

## Chapter 1 Introduction

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This study is focussed at the intersection of three major issues in literacy pedagogy in the context of primary school education in Australia. The first issue is the need to re-conceptualize literacy and literacy pedagogy (and hence literacy assessment) to take account of the almost ubiquitous joint role of images and language in constructing meaning in a very wide range of the types of texts encountered in schooling and in the wider social world. The second issue concerns the bi-partisan commitment of the Australian Government (in common with a significant number of other western governments) to mass testing of students' literacy at defined intervals in primary and early secondary schooling. The third issue concerns the documented very low literacy achievement of Indigenous students relative to non-Indigenous students, and of students in rural and remote areas relative to those in metropolitan areas, and whether and how this relativity is reflected in measures of reading comprehension of image-language relations in reading tests.

The first two issues concern the multimodal nature of contemporary literacy and how it is assessed. National literacy testing had not commenced when this study began, however, although there has recently been talk around the possibility of introducing computer based national assessment, both the current national tests and the former state tests have been limited to print text. Therefore the scope of the research will be limited to multimodal texts in state-wide print reading assessments. As the third issue concerns the low achievement of Indigenous and rural students relative to other students in reading assessments, the focus on state-wide tests is important to enable a comparison of student groups on a single scale of achievement. Interviews will be

conducted to probe what the students think about the multimodal texts to ensure that assessment of comprehension of the texts is not limited to a few test questions. As language use has been linked to thinking (Vygotsky 1978; Bernstein 1974; Hasan & Cloran 1990; Mercer, Wegerif & Dawes 1999) and reading (Morice & Slaghuis 1985; Beron & Farkas 2004; Lyle 2008), the students' spoken language will also be investigated.

It is hoped that investigation of these three issues can inform the way teachers work with multimodal texts, their expectations of student response to texts and the analysis of students' reading. The research could also be able to inform the way tests are developed through a consideration of whether reading assessments might disadvantage Indigenous and/or rural students and whether any disadvantage might be due to differences in social and cultural orientations.

The main research question is therefore, 'How do Aboriginal and non-Aboriginal students in different geo-locations comprehend and talk about a variety of image-language relations in reading tests?' As there are a number of components to this question, the following four enabling sub-questions will be explored in this investigation.

- A. How do images and language in reading materials interact to construct meaning and how do reading questions address students' comprehension of the image-language interaction?
- B. Does reading difficulty differ according to the
  - (i) nature of various image-language relations in multimodal texts?

- (ii) linguistic complexity of the multimodal texts (grammar and vocabulary)?
  - (ii) visual complexity of the multimodal texts (images)?
- C. Are the strategies that students use to read multimodal texts, related to reading comprehension test scores? If there is a relationship, is there any variation according to gender, geographic location or Aboriginal status?
- D. When students talk about images and verbal text, are there any differences according to gender, geographic location, Aboriginal status or reading ability,
  - (i) in the number of inferences made about the verbal text and images
  - (ii) in the amount of linguistic complexity in students' spoken languageIf there are differences according to reading ability, are there significant relationships between reading score, the number of inferences made and the amount of linguistic complexity in students' talk about images and verbal text?

Questions A addresses the first issue of the nature of multimodal texts through analysis of how images and language relate to each other in reading assessments.

Question B addresses the second issue of how multimodal literacy is assessed through analysis of the complexities that contribute to the difficulty of items assessing comprehension of image-language relations. Question C addresses the third issue of lower literacy achievement by Aboriginal and rural students through identification of the strategies used by different groups of students to answer the reading questions.

Question D also addresses the third issue by investigating and comparing the understanding of multimodal texts by different groups of students through analysis of the inferences they make and the language they use when thinking aloud about the texts.

It will be argued in the first section of chapter two that most reading throughout primary and secondary schooling, and a very significant proportion of reading in the context of wider community life, entails the negotiation of meanings jointly constructed by images and language in a range of different types of text. Indeed a range of syllabi will be shown to clearly acknowledge this. It appears logical therefore, that mass-administered reading tests would significantly address students' comprehension of the role of images and language in the construction of meaning in texts. In the second part of chapter two it will be shown that the reading comprehension elements of the NSW Basic Skills Tests (BST) did include comprehension questions that entail the role of image and language in the construction of meaning in the stimulus texts. However, it will be pointed out that at the time of the generation of such questions there was an absence of any well-established theory of the nature of different kinds of image-language relations and how these contribute to the meanings of texts.

The first part of the third chapter will show how theories deriving from systemic functional semiotics can address the roles of both language and images in texts. The second part of chapter three will provide an overview of the nature of Systemic Functional Linguistic (SFL) theory (Halliday 1994) and the extrapolation from SFL to the functional semiotic accounts of images in 'Visual Grammar' (Kress & van Leeuwen 2006). The third part of chapter three will critically review the research on image/language relations (Royce 2007a, 2007b; Lemke 1996, 1998a, 1998b and Martinec & Salway 2005) dealing with both research based on systemic functional semiotics and other research from a literacy education tradition. The review of the literature concerned with explicating the nature of image-language relations in texts

will include an Australian Research Council funded study, (Unsworth, O'Donnell, Barnes, Chan & Daly 2009) of which this thesis is a part, investigating the nature of image-language relations and students' comprehension of them in the NSW Basic Skills Tests. The intention of this review is to establish the case for adoption of a tentative model of image-language relations for describing how image and language interact to construct meaning in the NSW Basic Skills Tests selected for use in this study. It will then be possible to investigate how the test items assess comprehension of these image-language interactions.

The starting point for the fourth chapter is an overview of the evidence of research on social differences in student reading comprehension and theories relating such differences to poverty, parental education and cultural difference. There is evidence of low literacy achievement by Indigenous students relative to non-Indigenous students and also by students in rural and remote areas relative to those in metropolitan areas. What we don't know is whether or how the comprehension of image-language relations contributes to this relatively low literacy achievement. In chapter four the potential impacts on the difficulty experienced by students in comprehending image-language relations will be reviewed on the basis of the current theory and existing studies of reading comprehension of Indigenous and geographically disadvantaged students.

Chapter five will outline the research design and methodology. The first part of the chapter will discuss the methods to be used. The second and third parts will identify how the Basic Skills Tests have been used to identify research sites and participants and to compare the reading performance of Aboriginal and non-Aboriginal students in

different geographic locations. The fourth and fifth sections of chapter five identify the procedures for analysis of texts, test items, student performance and interview data.

Chapter six will report the findings of the investigations with regard to text and item analyses that answer the contributing questions about the research materials with regard to the image-language relations, verbal complexity and image complexity in the reading texts. Chapter seven will report the findings of the investigations with regard to the analyses of students' reading strategies, their inferential comprehension and the linguistic complexity of their talk during interviews, while providing exemplars from case studies. Chapter eight will conclude the thesis by discussing the findings, stating possible implications for teaching reading and developing literacy tests and suggesting future directions for research.

## **Chapter 2 Multimodal texts and reading comprehension assessments**

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- 2.1 Contemporary definitions of reading comprehension, strategies, skills**
- 2.2 The multi-semiotic nature of contemporary texts**
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- 2.3 What does the BST reveal about multi-semiotic comprehension?**
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## **Chapter 2 - Multimodal texts & reading comprehension assessments**

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Contemporary texts are very different from traditional texts and are rapidly changing to fulfil many different purposes using old and new technologies. As texts change it is necessary to ensure that our concept of reading comprehension, and how it is assessed, remain aligned and relevant to contemporary multimodal texts. This chapter commences by discussing the terminology of this thesis, in particular defining the terms, reading comprehension, reading strategies and reading skills, multimodal and multi-semiotic, and then discussing how these definitions impact on literacy pedagogy, curriculum frameworks and literacy assessment. The chapter concludes with an overview of what current and past literacy assessment of primary students in New South Wales reveals about comprehension of multimodal texts.

### **2.1 Contemporary definitions of reading comprehension, strategies, skills**

Even in recent times many definitions of reading comprehension have been self-limiting, for example, the RAND Reading Study Group defines reading comprehension as a ‘process of simultaneously extracting and constructing meaning through interaction and involvement with written language’ (Snow 2002:11). By only specifying ‘written language’, this definition ignores the images in texts and how those images might interact with labels, captions and other written language. A more appropriate definition for comprehension of contemporary texts is one adopted by Clark and Graves (2008:9 citing van den Broek & Kremer 2000:2), whereby comprehension is defined as ‘representation in memory of the textual information and its interpretation’. The use of the term ‘textual information’ carries the implication that all parts of a text including images are being considered. This definition makes very

different assumptions about the nature of reading compared to Snow's definition. It is more general and therefore more encompassing of multimodal texts thus being more relevant to the current study of multimodal texts.

The inclusion of 'memory' in the latter definition specifies another important aspect of comprehension. Working memory is necessary when a reader makes connections between separated parts of texts by being able to remember one part while looking at another. A dynamic working memory strategy is particularly important in the comprehension of multimodal texts involving two or more semiotic resources, for example, a graph or diagram with mathematical symbolic statements (O'Halloran 2008) which could also be combined with written text. Although a dynamic working memory strategy might be what 'constructing meaning' (Snow 2002:1) would need to entail, a longer term memory strategy might also be required. For example, students who choose incorrect answers often seem to understand a text, but then answer questions incorrectly because they rely on memory and do not check the text again to confirm answers, however, when asked where they found their answer, most students looked at the texts and discovered their errors (Daly 2007:43). This highlights the need for teaching strategies that encourage students to justify their opinions about texts with evidential reasoning.

Reading comprehension has also been defined as, 'Intentional thinking during which meaning is constructed through interactions between text and reader' (Harris & Hodge 1995:207). However, there is a difference between a view of reading comprehension that concerns construction of meaning (constructed from a dialogue between writer and reader) and one that concerns 'social' construction, such as that propounded by

Vygotsky (1978) who ‘expanded [the] idea of construction of meaning to include the input of others and the environment’ (Hawes 2002:30). Interactional theories are not the same as a transactional theory of reading which acknowledges ‘the individual reader and individual text as bearers of culture creating new cultural events in unique transactions’ (Rosenblatt 1985:106).

These definitions have been expanded even further by Luke, Woods and Dooley (2010) who claim that, ‘comprehension is a cognitive *but also* social *and* intellectual phenomenon, and that narrow understandings of comprehension are insufficient for effective literacy pedagogy for teaching culturally diverse, minoritized and socio economically marginalized students’ (Luke, Woods & Dooley 2010:1). These researchers contend that comprehension instruction in such communities needs ‘an emphasis on student cultural and community knowledge, and substantive intellectual and socio-cultural content in elementary school curricula’ (Luke, Woods & Dooley 2010:1). They explain that where there has been a focus on strategies, without also focusing on the content of what is read, there has been little evidence of improvement in reading skills or increase in classroom talk around texts, all of which have been shown to be key elements in successful reading outcomes (McKeown, Beck & Blake 2009; Lai, McNaughton, Amituanai-Tolosa, Turner & Hsiao 2009).

This research investigates both the textual content of reading assessments and the reading strategies used by students. It is therefore appropriate at this point to clarify what ‘reading strategies’ entail and to differentiate them from reading skills.

Afflerbach, Pearson and Paris (2008) distinguish skills and strategies by determining whether a reader’s actions are automatic or deliberately controlled. In other words, a

reading skill is used automatically, out of habit and unconsciously, whereas a reading strategy is a ‘deliberate, conscious, metacognitive act’ (Afflerbach et al. 2008:368). When a reading strategy becomes effortless and automatic it has become a reading skill and this ‘progression from effortful and deliberate to automatic use of specific actions while reading occurs at many levels’ (Afflerbach et al. 2008:368). This distinction is important when considering the strategies identified by students particularly where students might be trying to recall skills that have become unconscious and automatic rather than conscious and effortful strategies. Students may not be aware of making a connection with another part of a text if they have done this automatically, so they might not be able to comment on that aspect of their reading if they were unaware of it.

