic status on the reading comprehension scores obtained by the children. This supports the above findings that socio-economic status does not have a significant impact on reading comprehension.

Table 11

Summary of the main effects on reading comprehension with specific reference to social deprivation

Source	**DF**	**Mean Square**	**F**	***P***
Groups	1	50.28	0.39	0.68
Noise Levels	3	24.84	0.19	0.83
Social Deprivation	1	217.16	1.69	0.197

Chapter 5

Discussion and Conclusion

5.1 Introduction

This study aimed to look at the impact on children's reading comprehension when exposed to chronic aircraft noise. This chapter discusses the implications of the results highlighted in chapter 4. The findings are examined whilst making reference to that which has been discussed in the literature review. This is followed by the limitations of the study as well as the recommendations for future research.

5.2 The effect of aircraft noise on reading comprehension

Hypothesis one was concerned with looking at the effects of aircraft noise on children's reading comprehension, specifically regarding whether the effects of aircraft noise negatively affect reading comprehension. The results revealed that despite the experimental group being exposed to higher levels of aircraft noise in comparison to the control group, on average, they performed better. Furthermore the lowest reading comprehension scores were obtained at the lowest and highest noise conditions, with the best results produced in the second quietest conditions and the second lowest reading comprehension scores in the second highest noise level. Further statistical tests revealed there to be no significant difference between the reading comprehension scores obtained and the noise levels that the participants were exposed to.

The results of this study support the findings of both the Los Angeles Airport Study, as well as to some extent the Munich Study. The Los Angeles Airport Study produced results that suggested that children from seven different schools, matched for scholastic performance, socio-economic and racial factors, showed no differences that could be attributed to aircraft noise negatively impacting the participants' reading comprehension (Matheson et al., 2003). Follow up studies were conducted a year later as a means of ascertaining whether the results seen during the first wave of testing were still valid, or whether the children had adapted to their noisy surroundings. Once again no differences were found (Matheson et al., 2003).

With regards to the Munich Study, a significant difference was not found on children's reading comprehension. It should however be noted that both the Munich Study and the West London Study did not directly assess the children's reading comprehension levels. These were instead obtained through school records or reading performance. Reading comprehension was thus not directly examined in relation to the noise levels and therefore results should be interpreted with caution (Matheson et al., 2003).

From a theoretical point of view, there appears to be no explanation as to why the two lowest scores obtained in the reading comprehension were recorded at the lowest and highest noise levels. One would have expected the best results to have been obtained in the quietest conditions and the performance to drop as the noise levels increased. The only possible explanation could be linked to extraneous variables associated with the schooling environment. The two schools, whose average noise levels fell into the high and low aircraft noise category, may have had lower performing learners. Alternatively, they may have been exposed to poor English teaching which negatively impacted their reading comprehension abilities.

5.3 The effect of the removal of high aircraft noise on reading comprehension

Hypothesis two was concerned with looking at the effects of children's reading comprehension when the high noise levels which were experienced in 2009, were removed due to the relocation of the Durban International Airport. This meant that the children whilst initially exposed to high levels of noise, were subsequently exposed to normal noise levels expected in a school setting. The results revealed that there was no significant difference in the mean reading comprehension results between the experimental and control group obtained at the first set of testing. In these, both the control and experimental groups were subject to higher aircraft noise levels, compared to those obtained at the second (2010) and third (2011) time of tesing. This occurred in spite of the mean reading comprehension scores increasing in both the experimental and control groups over the three years. Little research, has been conducted on this topic, with the most noteworthy study being the Munich study which found contraditory evidence suggesting that the negative effects incurred on children's reading comprehension when exposed to high levels of noise, were reduced when the noise

levels lessened, leading to increased performance on cognitive tests (FICAN, 2000). It would therefore seem that further research into this area is needed.

Whilst the results did not show a significant difference, it was however apparent that the children's reading comprehension scores increased in 2010, and even further in 2011, despite noise levels remaining the same. Literature and previous studies have highlighted the reduction in noise leading to improved reading scores over time, however there is little written on the extent that the results improved over the testing time period. It is thus unclear as to whether one would expect them to additionally increase the second year, even though noise levels remained constant. The steady increase in the results may be indicative of the participants becoming 'test-wise.' Over the three years that the study was conducted, the learners were administered the same Suffolk Reading Scale 2 and therefore the increase in their scores could be due to familiarity with the test and knowing what material was being tested. Furthermore, from a developmental point of view, the same set of children were administered the test every year and therefore every year they were tested, they were older. The increase in results could thus also be related to an increase in knowledge associated with obtaining more schooling, as well as developmental maturation.

5.4 The effects of home language on reading comprehension

Hypothesis three is concerned with the effect that home language has on primary school children's reading comprehension, with specific reference to having English as a first language compared to that of English as an additional language. The results revealed a significant difference in the participants' reading comprehension performance when looking at first language, or additional language English speakers over the three years that the study was run. The results were in favour of those learners who spoke English as their primary language. This confirms the hypothesis that having a different language to English as your home language negatively affects primary school children's reading comprehension. This supports research conducted by Cummins (1981) who believes that being taught and tested in a language other than one's home language often creates difficulties with comprehension and lowered performance, compared to those children whose home language it is. This is attributed to the difficulty of having to master two language systems compared to one (Cummins, 1981).

Furthermore, when looking at the impact of this finding in the South African context it becomes apparent that with eleven official languages, numerous children are taught and assessed in their second language and are therefore seen to underachieve in English and the literacy components (Alexander, 2003). This has, in part, been as a result of policies and laws implemented during the Apartheid regime where all learners were forced to learn in either English or Afrikaans, with no teaching being conducted in many of the student's mother tongue (Alexander, 2003). Since democracy in 1994, adaptations have been made to language policies, most notably the Language-in-Education Policy of 1997, which encouraged learners, particularly in the foundation phase, to be taught in their mother tongue. Through various investigations conducted by the Department of Education (2008) however, evidence has suggested that the majority of schools do not teach their learners in their home language, with English remaining the dominant language utilised in teaching institutions. This places countless learners at a disadvantage, as it is pivotal to learn and establish the basics in one's home language before introducing a second or additional language (Cummins, 1981). As a result, language barrier problems, negatively impact on children's academic progress and comprehension in the classroom (Alexander, 2003).

With regards to the lower performance of participants for whom English was an additional language, this may have been due to a lack of exposure to the language prior to their entry into the schooling system. Their ability to understand and comprehend the questions was not as developed and sophisticated as their peers, whose home language was English, resulting in limited understanding of the text. They most probably would have been required to translate the text into their home language and then back again into English, placing them at a disadvantage in terms of gaining meaning from the text and understanding words (Seabi et al., 2012). All of the above could be seen to have negatively impacted on the learners' reading comprehension performance when English was used as an additional language. It would thus appear that language plays an important role in reading comprehension performance. It should be noted that differences between performance on reading comprehension assessment in terms of EFL and EAL learners, may also be impacted on by extraneous variables such as motivation levels of learners and access to learning resources, which were not controlled for in the study. As long at the Suffolk Reading Scale 2 is an English based test, first language English learners will continue to remain advantaged over pupils who speak English as an additional language. It would therefore be important to

develop assessment tools that cater for learners whose home language differs from that of English, though this would be difficult to execute due to limited resources (Seabi et al., 2012).