Comprehension develops over time and different levels of comprehension can be related to varying levels of complexity in texts as well as varying degrees of familiarity with the field of knowledge required to understand the text. Text complexity resides in a range of text features including vocabulary, syntax, abstractions, metaphors and meanings that are implicit rather than explicit. Such meanings often rely on background (or field) knowledge that the author assumes the reader possesses. Such complexity can reside not only within the different semiotic resources of multimodal texts but also between them. Complexity within this inter-semiotic realm will be further investigated in this research.

## **2.2 The multi-semiotic nature of contemporary texts**

When discussing multi-semiotic texts and how they communicate information, O’Halloran (2008) states that it is important to distinguish between semiotic resources

(ways of communicating meaning through signs and symbols), such as linguistic, pictorial or gestural semiotic resources, and the modalities of their materialization, such as visual, auditory or somatic modality. Not all multi-semiotic texts have multimodal materialization, for example, a text with written language and images only involves the visual mode, whereas most DVDs are both auditory and visual. However, the dictionary definition of mode is ‘manner of acting or doing; a method; a way,’ and the term could be considered differently from the perspective of how meaning is created, rather from the perspective of how it is received. Two different methods (writing and illustrating) are used on the printed page to represent language and images, and although Chinese characters might be considered illustrative and English letters are ‘drawn’ on the page, both are different from photographs. Although all are viewed, the interpretation of written language requires different skills to the interpretation of images. Thus from a different perspective the use of the term multimodal to describe multi-semiotic texts can be justified.

Lemke (1998a) uses the term ‘realisation’ rather than ‘materialisation’ and the overarching term, ‘multimedia’, when speaking about ‘words and images, read or heard, seen static or changing’, and states that,

Meanings in multimedia are not fixed and additive (word meaning plus the picture meaning), but multiplicative (word meaning modified by image context, image meaning modified by textual context), making a whole far greater than the simple sum of its parts. (Lemke 1998a:283-284)

The combination of image and written language, for which Lemke uses the term ‘multimedia’, is referred to by some other researchers as multimodality (Guo 2004; Kress & van Leeuwen 2001; Lim 2004; Royce 2007a, 2007b; Unsworth 2007, 2008a).

Matthiessen (2007:29) refers to a 'kind of multimodality with image and written text' but he also points out that multimodality is expressed on different planes with different modes of meaning being realized by different modes of expression and manifested in different media of expression (p. 24). Despite the many different forms and definitions of multimodality and multimedia which do not encompass the printed page (a single medium expressed in the visual mode), this research will use the terms multimodal and multi-semiotic interchangeably to describe paper-based texts with both written language and images. As the term 'multimodal' is used in quotations from many researchers, it is less confusing to use the same term when referring to their studies, while still remaining aware of O'Halloran's (2008) contention that the printed page represents only the visual channel of communication.

Multimodal texts are very common in all aspects of communication today including school texts. There has been some research into how image and text combine in print-based texts read by students, for example, comics and cartoons (McCloud 1994; Porcelli 2000), picture books (Gill 2002; Lewis 2001; Unsworth 2007; Sipe & Pantaleo 2008), science texts (Veel 1998; Henderson 1999; Guo 2004; Roth, Ardenghi & Han 2005), geography (van Leeuwen & Humphrey 1996), visual art texts (Macken-Horarik 2004), mathematics (O'Halloran 2003, 2004) and assessment texts (Unsworth, Thomas & Bush 2004) but there has been little research into how students respond to any of these texts except picture books (Pantaleo 2005; Sipe & Pantaleo 2008).

### **2.2.1 The re-conceptualization of literacy and literacy pedagogy**

There has been a fundamental change to many books, including text books, whereby language was once the dominant medium but now visual images are often used to

convey the central information (Kress 2000a:199). Consequently, in relation to reading, ‘the process has shifted from serial cognitive processing of linear print text to parallel processing of multimodal text-image information sources’ (Luke 2003:399) because the images are related to the print and they usually elaborate on each other.

With the exception of novels and academic papers, the majority of reading material today includes images. This is not only the case in school texts and picture books, but also in local environmental communications, such as advertising brochures, information leaflets, posters and signs, and in more widespread everyday communications, such as television advertisements (Thibault 2000), newspapers (Macken-Horarik 2003a; 2003b) and CD-ROM Programs such as Encarta (Zammit & Callow 1999). Therefore there is a basic need to re-conceptualize literacy to encompass an ability to understand these multimodal texts so that students are prepared to operate in society. There is a particular need for the re-conceptualization of literacy pedagogy in relation to teaching students how to comprehend multimodal pages in history texts (Coffin & Deriwianka 2008), scientific texts (Henderson 1999; Roth, Pozzer-Ardhenghi & Han 2005), e-literature (Unsworth 2006a), picture books (Sipe & Pantaleo 2008) and websites (Unsworth 2007).

It is interesting that an ‘informal survey of students at all levels of education showed that they hardly ever attend to the photographs despite their abundance in the textbooks’ (Roth, Pozzer-Ardhenghi and Han 2005:107). However, these researchers were using high school text books and referred to high school and university students elsewhere, so it is probable that ‘all levels of education’ might not include students younger than teenagers. At least it could be assumed that the students who did not

attend to photographs were competent readers focusing on the written facts in text books, whereas in another study by Watkins, Miller and Brubaker (2004) the 58 out of 60 elementary students who only focused on images and did not read the accompanying text might not have been such competent readers or might not have seen the need to read the text when asked about the pictures in an interview situation.

These different observations could be showing differences between high school and elementary students, Brazilian and US students, purposes for reading, contexts for reading or the texts being read. In any case, the contrasting findings from these studies highlight the need for further investigation of student strategies to address the comprehension of multimodal texts with additional foci on the reading context (test or pleasure), the nature of the textual information (images that are integral to meaning or redundant) and the students' comprehension and reasoning. Such a focus on context is needed to identify whether attention to both semiotic resources is required to understand the texts and whether students are required to comprehend the texts or if they are in silent reading sessions just viewing what they find engaging.

Literacy is concerned with being literate, a term which is defined as being able to read and write. In the past it was assumed that literacy only concerned the written word because the texts being read and produced were primarily verbal. The following definition of literacy which is adopted in the introduction to the 1998 NSW *English K-6 Syllabus* focuses on 'written information':

Literacy is the ability to read and use written information and to write appropriately in a range of contexts. It is used to develop knowledge and understanding, to achieve personal growth and to function effectively in our society. (Board of Studies NSW 1998:5)

This focus on written language ignores the place of images in paper-based multimodal and mono-modal texts and seems to contradict the following statements on the same page of the introduction:

In this syllabus, the word ‘text’ is used broadly as any written, spoken or visual communication involving language.

In recognition of developments in multimedia and electronic communication, the syllabus outcomes also address the literacy demands of viewing and using computers.

(Board of Studies NSW 1998:5).

The latter statement only refers to viewing in relation to multimedia and electronic communications. The apparent lack of attention to static images may have arisen due to revision of the syllabus following its original release for optional implementation in 1994 and subsequent withdrawal in 1995 for review. The 1994 version of the syllabus had a strand called Reading and Viewing which was subsequently changed to just Reading. Although the NSW *English K-6 Syllabus* (Board of Studies NSW 1998) has some viewing indicators within the Reading strand, it does not have any major focus on viewing. In contrast, the Australian Capital Territory (ACT) syllabus and the National Statements of Learning for English (Curriculum Corporation 2005) give viewing equal status with reading by having a combined ‘Reading and viewing’ strand. Queensland’s English Essential Learnings (Queensland Studies Authority, 2007) also combine reading and viewing but their syllabus is currently being rewritten. The West Australian Outcome and Standards Framework - English (Department of Education and Training WA 2005) provides even greater focus on visual literacy by having Viewing as a separate strand of its framework beside Reading, Writing and

Talking and Listening. These syllabi address visual literacy, particularly the viewing of film and digital materials, but they do not include any framework for image/language relations.

Similarly, in The Australian Curriculum for English, which had not been implemented by NSW at the time of writing, regularly refers to ‘viewing’ and the Literacy strand clearly states that students learn ‘about how more or less abstraction and complexity can be shown through language and through multimodal representations’ (ACARA 2011:6). For example, the elaborations for Years 1, 2, 3, 4 and 6 state that students will be ‘making connections between information in print and images’ (ACARA 2011: 25, 30,35, 40 & 50) but there is no framework delineating the levels of ‘more or less abstraction and complexity’ in ‘multimodal representations’. Indeed, the repetition of the same skill across six years of schooling does not indicate any differentiation in the type or difficulty of ‘connections between information in print and images’. The only indications that some connections might be different are in two other elaborations. A Year 3 elaboration, ‘analysing the way illustrations help to construct meaning’ could imply that meanings in the print and image are concurrent, while a Year 4 elaboration, ‘inferring meaning from ... the interplay between words, images, and sounds’, implies the print and images have different representations because meaning must be inferred from the ‘interplay’ between them.

In New South Wales a need to re-conceptualize literacy pedagogy is evidenced in both curriculum content and assessment data. For example, in relation to assessment data, questions in the New South Wales Basic Skills Tests (BST) which involve visual literacy are among the most difficult as they have fewer correct responses (Daly

2007:44). In relation to curriculum content, the Reading Outcomes in the NSW *English K-6 Syllabus* (Board of Studies NSW 1998) mainly refer to written texts and language and the only reference in the outcomes to visual texts is in Early Stage 1, specifically Outcome ES1.7 for kindergarten: ‘Demonstrates an emerging awareness that written and visual texts convey meaning and recognizes that there are different kinds of texts that serve different purposes’ (Board of Studies NSW 1998:32).

Although the indicators for achieving outcomes include some references to visual texts, the only indicators above Early Stage 1 that refer to constructing meaning from both modes are in Stage 2 under Outcome RS2.6; ‘relates information in text to accompanying graphics’ and ‘skims a text for overall message using headings using headings, subheadings, layout, graphics’ (Board of Studies NSW 1998:31). It seems counter-intuitive that assessment items about visual literacy are among the most difficult but there are more references to multimodal reading in the NSW *English K-6 Syllabus* (Board of Studies NSW 1998) for the first year of schooling than for the next three stages of the primary syllabus. Indeed, the indicator for Stage 2 mentioned above, ‘relates information in text to accompanying graphics,’ seems very similar to the following indicators for achieving Reading Outcomes for Early Stage 1:

- makes connections between illustrations and written text (p. 30) and
- ‘uses illustrations to assist reading’ (p. 28)

There appears to be a lack of differentiation and specificity in the indicators relating to multimodal textual practices.

The difficulty experienced by students in answering reading comprehension questions about multimodal texts suggests that teachers might ‘not feel confident about teaching

visual literacy or do not analyse the diagnostic results [of reading tests] and therefore do not realize that they need to focus on these aspects of texts' (Daly 2007:44) or that they could lack knowledge to teach about these aspects of literacy. The latter is possibly the case in view of the lack of specific guidance in the syllabus indicators recounted in the last paragraph. Hopefully, this situation is changing with the wider access to teaching strategies provided with the National Assessment Program for Literacy and Numeracy (NAPLAN) results via SMART online. The literacy outcomes in NSW school curricula at the time of conducting this investigation will now be examined to see how they assisted teachers to know where to focus their attention when teaching about images and image-language relations in texts. However, it is acknowledged that at the time of writing most states other than NSW have agreed to commence implementation of The National Curriculum (ACARA 2011).

The NSW *English K-6 Syllabus* (Board of Studies NSW 1998) has many specific indicators for achievement of outcomes relating to the comprehension of verbal text, such as explaining the reasons for using passive voice, different tenses and modality. It also has one specific indicator relating to the comprehension of visual text, namely, 'identifies how camera angle, viewer position, colour, size and shading of a visual text construct meaning' (Board of Studies NSW 1998:33). However, as previously mentioned there are no specific indicators for the comprehension of how images and language relate to each other and such general descriptions as 'relates information in text to accompanying graphics' (Board of Studies NSW 1998:31), do not assist teachers to understand or convey the complexities of how language and image interact in texts to construct meaning.

Comprehending the various semiotic resources in texts and the connections between them involves the comprehension of varying levels of complexity in and between semiotic resources. It is therefore logical that if the ability to comprehend more complex multi-semiotic resources develops over time, there could be different levels of strategies that need to be taught at varying stages of the curriculum. Like teaching about written text, teaching about the comprehension of images and image-language relations needs to be a continuing and integral part of the curriculum in order to support the development of multi-semiotic resource comprehension. For example, students should be taught about the interpretation of directly represented images and image/language relations before more complex or abstract images in the same way that the Scope and Sequence chart for Grammar in the NSW English K-6 Syllabus (Board of Studies NSW 1998:74-75) stipulates students should be taught about the use of simple sentences in Early Stage 1, progress to sentences with simple conjunctions like ‘and, but, so’ in Stage 1, and then quoting and reporting speech in Stage 2 followed by complex sentences in Stage 3.

Indicators in the NSW English K-6 Syllabus (Board of Studies NSW 1998) provide evidence that school students are expected to learn about grammar for analysis of language in order to describe how words combine in clauses, sentences and texts to construct meanings. However, the syllabus does not provide teachers and students with a similar framework to understand the meaning-making resources of images, let alone any framework for image-language relations. In the present and immediate past there has been a cultural dominance of language in the written mode which has created an ‘impediment to an understanding of the semiotic potentials of, among other modes, the visual’ (Kress 2000b:159) and therefore,

A new theory of semiosis will need to acknowledge and account for the processes of synaesthesia, the transduction of meaning from one semiotic mode to another semiotic mode, an activity constantly performed by the brain. (Kress 2000b:159)

Such theories and frameworks are urgently needed in literacy education so that schools can meet the call to integrate into classroom practice metalanguage (Callow 2003; Unsworth 2008a) and explicit teaching (Unsworth 2001, 2004) about the role of images in constructing meaning in texts.

The need to include the study of multi-semiotic resources in literacy education is not confined to subject English. Literacy is an important aspect of all subjects and multi-semiotic texts with photographs, diagrams, flow charts, maps or artworks are often crucial to understanding key concepts in subjects such as history, science, mathematics and creative arts. Accordingly, the syllabus for each subject needs to address the comprehension of multimodal or multi-semiotic resources that are relevant to the subject, for example, comprehension of the sequencing and duration of events in visual representations of timelines in history texts (Coffin & Derewianka 2008).

### **2.2.2 Assessment of multi-semiotic literacy**

Literacy assessments need to reflect the type of texts that students are expected to read and comprehend. In the past, when it was assumed that students only needed to read the written word, literacy assessments were primarily aimed at comprehension of written language. However, the Basic Skills Tests (BST), for all students in Year 3 and Year 5 in NSW government schools from 1994<sup>1</sup> to 2007, have always included multi-semiotic texts and have increasingly included items that assess comprehension of the

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<sup>1</sup> There was also a BST for Year 3 from 1989 and for Year 6 from 1989 to 1994.

images and image-language interaction in those texts. This is in contrast to the 2008 inaugural NAPLAN in which there were only two out of 38 reading questions in Year 3 and two out of 36 reading questions in Year 5 that required understanding of images or image-language relations. This is surprising since the decision to develop a national assessment program for literacy and numeracy was because of a perceived need to more accurately assess achievement of the Australian National Benchmark standards for Reading, Writing, Spelling and Numeracy<sup>2</sup>, and the reading benchmark standards clearly state that students must be able to negotiate image-language relations.

The statements include that students achieving the Benchmark standard in Year 3 can ‘make links between a diagram and its label’ and in Year 5 students can ‘link information from a heading, written text and diagram’ (Curriculum Corporation 2000:23, 40). As the National Benchmarks standards in reading are minimum standards that students must achieve to be able to progress to the next stage of schooling, there is a definite need to include questions about comprehension of image-language relations within multimodal texts in literacy assessments.

### **2.3 What does the BST reveal about multi-semiotic text comprehension?**

As previously stated, the BST up to 2007 always included multimodal texts and the tests increasingly included items that assessed comprehension of the images and image-language interaction in those texts. The BST is therefore suitable for research into student comprehension of image-language relations in multimodal texts.

The relationship between written text and images with regard to skills assessment in group literacy tests was addressed by Unsworth, Thomas and Bush (2004:47-48) who

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<sup>2</sup> Up to 2007 achievement of the National Benchmark standards for reading, writing and numeracy were calculated for students in Years 3, 5 and 7 by applying a Benchmark cut-off point on each state’s reading, writing or numeracy scale.

investigated how the role of images was targeted by some questions in past BST tests and how students could use images to answer other questions that only targeted written text not the images. The study points out the need for a model of image/text relationships in the inter-semiotic construction of meaning. Such a model could identify differences in texts such as whether or not the written language and images correspond with, deviate from or elaborate on each other.

Unsworth, Thomas and Bush (2004:57) contend that the next challenge after developing a model of image/text relations is to develop assessments to determine how young readers comprehend these relationships. Meeting this challenge is one of the aims of the ARC 'linkage' project (Unsworth et al. 2009) which commenced at the beginning of 2006. The research uses material and data from the 2005 BST, which was the most recent test at that time. The assessment items involving image-language relations in the multimodal reading texts and from the Year 3 and Year 5 BST will now be briefly outlined.

### **2.3.1 Proportion of 2005 BST items involving image-language relations**

In the 2005 Year 3 BST there were five (out of nine) BST reading texts in which comprehension of meanings constructed through image-language relations was assessed. In the 2005 Year 5 BST there were six out of eleven texts which had assessment items involving image-language relations. However, even though the other texts all contained images that were relevant to the texts there were no questions about these image-language relations mainly because the test is of a finite length and cannot assess all aspects of all texts. The images in these other texts included photographs to accompany factual texts and illustrations to accompany a poem and a narrative.

Some of the texts in which multi-semiotic meanings were assessed had only one out of four questions that assessed comprehension of the images or image-language interaction. However, overall, one third of the questions in the Year 3 BST (12 out of 36 questions) and the Year 5 BST (15 out of 46 questions) involved making connections between written text and images.

### 2.3.2 Facility of multi-semiotic items and other items in the 2005 BST

The spread of difficulty among the reading items assessing image-language interaction was similar in the Year 5 BST to the Year 3 BST with slightly more in the difficult range for the Year 5 BST. This was discerned by using the BST software program called SMART (School Measurement, Assessment and Reporting Toolkit) for reporting and analysing the test results. The ‘Item Analysis’ function on SMART was used to order test items according to the percentage of students who achieved each skill, that is, from easiest to most difficult. Table 2.1, shows the number of Year 3 and Year 5 items that involved image-language interaction out of the total number of items located in quartiles of difficulty.

2005 BST (number of items)	First quartile (easiest items)	Second quartile	Third quartile	Fourth quartile (hardest items)
Year 3 (12 out of 36)	5 out of 9	2 out of 9	2 out of 9	3 out of 9
Year 5 (15 out of 46)	5 out of 11	1 out of 12	6 out of 12	3 out of 11

**Table 2.1** – Spread of BST items involving image-language interaction in 2005

In Year 3 Reading, the nine most difficult questions (hardest 25%) include three about image-language interaction. These questions include Question 31, where only 32 % of the state could sequence steps by interpreting a diagram of a Greek water clock and its

labels, and Questions 29 and 30, where 51% of students could infer by interpreting Egyptian and Greek water clock diagrams and their labels. To put this in context, the other six most difficult Year 3 reading questions included three questions about a poem, two questions about word meanings and one question about pronoun reference.

For Year 5 Reading, out of the eleven most difficult questions (the most difficult 25%), three items involved linking written text and visual images (the twelfth item also assessed image-language interaction). Two of these questions were answered correctly by 56% of the state. Of these, Question 37 required students to sequence steps by interpreting a diagram and its labels (this question is the same as Question 31 in Year 3) and question 5 required students to infer information by interpreting a map and key. For the other difficult Year 5 item, Question 28, only 44% of the state could identify part of an image by making connections between a written text and the painting it describes.

The remaining eight difficult Year 5 reading questions, that did not involve images, included three questions about figurative language in a poem, two inferences, the main idea and purpose of texts and recognizing that a female pronoun was used to refer to the sea. Most of these difficult Year 5 questions about verbal text required skills and outcomes expected by the end of Stage 3 (end of primary school) in the NSW *English K-6 Syllabus* (Board of Studies NSW 1998) so it is to be expected that those questions would be difficult. However, the visual literacy skills required for Questions 5, 28 and 37 are skills indicated for Stage 2 outcomes in the syllabus, so it is important to investigate why these questions about image-language interaction are difficult for students. It can be seen from Table 2.1 that items testing comprehension of image-

language interaction range across difficulty levels and yet the syllabus only states the ability to relate written text to images as a single outcome for students in Stage 2, which means it should be achieved by the end of Year 4 when students are around 10 years old. This anomaly suggests there is a need for a theory of the types of image-language relations and a determination as to whether this range of image-language relations relates to the range of difficulty amongst the assessment items.

## **2.4 Summary**

In this chapter the main concepts being investigated have been defined for the purposes of this research. Reading comprehension has been defined as intentional thinking during which meaning is constructed through transactions between text and reader and it is acknowledged that reading is a social and intellectual phenomenon as well as cognitive (Luke, Woods & Dooley 2010:1). A distinction has been drawn between reading strategies, which are deliberate conscious acts, and reading skills which are automatic and unconscious (Afflerbach et al. 2008:368).

Semiotic resources are defined as ways of communicating meaning through signs and symbols, such as linguistic, pictorial or gestural resources. Paper-based print texts with written language and images are therefore multi-semiotic resources. However, as the majority of researchers in the field have also referred to language and images as different modes of making meaning and referred to texts involving both modes as ‘multimodal texts’, this term is used interchangeably with multi-semiotic resources throughout the thesis.

Contemporary texts in all fields today include multimodal texts and the parallel processing of language and images in such texts is different from the serial processing

of written language alone (Luke 2003) resulting in meanings that are often multiplicative rather than additive (Lemke 1998a). It is therefore important to re-conceptualize literacy to reflect these differences, particularly in English curricula and literacy assessments. One third of the reading questions in the 2005 BST assessed comprehension of image-language relations in multimodal texts and these questions were among the most difficult, but less than five percent of the 2008 NAPLAN reading questions assessed such understandings. However, the substantial proportion of questions about image-language relations in the 2005 BST makes this a suitable site for the current investigation.

The National Benchmark statements require that Year 3 and Year 5 students achieving the minimal Benchmark standard can link information in written text and diagrams (Curriculum Corporation 2000:23 and 40). As the National Benchmarks standards in reading are minimum standards that students must achieve to be able to progress to the next stage of schooling, there is a definite need to include more questions about comprehension of image-language relations within multi-semiotic texts in literacy assessments. Despite this need and the difficulty of questions about image-language relations in BST reading assessments, the NSW *English K-6 Syllabus* (Board of Studies NSW 1998) reveals limited references to relating language to images in texts. This lack of focus could be limiting the amount of teaching that is focused on image-language relations and therefore contributing to the greater difficulty experienced by students when answering BST questions about image-language interaction in texts. The next chapter more closely examines the social, cognitive and intellectual aspects of multimodal reading comprehension as well as various issues of text complexity inherent in those aspects of the phenomenon.