5.5 The effects of socio-economic status on reading comprehension

The fourth hypothesis was concerned with whether socio-economic status had an effect on primary school children's reading comprehension. The results demonstrated that there was a statistical difference in performance on reading comprehension between children from a lower socio-economic bracket compared to those in a higher socio-economic bracket, in 2009. There was however, no significant difference in 2010 and 2011. When looking at these results, it might be an explanation that the participants who constituted the lower socio-economic bracket, came from areas where there were high levels of noise. In 2009, when noise levels in both the control and experimental groups were higher than in 2010 and 2011, they were better able to cope with the noise levels. This could indicate that they were more accustomed to the extraneous noise experienced and thus better able to concentrate during administration of the Suffolk Reading Scale 2, which in turn led to better performance results. In 2010 and 2011, when the noise levels across all groups were the same however, the advantage that they had had through increased exposure and potentially better adaptability, no longer presented in their favour and all learners were seen to perform on a far more equal footing.

This would suggest that the results obtained were inconsistent with that of research conducted by Van der Berg (2002) and Noble et al., (2006). Results they obtained demonstrated that children from lower-socio-economic backgrounds have less exposure to books and cognitively developing stimuli, experience greater difficulties in decoding words, have poorer phonological awareness and have parents with lower education levels and who are often unable to assist in homework tasks. Furthermore, often a lower socio-economic status impacts on the quality of education received, as does factors such as location to school, which are all seen to negatively impact on academic performance (Spaull, 2011; Timæus et al., 2011).

5.6 Limitations

The results of the present study should be read in the context of the following limitations. As this study constituted a longitudinal study, the Suffolk Reading Scale 2 was administered to the same set of children over a three year period. As was noted in the normalisation of the data received, as well as the average mark obtained by a participant in both the experimental and control groups, the learners performed better each year the test was administered, which might suggest that they became 'test wise". The effects of the removal of aircraft noise on children's reading comprehension scores were thus difficult to adequately gauge as a result of the use of a familiar test.

The noise levels that were recorded during the study were recorded in the outside grounds of the schools and were as a result not necessarily reflective of the noise levels experienced inside of the classroom. Dampening could have taken place, in which windows and acoustical treatments within the buildings lowered the noise levels that were recorded outside of the classroom. This may have led to children in the classroom experiencing reduced levels of noise that were not as loud as those measured outside, thus having less of an impact on the measured reading comprehension scores.

There was a large dropout rate from 2010 to 2011 with more than half the participants no longer participating in the study. This meant that the sample group over the three year period during which the study was conducted, did not remain constant. Whilst the 2009 and 2010 sample was therefore comparable, the 2011 sample is not. Although efforts were made to track such learners in Grade Eight, some schools did not allow the learners to participate in this study. The ability to generalise the results to the target population in 2011 is thus questionable.

A further limitation was the reliance on parental information regarding the participant's hearing, as parents could have been subject to response bias and as a result provided inaccurate data. Furthermore, this may too have been the case regarding the filling out of the biological questionnaire by the children, specifically in relation to receiving or not receiving free meals, the item used primarily to ascertain the participant's socio-economic status. Children may have failed to accurately report the information, instead providing what they believed to be the socially desired answer.

5.7 Recommendations for future research

The findings of this study suggest that further work and research in this field needs to be carried out. Standardizing the SRS2 in more than one language will be important if it is to be used in the South African setting to ensure its reliability and validity as an assessment tool. With numerous official languages recognised in the country, often school learners do not speak English as their mother tongue and are in turn forced to compete in a second language. Until standardized tests can be administered to learners in their home language, adequately assessing their true capability will continue to prove difficult.

It would further be recommended that the noise levels inside of the classroom are ascertained as well as the noise levels outside of the classroom. This will be important in ensuring that the actual noise levels to which the children are exposed are accurately measured. This will be a better indicator regarding the impact that noise levels have on children's reading comprehension.