## **Chapter 3 - Social semiotic perspective on multimodal text complexity**

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- 3.1 Rationale for using a social semiotic perspective on literacy**
- 3.2 What is a functional view of language and literacy?**
  - 3.2.1 Functional Grammar**
    - 3.2.2.1 Complexity in language**
  - 3.2.2 Visual Grammar**
    - 3.2.2.1 Applicability of Visual Grammar to educational contexts**
    - 3.2.2.2 Complexity in visual images**
- 3.3 The interface of verbal and visual meaning in texts**
  - 3.3.1 Literature related to image/language relations**
  - 3.3.2 Models of image/language relations**
    - 3.3.2.1 Martinec & Salway's subsystem of status relations**
    - 3.3.2.2 Martinec & Salway's subsystem of logico-semantic relations**
    - 3.3.2.3 Unsworth & Chan's tentative model of image-text relations**
- 3.4 Social, cultural, linguistic differences**

## **Chapter 3 Social semiotic perspective on multimodal text complexity**

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This thesis is about differences in comprehension of image-language relations in texts among students from different social groupings, so it is appropriate to adopt a social semiotic perspective, which is inclusive of words and images as well as taking social context into consideration. This chapter will provide a brief overview of social semiotics, systemic functional linguistics, functional grammar and Visual Grammar in order to consider how functional grammar and Visual Grammar can be used to identify levels of complexity in multi-semiotic texts. These theories underpin the research and theories about image/language relations, which will be reviewed in the second half of the chapter. All of these research areas will be considered in relation to students' ability to access meaning in multi-semiotic texts.

### **3.1 Rationale for using a social semiotic perspective on literacy**

Semiotics, which is generally described as 'the study of signs' (Harrison 2003:47), is inclusive of both words and images because both consist of signs, that is, they are essentially marks, figures or symbols that convey meaning. There are three main branches of semiotics:

- Semantics – the relation between signs and the things to which they refer, that is, their meaning or what they denote
- Syntactics – the relations among signs in formal structures
- Pragmatics – the relation between signs and the effects they have on the people who use them

All of these branches of semiotics, and particularly how we use signs in different social contexts, are integral to social semiotics which is defined as 'the way people use

semiotic ‘resources both to produce communicative artifacts and events and to interpret them – which is also a form of semiotic production – in the context of specific social situations and practices’ (van Leeuwen 2005:xi).

By considering ‘the context of specific social situations and practices’, social semiotics is able to account for the influence of different contexts on how texts are constructed and how the same text might be interpreted in different social contexts. The capacity of social semiotics to describe how written texts function differently according to social contexts is the basis for systemic functional linguistics, which in turn is the basis for work on Halliday’s (1985, 1994, 2004) functional grammar and on features beyond the clause such as cohesion in texts (Halliday & Hasan 1985; Martin 1992), genre (Martin 1993, 1997) and discourse (Martin & Rose, 2003). Systemic Functional Grammar describes the resources for making meaning in language via three meta-functions: the ideational, interpersonal and textual metafunctions (outlined below in section 3.2.1 of this chapter). It is at this fundamental level that the meta-functional approach to meaning enables a link to be made between the different meaning-making modalities of language and image. It was therefore possible for the functional grammar (Halliday 1994) framework to be adopted by Kress and van Leeuwen (1996) as the basis for their grammar of visual design in which they outline three metafunctions of images to communicate conceptual or narrative meanings.

The strong advantage of a social semiotic approach to functional grammar and visual grammar is that they have the same theoretical basis and so can operate in tandem to analyse multi-semiotic texts. In the past traditional grammar was used to describe how purely verbal texts were constructed but more recently the appropriateness of this grammar for contemporary texts has been reconsidered. When reading texts was only

a matter of processing linear print, traditional grammar was largely unquestioned in schools. However, traditional grammar cannot be used to describe non-linguistic semiotic resources, such as images, in multi-semiotic texts.

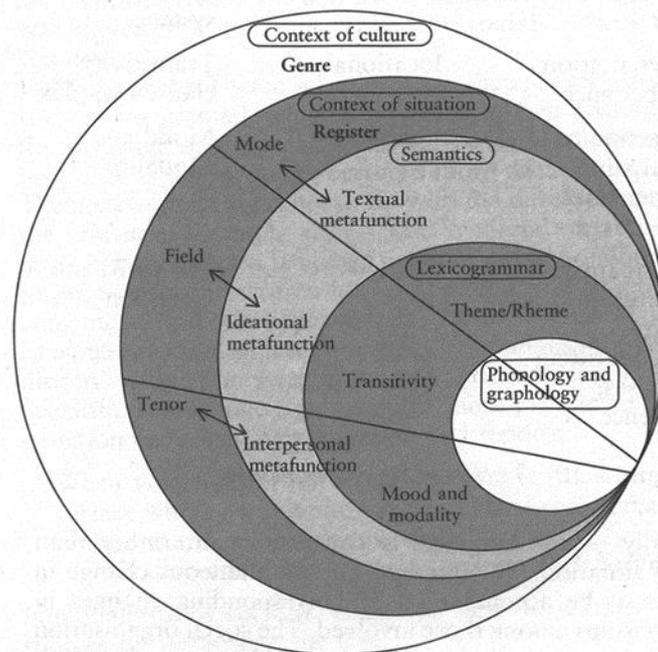
Traditional grammar is also limited in that it describes texts in isolation and therefore does not take into account their social function and context (Williams 1993:251), whereas systemic functional linguistics has social function at its core. A social semiotic perspective achieves a closer analysis of how language varies by facilitating recognition of the function of a range of semiotic resources to communicate meaning within specific social contexts. These social contexts include both an immediate social context in which language and images are used and also parts of the larger culture in which we live.

The context of culture ‘involves shared meanings and assumptions’ (Collerson 1994:2) across certain groups in society, but there will always be other groups, often less powerful or minority groups, who do not share those meanings and assumptions. A social semiotic perspective is therefore important for the current research which is investigating the reading comprehension of students within the different social contexts of geographic location (metropolitan, provincial and remote) and cultural background (Aboriginal and non-Aboriginal). Theories and research about socio-cultural differences in reading achievement are reviewed in Chapter 4. As a social semiotic perspective considers how language functions in society, it has led to a functional view of language and literacy, which is elaborated in the next section of this chapter.

### 3.2 What is a functional view of language and literacy?

A social view of language is primarily concerned with how we use language to make meaning and ‘get things done’ (Droga & Humphrey 2003:1). Language is therefore seen to perform functions within a social context. Patterns of language are superimposed on each other in layers of ever widening contexts: letter patterns in word patterns in sentence patterns in paragraphs and texts, with register patterns in the context of situations and genre patterns in the context of culture (Rose 2006a).

In the diagram reproduced at Figure 3.1, Unsworth (1993:340) shows how the three main metafunctions operate simultaneously across the layers of language in text and context.



**Figure 3.1** Language, context and text diagram (Unsworth 1993:340)

### 3.2.1 Functional Grammar

In his work on functional grammar, Halliday (1994) details how language performs the three main metafunctions of language, identified as interpersonal, ideational and textual functions, for example, through clauses, lexis and grammar, semantics and instances (p. 20). The metafunctions relate to three features (tenor, field and mode) of the immediate situational context of the language in the following manner:

- the **interpersonal** function of language is related to the **tenor** of the relationship between the people involved (the author and reader in written texts), the ‘tone’ of the language and the attitudes and emotions embodied in the language
- the **ideational** (or experiential) function of language is related to the **field** or context of human activity
- the **textual** function of language is related to the **mode** of language use such as spoken or written language

Spoken and written language involve two kinds of participants: the ‘interactive’ participants, who are interacting with one another by speaking and listening, and the ‘represented’ participants, who are the people, animals or objects represented by the spoken or written words. The *interpersonal metafunction* involves a range of ways of relating interactive participants, the stance of individuals in respect of the ideas represented and their status, while the *ideational metafunction* is about representing participants, actions and relations (as through nouns, verbs and prepositions) and the *textual metafunction* concerns the integration of these interactions and representations into a coherent whole in the text (Kress & van Leeuwen 1990:18).

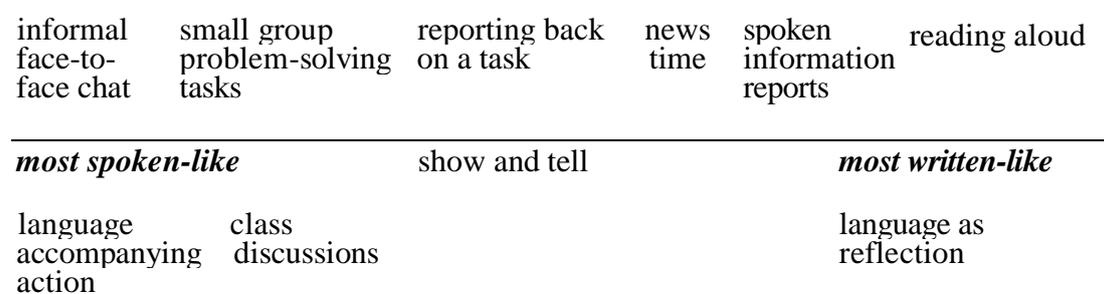
Halliday (1994:21) points out that grammar is the central processing unit of language, ‘the powerhouse where meanings are created’ and the structure is an organic configuration ‘so that each part has a distinctive function with respect to the whole and that some units may form **complexes**, iterative sequences working together as a single part’ (Halliday 1994:21, emphasis in the original). The notion of a ‘complex’ refers to not only clause complexes but also phrase complexes, group complexes, and word complexes. Halliday (1985) uses the term ‘clause complex’ instead of ‘sentence’ because ‘clause complex’ can be used to refer to both written and spoken language, whereas a ‘sentence’ is a unit of the writing system, bounded by a capital letter at its beginning and a full stop at its end, and therefore cannot be identified in spoken language. A clause complex is not necessarily the same as a complex sentence as it can include compound sentences. However, complex sentences are a source of more complexity or difficulty than compound sentences for young readers. The next sections will look at complex sentences and then complexity in vocabulary.

### **3.2.1.1 Complexity in language**

Within each metafunction, the lexico-grammar and other features of cohesion, register and genre beyond the clause-level realize many specific functions of words and stretches of language that describe how they convey intended meanings in specific contexts. A functional approach to grammar also makes it possible to identify different levels and types of complexity. Halliday (1985) talks about two kinds of complexity in language. The complexity of the written language is ‘static and dense’ whereas that of the spoken language is ‘dynamic and intricate’ (Halliday 1985:87). He explains that in spoken language grammatical intricacy takes the place of lexical density.

The lexical density of a stretch of language is measured as the number of lexical items (words that carry meaning in contrast to grammatical items that are concerned with structure) as a ratio of the total number of clauses. High lexical density, which usually occurs in academic written language, is difficult for young children to understand. It is often characterized by generalizations, abstraction and grammatical metaphor. This is a more difficult feature of written language where the same lexical item takes on a different grammatical form as when a process or verb, ‘apply’, becomes a participant or noun, ‘application’, through nominalisation. Grammatical metaphor ‘is unlikely to be mastered until the age of eight or nine’ (Halliday 1985:96). As lexical density is not a common feature of primary school texts most research at the word level with young children has concerned the quantity or quality of vocabulary (Carter 1987, Chall & Curtis, 1991, Biemiller 2003).

There is a language continuum from everyday colloquial language, involving clauses strung together in mostly simple and compound sentences, to more formal academic language involving dense nominalised structures (Martin 1985). That continuum has been adapted by Jones (1996) to show a spoken language continuum (see Figure 3.2).



(adapted from Martin 1985)

**Figure 3.2** Spoken language continuum adapted by Jones (1996)

Complex sentences would be midway along this continuum where language would be less contextualised and more reflective. It is likely that children need to be familiar with connecting ideas by using dependent clauses in complex sentences before they could turn the dependent clauses into nominalisations.

Young children commence speaking in simple sentences and move on to compound and then complex sentences to connect ideas. This sequence of language development is reflected in Australian English Curriculum (ACARA 2011) in which students are

- ‘understanding that a simple sentence expresses a single idea’ in Year 1 (p.23)
- ‘learning how to express ideas using compound sentences’ in Year 2 (p. 28)
- ‘using appropriate simple, compound sentences and complex sentences to express and combine ideas’ in Year 3 and Year 4 (p.35).

Meanings which would be expressed as dependent clauses in spoken language are expressed as extended noun groups, nominalisations or embedded clauses in more advanced academic texts. Such features are found in formal academic texts used in secondary schools, therefore it is appropriate that embedded clauses and nominalisation are not mentioned in the Australian English Curriculum until Years 7 and 8 (ACARA 2011:53, 58). Even though they might not be mastered in writing until secondary school, these features will sometimes be encountered in spoken language and reading in primary school. Familiarity with complex sentences is an important step in the sequence of language development culminating with lexically dense texts. Complex syntax was found to be relevant in the study of a disadvantaged multicultural community with a substantial Indigenous population, where it was found that 44% of the children had language development delays and 38% had a delay in receptive

vocabulary. The researchers suggested that ‘teachers should concentrate on strategies that enhance children’s vocabulary development and facilitate their use of more advanced and complex syntax’ (Hay, Elias, Homel, Freiberg, Ernst & Jensen 2003:44). The use of more complex syntax and vocabulary can assist students to read more complex texts because these texts require knowledge of less familiar words and language patterns which increases the cognitive and linguistic demands on the reader (Chall & Curtis 1991:351).

Hay et al. (2007) recommend more dialogue because developing children’s spoken language proficiency and indirectly facilitating the development of their reading skills, involves ‘engaging the child in reciprocal verbal interactions that support the child in using progressively more linguistically complex dialogues’ (Hay et al. 2007:405). The researchers noted that when children were asked to explain their answers, the teacher was facilitating the children’s verbal reasoning. This effect is relevant to the current research where students are asked to think aloud about the meaning of texts and state how they decided on their answers. In view of this possible effect, it will be important to only analyse students’ spoken language when they are thinking aloud, not when they are explaining how they selected their answers, so that the data represents unassisted comprehension of texts similar to a test situation.

Thinking aloud is the basis of exploratory talk, a term coined by Barnes (1976, 1992), whereby ‘students talk their way through and into ideas’ (Pantaleo 2011:261). A study, that confirmed the value of using exploratory talk to explicitly teach children how to use language to reason, included identification of the number of ‘because’ statements (Mercer, Wegerif & Dawes 1999). However, it would seem appropriate to include a whole range of other conjunctions which are used to link ideas and explain events in

dependent clauses. For example, the type of responses found in a group of secondary science students who acquired technical literacy skills were associated with the causal/conditional sequences of explanations (Rose 1997/2000:71). Such explanations require the ability to connect, relate and order ideas within language and hence this type of language usually involves the use of syntactic complexity in the form of dependent clauses of time, manner, condition, purpose and reason. These dependent clauses often begin with conjunctions such as *while, when, as, before, after, so, if, then* and *so that* in addition to *because* (Rose 1977:58-61).

In relation to younger children, conjunctions have been found to be indicators of age-related changes in children's use of literate language features for pre-school children (Curenton & Justice 2004) and children with language impairment (Greenhalgh & Strong 2001). A storytelling intervention currently being investigated includes a focus on underlying functional grammar through use of subordinating conjunctions in complex sentences to increase children's use of decontextualized literate oral language and then written language (Dawkins & O'Neill 2011:303).

When comparing spoken language performance with reading comprehension for eight year olds, Morice and Slaghuis (1985) used a syntactic index that was composed of structural complexity and syntactic errors. Surface features of language such as syntactic errors are probably not relevant to reading comprehension (Bernstein 1974; Daly 2006a, 2007), however, it is relevant that compared with good readers, poor readers generally had less structural complexity in their spoken language and used fewer embedded clauses (Morice & Slaghuis 1985:149).

Painter (1996) suggests that language develops as new grammatical realisations of meaning, however, well-scaffolded dialogue is important in developing language because ‘the new possibilities for meaning that arise, will depend on the nature of the texts children are enabled to create in interaction’ (Painter 1996:80-81). Opportunities to engage in meaningful activities that enable or require students to use talk to learn are needed (Pantaleo 2011:275), especially for students who have missed out on the kind of pre-school interactions documented in Painter’s research.

The effects of different social interactions experienced by students are evidence that language does not exist in a vacuum. This is crucial to the social semiotic view of language and it adds another dimension to language complexity. Symbols (language or images) are socially generated and individually interpreted and internalized, therefore the sense we make of them is the sum of all the experiences aroused in our mind by the symbols (Vygotsky, 1962). A transactional view of reading whereby meaning occurs between the reader and the text, describes these experiences as ‘the experiential and linguistic reservoir, the cognitive and affective residue of our past experience with life and language, on which each must draw in any linguistic transaction, whether speaking or listening, writing or reading’ (Rosenblatt 1985:99). However, reading multimodal texts does not only involve linguistic transactions so perhaps viewing could be added to this list of transactions to address the many varied iconic and symbolic images used to make meaning in contemporary texts.

In the next section visual grammar will be considered. Socio-cultural differences will be considered at the end of this chapter and in the next chapter.

### 3.2.2 Visual Grammar

This section will outline how the three language metafunctions identified by Halliday (1994) have been applied to how images function and create meaning in texts.

Gunther Kress is one of the New London Group (1996:1) who called for ‘a much broader view of literacy than portrayed by traditional language-based approaches’. Kress and van Leeuwen (1996) proposed a Visual Grammar to describe the way in which people, places and things depicted in images, combine in visual ‘statements’, that are arranged and framed in order to interact with and influence the reader. The three metafunctions in language were considered by Kress and van Leeuwen (1990:18-21) to also be applicable to what happens in images. These metafunctions are realized in images as follows:

- the *textual metafunction* is realized through compositional features such as horizontal and vertical placement and the size of elements;
- the *interpersonal metafunction* is realized through features, such as gaze at the viewer, perspective and angle of view to relate interactive participants.
- the *ideational metafunction* represents participants and processes and relates them through features such as vectors (directional elements) or symmetrical arrangements.

Similar features in texts can perform different roles within different metafunctions. For example, within the ideational metafunction, vectors play an important role conveying material and behavioural processes in narrative images, thus distinguishing these images from conceptual images which often display participants and their attributes in more symmetrical arrangements. However, the interpersonal metafunction, which is

concerned with a particular social relation between the producer of an image and the viewer of the image, is also realized through vectors. These vectors are created by eye lines of the participants and whether they are looking at or away from each other or the camera/viewer, for example, a demand is created when a character, such as the chimpanzee in *Gorilla* (Browne 1983), gazes directly at the viewer, whereas an offer exists when characters look in any other direction.

### **3.2.2.1 Applicability of visual grammar to educational contexts**

This section seeks to outline how visual grammar can be successfully applied to educational texts to understand how their images achieve their purposes in educational contexts and how they can function in a similar way to, and in conjunction with, language, for example, through features such as coding orientations and tenor. The following examples show how visual grammar has been used for the analysis of images in multimodal texts.

Callow and Zammit (1999) have used visual grammar to carry out analysis of two computer screens from CD ROMs designed for children. They found that ENCARTA (Microsoft 1994), the multimedia encyclopaedia, uses a scientific taxonomy to organize its information, foregrounds text and uses text buttons to navigate, while THE ANIMALS! (Arnowitz Inc. and the Software Toolworks Inc. 1992-93) from the San Diego Zoo addresses information from an environmental perspective, emphasizes images and uses symbolic images (icons) for navigation (Callow & Zammit 1999:102-3). These differences correspond to the predominantly naturalistic and sensory coding orientations of images in THE ANIMALS! and the more technological and abstract coding orientations of images in ENCARTA (Callow & Zammit 1999:102).

Veel (1998:149) noted similar differences between scientific and environmental books written for children and he concluded that visual images and humanities style rhetoric are combined with the linguistic resources of traditional science to construe new meanings in environmental texts. Veel (1998) provides an example from a text about carbon transfer, where full-saturated colour photographs of burning trees, animals and carbon molecules relate to the viewer's everyday experience of the world whereas the diagrams and text present scientific knowledge 'which is at a greater 'semiotic distance' from the viewer's first-hand experience of the world. The effect is to take the reader from what they have experienced and can relate to personally towards the world of shared, abstract scientific knowledge' (Veel 1998:141). The greater 'semiotic distance' in technical diagrams and the abstract scientific concepts are what contributes to their complexity and hence more difficulty in comprehending them.

The suitability of Kress and van Leeuwen's visual grammar as a framework for analysis of children's picture books is validated by Lewis (2001), who provides examples of the various categories, such as the transactional reaction process shown when Hannah watches her father and the non-transactional action process in the image of Supergorilla on the cinema screen in *Gorilla* (Browne 1983). Lewis gives examples of nearly all the other processes and circumstances in narrative structures and analytical structures, as well as examples of demands, offers, perspective, angles, modality and compositional features. Gill (2002:10-11) also finds the visual grammar framework useful but she extends it, in order to account for instances of one-sided gaze and mutual gaze in *Gorilla* (Browne 1983), by adding unidirectional and bidirectional transactional and non-transactional categories to behavioural and

reactional processes. Such analysis is important for understanding how such picture books achieve their purposes and facilitates a more critical understanding of the genre.

Within factual genres, Unsworth (1997:37) uses the visual grammar framework to identify four different coding orientations in his analysis of science explanations for children: naturalistic (photographs), realistic (colour paintings), scientific (line drawings) and fantasy (cartoon characters). These functional descriptions are assisting teachers to attend to the multimodal nature of texts in developing critical literacy practices (Unsworth 2001).

### **3.2.2.2 Complexity in visual images**

As well as simply describing how images are coded, visual grammar offers opportunities to describe complexity in images in a similar manner to that in which functional grammar can describe complexity in language. For example, abstraction is more common in dense written language and use of modality is more common in complex persuasive language than in everyday spoken language. Similarly, images which have abstract coding orientations are ‘used by sociocultural elites’ (Kress & van Leeuwen 1990:54), and viewers need to be educated about or offered cultural entrée into their specific complex meanings. Semiotic theory helps to explain why meaning is more easily apparent in the iconic references of naturalistic coding orientations than in symbolic references, which are often in abstract coding orientations, as follows:

Icons use iconic reference *directly*, because their meaning is apparent in the surface – for which reason icons can be understood without having to learn a convention. Symbols, on the other hand, use iconic reference *indirectly*, because the connection between the M-concept [meaning] and the surface is convention-based – for which reason symbols cannot be understood without the prior learning of the convention. (Hausser, 1999/2000: 116)

Another aspect of linguistic complexity which can be applied to images is the use of grammatical metaphor such as in nominalizations, where processes typically expressed through verbs are represented as participants expressed through nouns. This is similar to how semiotic metaphor occurs in images and symbolic text, as shown by semiotic analyses of mathematics materials, namely a translation of Descartes (Stewart 1999) where, in addition to the line segments noted in Descartes' drawing, a 'new participant, the triangle, is introduced visually, and the new participant,  $\sin \alpha$ , is introduced symbolically' (O'Halloran 2003:360). Kress and van Leeuwen (1996:53) also point out that the triangle is one symbol (participant) that can also act like a vector. It can thus perform the dual role of representing processes or actions via its sides and points acting as directional vectors as well as representing a participant in the form of a symbolic object, the triangle. This is similar to how grammatical metaphor works in written text to convey the essence of both participants (nouns) and processes (verbs).