5.8 Conclusion

Previous studies produced mixed results regarding the effects of aircraft noise on reading comprehension, with some maintaining that it impacted negatively on children's reading comprehension, whilst others suggested its impact to be negligible. With all this conflicting evidence, it was clearly important to investigate this topic further. The findings of this research however, indicate that the effects of aircraft noise are not detrimental to reading comprehension. Furthermore, there was no evidence to suggest, that the removal of noise leads to an improvement in reading comprehension results. The insignificant improvements in results obtained, could in all likelihood be attributed to developmental maturation and test-wiseness. Socio-economic status proved to be a factor in performance only when learners were exposed to high levels of noise. In contrast First Language English speakers were seen to perform better than those for whom English was an additional language, highlighting that language plays an important role in reading comprehension performance. Such a finding supports the need to critically examine normalised assessment tools in this country. Furthermore, noise levels will need to be tested within the classroom environment, to ensure that those measured outside the school are reflective of the noise levels to which the children are exposed within the classroom setting. This will assist future researchers in obtaining a more accurate indication regarding the impact of aircraft noise on children's reading

comprehension. This is important in building a knowledge base around factors that negatively impact children's learning and education, to ensure favourable educational environments. This study would therefore imply, accounting for all limitations, that the impact of noise on cognitive performance is not substantive and certainly far less significant than aspects such as language.

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Appendices

Appendix 1: Parents Informed Consent Form

Psychology
School of Human & Community Development
University of the Witwatersrand
Private Bag 3, WITS, 2050
Tel: (011) 717 4500 Fax: (011) 717 4559

Dear Legal Guardian

My name is Isla Maynard and I am conducting research for the purposes of obtaining a Degree in Masters of Educational Psychology at the University of the Witwatersrand. The title of my research is "The Effects of Aircraft Noise on Learners' Reading Comprehension". My area of focus is to establish whether aircraft noise does have negative effects on children's reading comprehension and if the noise is then removed whether this factor is seen to improve.

I would like to invite your child to participate in this study. Participation in this research will entail completing demographic questionnaire and the Suffolk Reading Scale 2. Participation is voluntary, and your child will not be advantaged or disadvantaged in any way for choosing to complete or not complete the questionnaire. Questions are asked about your child's age, race and grade. The completed questionnaire pack will not be seen by any person in the school at any time, and will only be processed by myself, and my supervisor. Your child's responses will only be looked at in relation to all other responses. He/she may choose to refuse to answer any questions she/he would prefer not to, and she/he may choose to withdraw from the study at any point. All information collected will be treated confidentially. There are no direct risks or benefits attached to participating in this study.

If you consent for your child to participate in the study, she/he will be asked to complete the questionnaire pack as carefully and honestly as possible. The questionnaire pack consists of a student questionnaire, the Suffolk Reading Scale 2, as well as other cognitive activities of memory and attention. Completing the activities would be done during one school morning before first break (8:00-10:00). Once she/he has answered the questions, these will be collected immediately and placed in a sealed envelope.

Your consent for your child's participation in this study would be greatly appreciated. This research will contribute both to a larger body of knowledge on the impacts of noise exposure on cognitive performance in the South African context. Please do not hesitate to contact me or my research supervisor should you require further information. A feedback letter will be provided to the school once I have analyzed my results. Should your child experience any distress after participating in the study free helpful contact numbers of counselling organizations will be provided to her/him. A feedback letter will be provided to the school and yourself once I have analyzed my results Note that because participation is anonymous and confidential I will not be able to disclose information about your child's reading comprehension scores.

Kind Regards

Isla Maynard

Contact details

Joseph Seabi (research supervisor) - (011) 717-8331

Isla Maynard (researcher)- 084 491 0621

Parental consent from

I _____ give consent for my child to partake in the study on _____.