McCloud (1994:46) claims that the scale from realism to iconic abstraction is a scale from complex to simple, specific to universal, and objective to subjective. A realistic image is objective because it is about external reality, the object of our thought, while an iconic abstraction is subjective because it is reduced to the essential and as thus exists within the mind of the viewer. McCloud (1994:30) points out that cartooning is 'a form of amplification through simplification' because 'when we abstract an image through cartooning we're not so much eliminating details as we are focusing on specific details', for example, an iconic abstraction of a face can be as simple as a circle, two dots and a line. This explains the universality of cartoon imagery, as the

more simplified or cartoony a face is the more people it could be said to describe (McCloud 1994:31). For example, the images in Dick Bruna's books for children, which do not use perspective and have two-dimensionality similar to simple cartoons, had relevance for the whole of an increasingly varied Dutch population when they were first printed in 1953 because they were 'adaptable to a variety of cultural and ideological constructions' (Kress & van Leeuwen 1996:27).

Cartoon-like images could be easier to understand because they are simplified drawings or the codification of symbols could be harder to interpret, if it is culturally biased to an unfamiliar culture. Since all semiotic understanding has a cultural basis, there could be differences in how different cultural groups value and take meaning from images, especially symbols, and text. It is also possible that some highly detailed naturalistic three-dimensional images are easy to understand, despite their complexity of detail, because they are closer depictions of reality. In fact it seems most probable that ease of understanding has less to do with how much detail is in a drawing and has more to do with the 'common sense naturalistic coding orientation, which remains, for the time being, the dominant one in our society' (Kress & van Leeuwen 2006:165).

Similarly, greater difficulty (complexity) in understanding abstract symbols or technological images, would be in accord with the depiction of abstract coding orientations as being 'used by sociocultural elites' and technological coding orientations as being used for a 'scientific or technological purpose' (Kress & van Leeuwen 2006:165). Such possibilities about the interpretation of images are highly relevant to this research because in addition to investigating student comprehension, it analyses the complexity of images, written text and image-language relations.

Henderson (1999:17) points out that there does not seem to be a great deal of research about children's understanding of diagrams and suggests it is possible that a significant number of students have difficulty in relating to them. Henderson (1999:20) states that it cannot be assumed that all student perceptions are the same, or that they are the same as their teachers' perceptions, because making sense of a diagram depends on the learner's existing knowledge. That knowledge needs to include knowledge of the conventions underlying symbolic references (Hausser, 1999/2001) which often need to be explicitly taught.

Henderson's observations, that a diagram may be 'interpreted in unsuspected ways' (1999:23) or students may ignore it because they cannot make sense of it, are in line with Peirce's (1933) semiotic theory whereby meaning relies on sign, object and interpretant. Rosenblatt's (1969) transactional view of the reading process also underlines the essential importance of both reader and text in the reading transaction and explains how individual readers make different interpretations.

The focus on an individual's interpretation is also indicated by Parkinson and Adendorff (2005:232) who consider that factual genres are not necessarily more difficult to understand but they need to be more widely available so that all children can become more familiar with them. The idea that the children who find these texts more difficult do not have as much access to them is similar to the findings of Brice Heath (1994:92) who noted that in a working-class black community in the US 'children seemed to have skipped learning to label, list features, and give what-explanations' and they were generally more familiar with narrative genres than factual

genres (this research is discussed further in section 4.1.1). There might be a similar basis to findings about Aboriginal students for whom test questions about written narrative texts were relatively easier than those about factual texts (Daly 2000; 2004).

Henderson (1999:25) also believes we should question the assumption that diagrams are easier than verbal text for low achievers. He found that ‘the ability to interpret diagrams is largely context-dependent and is also dependent on the development of particular diagram-processing skills’ (Henderson 1999:25), which need to be explicitly taught particularly in the specialized context of scientific drawings. This seems to imply there are different levels of complexity in diagrams according to the context and how the images are processed, or in the skills or strategies used by students to comprehend them.

As most diagrams include supplementary text and they often supplement longer stretches of written text, another aspect of levels of difficulty in processing could be how the image relates to verbal text. When considering how images and language relate to each other at the point where their meanings interact, it is important to be able to use grammars developed from the same systemic functional framework so that the same terms with the same functional meanings can be applied to both visual and verbal features of a text. Since visual grammar was based on functional grammar it uses the same terminology, for example, ‘participants’ name or represent objects and people in either the verbal text or image, ‘material processes’ tell about actions in the verbal text or show actions in the images, ‘temporal and spatial circumstances’ are features that locate events in time or space in either the words or images. These grammars also express the relations between those features within the verbal text or

within the images and how they relate to the immediate and cultural contexts of the verbal text and images. As they carry the same functional and contextual meanings these grammars are integral to the development of theoretical models of relations between images and language within texts.

### **3.3 The interface of verbal and visual meaning in texts**

One of the earliest theories of image-text relations was proposed by Barthes (1977) who considered images were too open to a variety of meanings by themselves as ‘the image is felt to be weak in respect of meaning’ (Barthes 1977:32). However, according to Kress and van Leeuwen (1990:3), the capacity of images to communicate the same metafunctions as language means they are not as dependent on verbal text as was argued by Barthes.

Barthes’ concepts of extension and elaboration of meaning are useful but they do not include other image-language relations, for example, where images and verbal text are purposefully divergent in order to create new meanings as in some advertisements or in picture books such as those created by Anthony Browne. Barthes also assumes use of a top to bottom and left to right style of linear reading used in older Western print texts and does not account for the different pathways followed when reading texts such as websites and modern illustrated information books. Such texts are not designed ‘to be read only in the strict linear order in which the text appears on the pages’ (Lemke 1996:216). The combined verbal and non-linguistic resources are often read by following a ‘back-and-forth reading sequence’ (Guo 2004:203) whereby readers look at images to clarify the information in the verbal texts or they unpack the meanings in images by referring to information in labels, captions and the main text.

Indeed the layout of many picture books and digital texts usually requires a non-linear reading sequence because the text and image segments are often scattered around the page or screen. Digital texts often include hyperlinks that involve leaving one page to view another page or site before returning to the original page.

Other descriptive accounts of image/language interaction include work on comics (McCloud 1994), work on science texts (Roth, Pozzer-Ardhenghi & Han 2005) and diagrams (Henderson 1999), but the most detailed theoretical work has been based on systemic functional semiotics (Kress 2000; Lemke 1998a, 1998b; Macken-Horarik 2004; Royce 2002, 2007b; Unsworth 2004, 2007). Most of the research into image/language relations in texts has been based on specific types of texts, such as mathematics and science texts (O'Halloran 2003, 2008; Kress 2003), ArtExpress (Macken-Horarik 2003) and television advertisements (Thibault 2000). These research studies have mainly been applicable to adult or high school contexts. The conclusion to a study of image-language relations in primary literacy assessments stated that 'there is a paucity of research-based theoretical frameworks to guide the teaching and assessment of students' understanding of how images contribute to the interpretive possibilities of texts' (Unsworth, Thomas & Bush 2004:57). In response to this perceived need, considerable work concerning image-language relations in texts for primary age children has been carried out by Unsworth (2006, 2007, 2008b, 2008c) and Unsworth and Ortigas (2008) but not by many other researchers.

### **3.3.1 Literature related to image/language relations**

Gill (2002) analyses texts from the two mono-modal perspectives of verbal text and visual text, on their own, as well as from an inter-modal perspective showing how text

and image inter-relate. She notes that the inter-relation is necessary because the verbal and visual modalities are 'interdependent elements of a single text' (p. 72) which require the reader to look back and forth from text to image. Lewis (2001:8) suggests that the picture book 'acts as a kind of miniature ecosystem' resulting in 'interanimation' of the words and pictures in that they 'come to life in the context' of each other. Gill (2002:84) also identifies a cline according to the degree of inference required to recognize an inter-modal link, from ideational concurrence, which requires low reader inference, through to indirect coherence, which requires high reader inference. Identifying features such as ideational concurrence between image and verbal text in the current research project will be important to see if this type of interaction in texts is easier for a particular group when relating comprehension of image/language interaction to item facility, gender, geo-location and Aboriginality.

Lemke (1996:7) claims there is a need in scientific education 'to understand better the role of topological meaning in verbal semantics and reasoning, in gestural-kinesic and visual semiotics, and in the integration of mathematics with both verbal and visual reasoning' and he believes that semiotic analysis offers some useful tools for doing this. He distinguishes between the typological meanings (categories), made in language and the topological meanings (variations of degree), made through visual perception and spatial gesturing (Lemke 1998a:290). He points out that a diagram and its caption can tell us far more than a drawing or a text alone could do, because typological and topological meanings are complementary in many fundamental ways. Henderson (1999) comes to a similar conclusion from a non-linguistics background. He cites Mayer and Anderson's (1992:444) 'dual coding theory' which assumes that humans have two distinct information processing systems: one each for verbal and

visual information. The dual coding theory suggests that using diagrams as well as written text is more effective than using either alone and that the benefit from using both only comes when learners build 'referential links' between them (Henderson 1999:24). Henderson also suggests that the building of these links can be assisted by the addition of 'instructive' captions (statements with material processes) reinforcing the processes which parts of a diagram are intended to show.

Henderson's claim that 'instructive' captions can assist the viewer to build referential links is relevant to the interpretation of diagrams since they are not often independent of verbal text. Interpretation of visual images usually also requires the interpretation of labels, commentary about processes and captions. Some images may be difficult to understand for students who are unfamiliar with the morpho-syntax (grammar) or lexico-semantics (meaning) in the main verbal text, captions or commentary.

The relationship between text and images with regard to skills assessment in group literacy tests is addressed by Unsworth, Thomas and Bush (2004:47-48) who analyse how the role of images was targeted by some questions in past Basic Skills Tests (BST) papers (NSW Department of Education and Training 2000) and how students could use images to answer other questions that only targeted written text not the images. This study points out the need for a model of image/text relationships in the inter-semiotic construction of meaning. Such a model could identify texts where the written language and images correspond and thus identify that in such texts some or all of the information that is related in print is also represented in images.

Roth, Pozzer-Ardenghi and Han (2005:89) note that written text and photographs are used together to elaborate each other in biology texts and they identify four functions or roles of photographs in a hierarchy of increasing informational value: decorative, illustrative, explanatory and complementary. They claim that the photographs without captions have a purely decorative role, because there is no direct association to the text. The examples given are from secondary biology texts, however, it would not be wise to apply this framework to young children's picture books (fact or fiction) where there are often no captions and the main text directly relates to photos or other illustrations.

Unsworth (2006b) comments that the example given by Roth et al. (2005) for the decorative function, which is an image placed at the beginning of a chapter, 'may be more interpersonally than ideationally oriented, included to engage the reader interactively' (Unsworth 2006b:8). This reference to Halliday's (1994) metafunctions identifies the importance of considering the function or purpose of an image and not just dismissing an image which is not a representation or elaboration of an idea or concept in the text. The purpose might be to make an interpersonal appeal from the producer of an image to the receiver or viewer thus projecting a social relation between them. This could be through demands or offers in the gaze of participants but it could also be in the coding orientation of an image, for example, Aboriginal designs might make a text have more relevance to Indigenous students. Such relevance might increase student engagement with reading, an important factor associated with reading performance. This is particularly important for Indigenous males, who were found to be less engaged with reading than Indigenous females and non-Indigenous males and females in a PISA study (De Bortoli & Cresswell, 2004:21).

Where captions just identify what is represented, Roth et al. (2005:107) considered the images to be filling an illustrative function. In relation to the examples provided for the illustrative, explanatory and complementary functions, Unsworth (2006b:8) raises concerns about the broad categories used in the analyses and the way that ‘the analysis seems to deal with the relationship of the caption text to the main text rather than examining the role of the image to the verbiage of the caption and/or the main text’. Unsworth (2006b) points out that, both exemplification and exposition could involve describing what is in the image, and the image referred to could be useful in understanding the text, but the Roth et al. study regards the illustrative function as being less important since the reader can understand the concept ‘without the information provided by this photograph and caption’ (Roth et al. 2005:94).