I understand that:

- Participation is this study is voluntary.
- That my child may refuse to answer any questions he/she would prefer not to.
- My child can withdraw from the study at any time.
- No information that may identify my child will be included in the research report, and my child's responses will remain confidential
- There are no direct risks or benefits attached to participation

Signed: _____ Date: _____

Appendix 2: Participants Informed Assent Form

UMTHOMBO WOPHUHLISO LOLUNTU
School of Human & Community Development

Psychology
School of Human & Community Development
University of the Witwatersrand
Private Bag 3, WITS, 2050
Tel: (011) 717 4500 Fax: (011) 717 4559

UNIVERSITY OF THE WITWATERSRAND JOHANNESBURG

Hello

My name is Isla Maynard and I am conducting research for the purposes of obtaining a Degree in Masters of Educational Psychology at the University of the Witwatersrand. The title of my research is "The Effects of Aircraft Noise on Learners' Reading Comprehension". My area of focus is to establish whether aircraft noise does have negative effects on children's reading comprehension and if the noise is then removed whether this factor is seen to improve.

I am inviting you to take part in this study. To take part in this research one has to complete demographic questionnaire telling me about your gender, race grade and age, student questionnaire and the Suffolk Reading Scale 2. Participation is voluntary, and you will not be advantaged or disadvantaged in any way for choosing to complete or not complete the questionnaire. Questions are asked about your age, race and grade. The completed questionnaire pack will not be seen by any person in your school at any time, and will only be handled by myself, and my supervisor. Your answers will only be looked at in relation to all other answers. You may choose to refuse to answer any questions you would prefer not to, and you may choose to pull out from the study at any point. All information collected will be treated confidentially. It should be noted that there are no direct risks or benefits attached to participating in this study.

If you choose to participate in the study, you will be asked to complete the questionnaire pack as carefully and honestly as possible. Once you have answered the questions, these will be collected immediately and placed in a sealed envelope.

Your participation in this study would be greatly appreciated. This research will contribute both to a larger body of knowledge on the impacts of noise exposure on cognitive performance in the South African context. Please do not hesitate to contact me or my research supervisor should you want more information. A feedback letter will be provided to your school once I have analyzed my results. Should you experience any worries after participating in the study free helpful contact numbers of counselling organizations will be provided to you. A feedback letter will be provided to the school and you once I have analyzed my results Note that because participation is unknown and confidential I will not be able to disclose information about your reading comprehension scores.

Kind Regards

Isla Maynard

Contact details

Joseph Seabi (research supervisor) - (011) 717-8331

Isla Maynard (researcher)- 084 491 0621

Parental consent from

I _____ give consent for my child to partake in the study on _____.

I understand that:

- Participation is this study is voluntary.
- That my child may refuse to answer any questions he/she would prefer not to.
- My child can withdraw from the study at any time.
- No information that may identify my child will be included in the research report, and my child's responses will remain confidential
- There are no direct risks or benefits attached to participation

Signed: _____ Date: _____

Appendix 3: Biographical Questionnaire

Code_____

Date_____

Level A_____

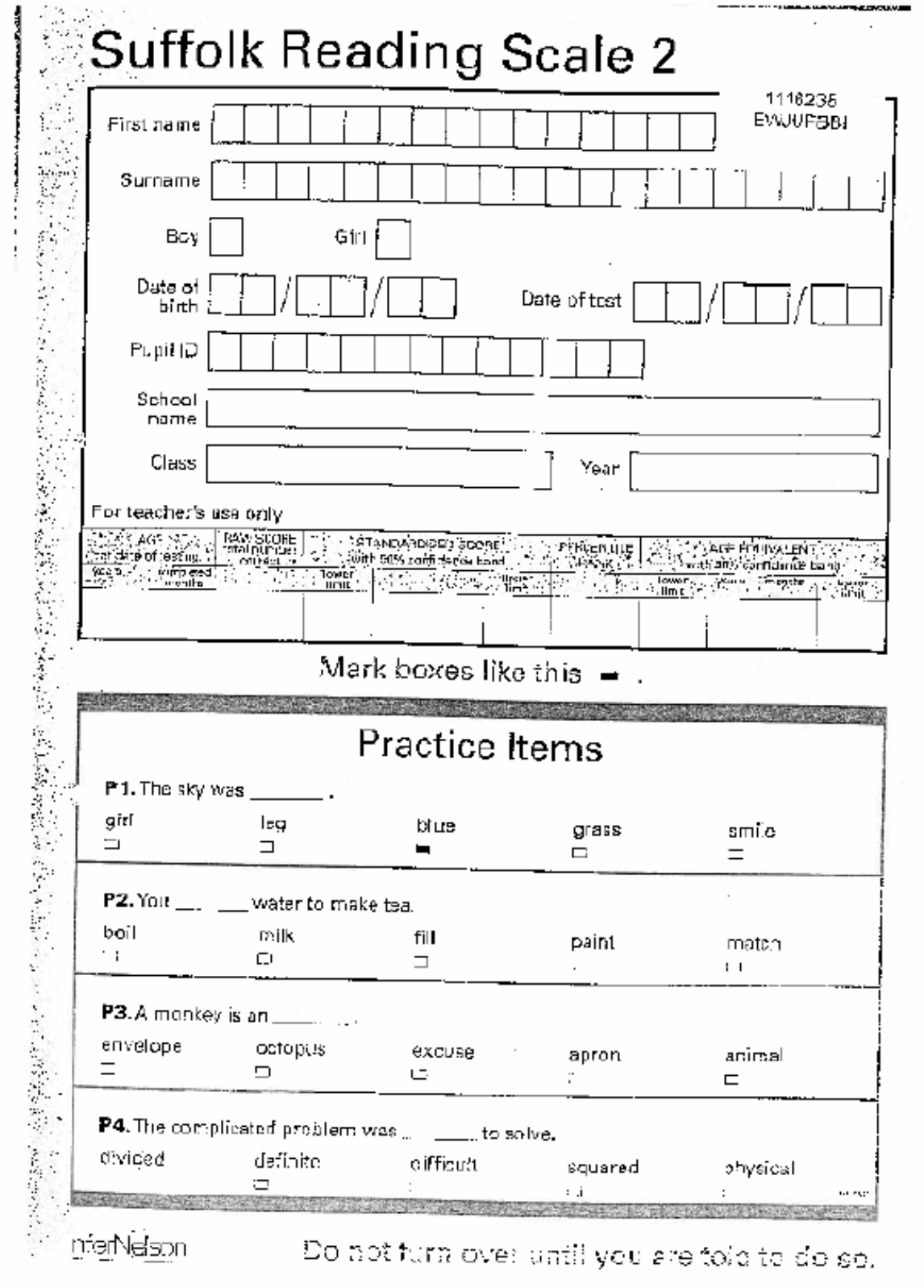
Questionnaire for children

Your answers are **CONFIDENTIAL** .

They will **NOT** be seen by your parents, carers or teachers.

Appendix 4: Suffolk Reading Scale 2

Suffolk Reading Scale 2



Suffolk Reading Scale 2

1116235
EWJUFBBJ

First name

Surname

Boy ☐ Girl ☐

Date of birth ☐☐/☐☐/☐☐ Date of test ☐☐/☐☐/☐☐

Pupil ID

School name

Class Year

For teacher's use only

AGE at date of testing	RAW SCORE total number correct	STANDARDISED SCORE with 95% confidence band	PERCENTILE	AGE EQUIVALENT with 95% confidence band
Years Months		Lower limit / Upper limit	Lower limit / Upper limit	Lower limit / Upper limit

Mark boxes like this ■ .

Practice Items

P1. The sky was _____ .

girl ☐ leg ☐ blue ■ grass ☐ smile ☐

P2. You ___ ___ water to make tea.

boil ☐ milk ☐ fill ☐ paint ☐ match ☐

P3. A monkey is an _____ .

envelope ☐ octopus ☐ excuse ☐ apron ☐ animal ☐

P4. The complicated problem was ... ____ to solve.

divided ☐ definite ☐ difficult ☐ squared ☐ physical ☐

nferNelson

Do not turn over until you are told to do so.