The meanings in displays of image and verbal text in a print advertisement are more specifically categorized by Cheong (2004:171) as explicit, implicit, congruent and incongruent (the advertised product is realized through symbolism). In relation to advertisements, Cheong (2004:188) also discusses what he calls the contextualization propensity (the extent to which linguistic items contextualize the visual images), interpretative space (for viewers to invent their own meaning), semantic effervescence (choice of meaning) and ‘the ideology of manipulation’ whereby ‘viewers have played themselves into the hands of advertisers’ (Cheong 2004:191). Cheong’s categories form a useful framework but they are specific to the purposes of advertising. It is therefore necessary to consider the extent to which Cheong’s work has more general application or look at more general models of image/language relations.

Subsequent to the commencement of the research in this thesis, Royce (1998, 1999, 2007a) has used the three metafunctions of functional grammar and visual grammar in his framework for intersemiotic complementarity. He identifies visual message elements (participants, processes, circumstances and attributes) represented in the visual aspects of a text and determines whether similar or differentiated meanings are evident in the verbal aspect of the text. This framework is based on Halliday and Hasan's (1985) approach to the analysis of cohesion in text and 'is used to explicate the ideational cohesive relations between the modes in a multimodal text' (Royce 2007a:70). The possible relations proposed between experiential meanings in different modes are Repetition (identical), Synonymy (similar), Antonymy (opposite), Hyponymy (a general class and its subclasses) and Meronymy (a whole and its constituents) and a general category of Collocation is used for a high probability to co-occur in a field or subject area (Royce 2007a:68). This framework also describes relations in the interpersonal and textual metafunctions. It achieves what was intended, which was 'to explain just what features make multimodal text visually-verbally coherent' (Royce 2007a:63). However, while the categories in Royce's framework describe some cohesive features that exist through terms such as Synonymy and Antonymy, these terms do not capture the range of possible ways that visual and verbal modes can relate or why the features are used. For example, similar meanings might be equivalent or elaborating the other mode, while different meanings might be complementing, adding to or diverging from meaning in the other mode without being opposite. Therefore this framework does not fully address the function or purpose of the image-language interaction, which should be a central aspect of a functional model of image-language interaction. The next section outlines some models of image/language relations that attempt to do this.

### **3.3.2 Models of image/language relations**

It has been argued by Martin (2002) that the ‘same modes of meaning can be deployed for analysing relations across modalities in multimodal texts’ (p. 311). In this quote, when Martin uses the terms ‘modalities in multimodal texts’, he is referring to verbiage and image. The verbiage/image relations identified by Martin (2002:312) are the logico-semantic relations (defined by Halliday in relation to language), elaboration, extension, enhancement and projection, based on the work of Lemke (1998a, 1998b) and O’Halloran (1999). Overarching theoretical models of image-language relations in texts have since been separately developed by Lim (2004), Martinec and Salway (2005) and Unsworth and Chan (2008). The strengths and weaknesses of these models will now be discussed and the most appropriate model for use with student texts will be identified.

Lim’s (2004) Integrative Multi-Semiotic Model (IMM) produces a framework that is generally applicable across a variety of texts. Valuable aspects of IMM are the planes and strata that extend across both language and visual images determining how a text functions. Lim (2004) shows that ideology, genre and register are features of the Context Plane that are the basis of both language and image in a text. Similarly discourse semantics in the Content Plane runs through both language and images, being differentially realized through lexico-grammar and visual grammar, and finally expressed through typography and graphics in the Expressive Plane. Lim (2004) places a ‘space of integration’ between language and visual images in his model that begins to take account of image-text relations, however, what happens in this space is what needs to be further developed.

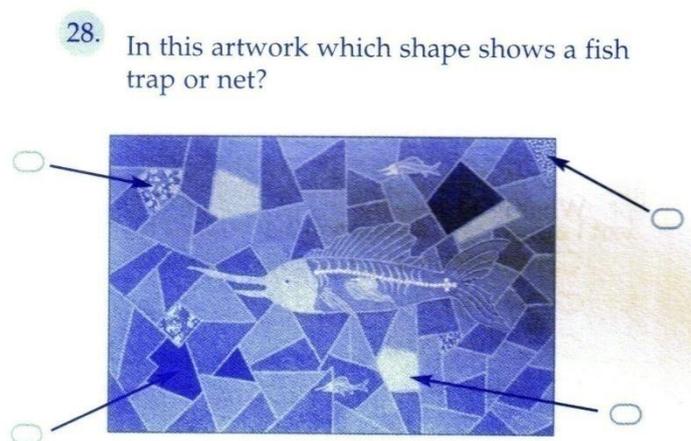
The model of Martinec and Salway (2005:343) is a system that categorizes image-text relations into two subsystems: status and logico-semantic. The system is 'based on combining Halliday's (1985, 1994) logico-semantic and status relations, developed to classify the relationship between clauses in the clause complex, with Barthes' (1977a [1961], 1977b [1964]) text relations' (Martinec & Salway 2005:340).

### **3.3.2.1 Martinec and Salway's subsystem of status relations**

The status relations between image and written text is like the relationships of parataxis and hypotaxis (Halliday 1985:83) between clauses in written text, in that it concerns whether the parts are equal and if so whether they are independent or complementary (when one is modifying the other) or if they are unequal, whether the image is subordinate to the text or vice-versa. However, decisions about what is subordinate are quite clearly delineated by rules in verbal grammar whereas the conditions given by Martinec and Salway (2005) for such classification between written text and image do not seem to be as clear or universally applicable. In their example, they state that a text that is subordinate to an image may only be related to part of it, but a 'reliable indication of text subordination is the presence of implicit devices that need to be decoded by reference to an image' and they give an example with textual references that include 'this' and 'the work' (Martinec & Salway 2005:345). When these conditions for the system of status relations are applied to a text from the 2005 Year 5 BST, they do not seem appropriate to describe the image/language interaction. In this image description from that text, the reference, 'This art', needs to be decoded by reference to the image:

The sailfish is believed to be a cunning fish, able to feed amongst the various fish traps and nets shown by the dark areas, without being caught. This art highlights the use of long lines and nets that are destroying our coastal fish. (NSW Department of Education and Training, 2005b)

However, it is equally true that to answer the question (see Figure 3.3), the image needs to be decoded by reference to these ‘implicit devices’ because the abstract geometric shapes in the background of the image, ‘Escaping the nets’, can only be interpreted as nets or traps by reference to the written text. One would not know that the painting is about long lines and nets destroying coastal fish without reference to the written text. One would therefore expect the whole written text and image to be considered complementary regardless of whether Martinec and Salway’s condition of equal status is determined.



**Figure 3.3** ‘Escaping the Nets’ by Moe Cunningham, © Tobwabba Art Gallery, as represented in the 2005 Year 5 Basic Skills Test answer booklet.

Although the grammatically independent clause in the first sentence of the paragraph about ‘Escaping the Nets’ is able to stand as a statement independent of the image, the dependent clauses in the first sentence obviously refer to the image via the words,

‘shown by the dark areas’. However, Martinec and Salway’s system would only categorise an image as relating to the whole paragraph, ‘if all the processes in independent clauses in a paragraph are related to an image’ and they go on to stipulate that, ‘clauses in the paragraph that only relate to images by cohesion between a participant or circumstance are not considered to be related at this level’ (2005:347). Since there is no reference to the image, other than through the participant, ‘sailfish’, in the main clause of the first sentence, ‘the image is said to relate to a part of the paragraph’ (p. 347) thus excluding a complementary equal status relation. As no explanation is provided as to why processes in dependent clauses are considered in a whole text that consists of one clause complex but are not considered in a whole text the length of a paragraph, the distinction appears to be arbitrary.

Unsworth and Cleirigh (2007:6) point out ‘a number of potential inconsistencies inherent in this system that make it very difficult to use.’ These inconsistencies include an unclear definition of what counts as whole text and some definitions that do not exclude other options in the system. Such inconsistencies cause confusion, however, Unsworth and Cleirigh (2007:7) raise an even more important issue when they question the value of determining whether verbiage and image are of equal or unequal status. They consider Martinec and Salway’s (2005) deployment of Halliday’s system of logico-semantic relations as more promising in furthering ‘our understanding of how verbiage and image collaborate in the creation of a unified, coherent text’ (Unsworth & Cleirigh 2007:7). This sub-system will now be briefly outlined.

### **3.3.2.2 Martinec and Salway’s subsystem of logico-semantic relations**

To describe their logico-semantic relations, Martinec and Salway (2005:349) use the terms, expansion and projection, the two main types of these relations identified in

Halliday's (1994) functional grammar. Kress and van Leeuwen (1996) use the term projection for what has been said or thought, as in comic strips and cartoons, but Martinec and Salway (2005:349) also use the term to account for cases where content in a verbal or visual semiotic resource has been re-represented in the other semiotic resource, for example, 'diagrams that summarize texts', which is a useful way of categorizing image and verbiage interaction in such texts.

Halliday's three main types of expansion within verbal text – elaboration, extension and enhancement – are identified by Martinec and Salway (2005) as types of expansion relating images and verbal text. Exposition and exemplification are identified as two kinds of elaboration such that the image and the text are of the same level of generality in exposition, whereas the levels are different in exemplification (Martinec & Salway 2005:350). Although this description concurs with the frameworks (Martinec & Salway 2005:352, 358), examples are given where, 'The logico-semantic relation between the image as a whole and this text is [exposition: text more general]' (p. 356) and this classification is repeated with regard to logico-semantic relations involving first-level, second level and third-level embedded analytical processes (p. 356-7). There is therefore confusion as to whether the image and text are of the same level of generality (Martinec & Salway 2005:350, 352, 358) in relations of exposition or whether exposition can involve text that is more general than the image (Martinec & Salway 2005:.356-7).

Martinec and Salway (2005:350) state that when either the image or written text adds new related information there is a relationship of extension and when an image and written text are related by enhancement one qualifies the other circumstantially, by

time, place or reason, for example, a picture of a starfish's suction cups is enhanced by the purpose or reason, 'to help the starfish hold onto slippery surfaces'. This example seems to conflate the conditions for the categories of extension and enhancement as the enhancing text is providing new information in the form of an additional process, 'hold onto'. In fact, Martinec and Salway (2005:366) confirm this by stating, 'The enhancement relation of cause and effect is realized by the image depicting a process, while the text refers to a state or vice versa'. It is not clear as to what constitutes new related information for the category of extension, although it would seem from the previous quote that it would mainly be new participants, since new processes as well as circumstances seem to be classified under the separate category of enhancement.

The lack of clarity in defining and determining the categories in Martinec and Salway's system and the many combinations of status and logico-semantic relations make the system confused and unnecessarily complex. For systemic consistency it is imperative to have better clarification of definitions and criteria for each image-text relation. It also seems necessary to concentrate the focus on meaning-making, that is, on logico-semantic relations, if only because the main purpose of texts is to communicate meaning, not to establish status or hierarchies in semiotic resources. Such a focus is more apposite to use in pedagogic applications and has been adopted by Unsworth and Chan (2008) in their emerging model of image-text relations which will now be outlined.

### **3.3.2.3 Unsworth and Chan's tentative model of image-text relations**

Unsworth and Chan (2008) also use Halliday's (1994) terms elaboration and extension to describe relationships of image-language interaction. In elaboration, 'one mode

elaborates on the meaning of the other by further specifying or describing it, while no new ideational element is introduced by the text or image' (Unsworth & Chan 2008:72). In a study of the NSW Basic Skills Test (BST), on which the current thesis is based, they found two subtypes of elaboration, 'equivalence, where there is some redundancy of meaning since the ideational content corresponds across modes; and, exposition, which refers to the re-expression or reformulation of the meaning of the image or the text in the alternative mode' (Unsworth & Chan 2008:72).

In the BST data two sub-types of extension relations were found. These were augmentation and distribution, which Unsworth and Chan (2008:72) describe as follows: 'augmentation may involve an image extending or adding new meanings to the text or the text extending the meanings of the image' and 'distribution, refers to juxtaposed images and text jointly constructing activity sequences'. They point out that Gill (2002) describes two types of distribution: intra-process distribution, where images and text portray different aspects of a shared process, and inter-process distribution, where images fill a gap in meaning when only part of the meaning is conveyed by the text.

Chan (2010) provides a summary of the full framework for describing intermodal relations which demonstrates the inclusion of projection (locution and idea) and enhancement (spatial, temporal, causal) as in Martinec and Salway's system.

However, the confusion in Martinec and Salway's system is avoided because, instead of being grouped under extension, they are grouped alongside extension within a new major category. This new category is called complementarity, a term which 'has been used to describe inter-modal relations where the meanings in image and text are

different but complementary'. In this developing model of image-language relations extension has been more clearly defined and is shown to take on three different forms: augmentation, distribution and divergence. Chan specifies that, 'the new ideational element in augmentation is realized by participants or circumstances represented in the complementary semiotic mode' (Chan 2010:154). Intra-process and inter-process distribution are again defined according to Gill (2002) and divergence 'was used to describe the third type of extending relation, where the ideational content of the text is opposed or at variance to that of the image, or vice versa' or 'where the meanings in the text and image contradicted each other' (Chan 2010:156).

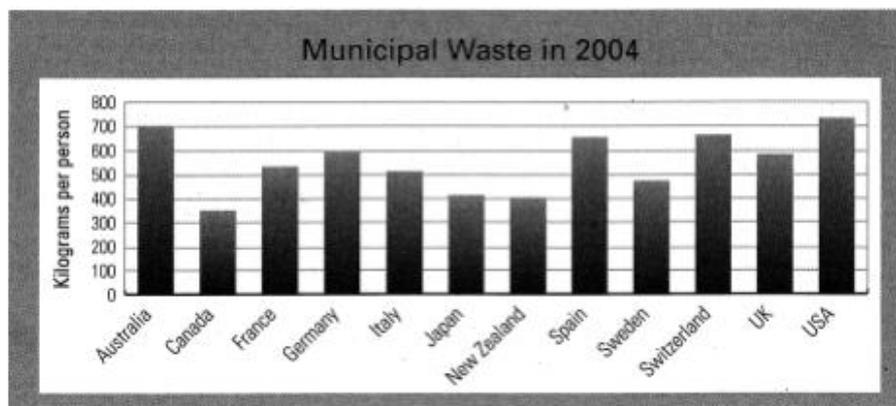
Chan's framework also shows that relations of complementarity are balanced by those of concurrence and she defines the relationship as follows:

Ideational concurrence (Gill 2002; Unsworth 2006) may be described as a correspondence of ideational meaning across semiotic modes... where one mode elaborates on the meanings of the other by further specifying or describing while no new ideational element is introduced by the text or image. (Chan 2010:149-150)

This relationship parallels Martinec and Salway's (2005) 'elaboration' and two of its subtypes are the same: exposition, where image and text reinforce each other by restating or reformulating meaning in some way; and exemplification, where image exemplifies text or text exemplifies image. However, although text and image still represent different levels of generality in exemplification (Martinec & Salway 2005), Chan specifies that, 'this is realized by a class-member relationship, where specified members are not an exhaustive set but rather, represent examples from that class set' (Chan 2010:152). The data in Chan's study showed that often, where image and text had a different level of generality, this was not necessarily in an exemplifying

relationship and conversely there were instances of exposition where image provided more specificity than verbal text or vice versa. For example, in the extract from the text ‘Ten Years of Recycling – The Good, the Bad and the Ugly’ (see Figure 3.4) the text segment refers to two specific parts of the graph (Australia and the USA) but it presents the same specific detail. It is not providing more specific examples of a generalized image. The graph and text are in a relation of exposition with the graph providing elaboration of the same municipal waste issue. Chan (2010:165 footnote 1) contrasts this with Martinec and Salway’s (2005:50) coupling of exposition and exemplification by defining them according to whether the levels of generality between image and text were the same or different.

In 2004, Australia produced 690 kilograms of municipal waste per person. This was more than in any other country in this study, except the USA.



**Figure 3.4** From ‘Ten Years of Recycling – The Good, the Bad and the Ugly’.  
Copyright the NSW Department of Education and Training

An important difference to the Martinec and Salway (2005) system of logico-semantic relations is the addition of relations of equivalence and homospatiality to the elaborating relations of concurrence. Equivalence between image and text is a very common feature often seen in keys or legends on maps or labels on parts of diagrams ‘where ideational content corresponds across modes in the participant-process-

circumstance configuration of an image and its accompanying text (following Gill 2002), resulting in some degree of redundancy in meaning' (Chan 2010:150).

Homospaciality is where different semiotic modes co-occur in one spatially bonded homogenous entity (Lim 2004) as when the shape of a word or words represents an image that matches the meaning of the word/s. Although Unsworth and Chan's (2008) model of image-text relations is tentative and untried, it has been used to analyse the texts used in this research because its specifications are based on systemic functional theory which applies to both images and text and seems to avoid some of the apparent inconsistencies in other published accounts of image/language relations.

### **3.4 Social, cultural, linguistic differences**

Social semiotic theory posits that visual communication (written language and images) is always coded and, although there is a certain amount of commonality of social semiotic perspectives across different cultures, symbolic ideas can only be fully understood by members of the culture that created the visual communication (or people who are very familiar with the mores of the creating culture).

Functional grammar (Halliday 1994) and visual grammar (Kress & van Leeuwen 1996) describe how verbal and visual texts function to meet their purpose of communication between individuals within social and cultural contexts. They therefore provide socio-cultural perspectives on language and images that acknowledge how meaning in texts is influenced by the cultural values of both text creators and viewers.

Bernstein (1974) used an early form of Halliday's grammar in an analysis of written texts by eleven year olds. He later used Halliday's network theory and theory of language functions to analyse of the speech of seven-year-old children when they were explaining how to play 'hide and seek' to investigate his theory that the major source of change in linguistic codes is located in the division of labour resulting in restricted linguistic codes being used by the working-class and elaborated linguistic codes being used by the middle-class. The analysis of grammar enabled him to 'show the *different* linguistic realizations of different contexts *and* decide whether each context had evoked either a restricted or an elaborated variant' (Bernstein 1974:248). He found 'a tendency for the middle-class children to refer much less to a local setting. Their explanations are relatively context *independent*, whereas the low-working-class children's explanations are rather more context *dependent*' (Bernstein 1974:255). The differences in grammar and lexis were also found in the speech of the mothers and a relationship was established between the speech of mothers and their children. As the differences were not explicitly taught, Bernstein suggested they were produced by ground rules implicit in the meanings, speech and social relationships realized in the process and contexts of socialization (Bernstein 1974:255).

Bernstein also drew an analogy between the experimental setting and the test situation in schools, noting that they 'are both relatively context independent' (Bernstein 1974:255) and therefore 'more favourable to middle-class children than working-class children' (Bernstein 1974:256). This analogy is relevant to the current research which involves reading test materials and interviews with students that are out of context. There could also be a connection between students' spoken language and reading test results in view of Vygotsky's (1962/1933) theories about the role of language in social

contexts for developing human cognition and how that might relate to inferential comprehension of reading materials.

Rose (2000) seems to extend Bernstein's two groups (the working class with restricted codes and the middle-class with elaborated codes) when he identifies three different levels of language comprehension skills in secondary students' scientific discourse. The first group acquire little more than the 'doing' component and are destined for manual occupations. The second group acquire the technical literacy skills associated with the causal/conditional sequences of explanations and are able to train for 'vocational' level position. The third group who can identify with the abstractions of scientific fields' (Rose 2000:71) are able to enter professional design and managerial positions. This clear distinction between different types of elaborated codes within the middle class could reflect changes in contemporary society with increasing technology in work that used to be performed manually.

The influence of social class and gender on child-control strategies was revealed in a study by Hasan and Cloran (1990) who found that commands in middle-class families tend to be more implicit, with a higher proportion of accompanying explanations than in working-class families. The literature concerning socio-cultural differences with regard to reading achievement is reviewed in the next chapter.

## **Chapter 4 – Socio-cultural differences in reading achievement**

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### **4.1 How socio-cultural differences affect literacy development**

#### **4.1.1 Seminal research from the United States of America**

#### **4.1.2 Social class differences in language practices in Australia**

#### **4.1.3 Possible causes of different literacy levels between social groups**

##### **4.1.3.1 Poverty**

##### **4.1.3.2 Language skills**

##### **4.1.3.3 Educational achievement of parents and literacy practices**

### **4.2 Indigenous literacy**

#### **4.2.1 Indigenous population statistics**

#### **4.2.2 Literacy achievement of Indigenous students**

#### **4.2.3 Economic considerations**

#### **4.2.4 Home language practices**

#### **4.2.5 Discourse patterns**

#### **4.2.6 Dialectal differences**

##### **4.2.6.1 Spoken and written language**

#### **4.2.7 Indigenous learning styles and cultural practices**

##### **4.2.7.1 Learning strategies**

##### **4.2.7.2 Visual literacies**

#### **4.2.8 Educational differences for Indigenous students in different locations**

### **4.3 Educational differences related to geographic location**

#### **4.3.1 Geographic location classifications**

#### **4.3.2 Population statistics for education by geographic location**

#### **4.3.3 Geographic differences in literacy achievement**

## **Chapter 4 – Socio-cultural differences in reading achievement**

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Before commencing a discussion of socio-cultural differences, it must be acknowledged that children struggle to understand texts for a variety of reasons including weak decoding and fluency skills, inadequate vocabulary and background knowledge and ineffective strategies for monitoring understanding. It is rare to have just one area of concern and as students struggle, motivation and engagement can suffer. Dalton and Proctor (2007:422) contend that, ‘The two most prevalent reasons for these challenges are (a) lack of access to good instruction and (b) learner differences that often interfere with learning from good instruction’. It is the possibility of differences in learners’ reading strategies and comprehension of multi-semiotic relations within texts that this study will be investigating as well as how these factors might be related and whether there might be implications for alternative instruction to cater for differences.

Cranny-Francis (2005:157) acknowledges a move in text analysis over the last two decades to focus ‘on what readers, viewers or users actually “do” with the text – what kinds of meanings they make in relation to texts’ and contrasts this with ‘the tendency of previous forms of text analysis to be prescriptive in relation to what a text “said” and how it “said” it’. Reading is a transaction between text and reader, a ‘dynamic process’ and an ‘organically-interrelated situation’ (Rosenblatt 1985:100) in which readers make different interpretations based on their individual experiences. Research into the differences between social groups of students in this study will involve considering ‘how the cultural or political specificity of their reading practice might disadvantage or disempower a reader from a different cultural or political positioning who might not make the same reading of a text’ (Cranny-Francis 2005:157).

Alloway and Gilbert (2003:175) call on teachers to ‘notice those whom we disenfranchise and disaffect’ and to alter their teaching in order to take into account cultural difference. Cultural diversity was considered in 1994, when Kalantzis and Cope initiated a meeting with nine of the world’s leaders in the field of literacy pedagogy in New London, New Hampshire, USA to consider what to do in literacy pedagogy to meet the challenges of what they called ‘Multiliteracies’. The two main issues that they discussed were the growing tendency to make meaning in multimodal texts through the influence of new communications technologies, and the growing significance of cultural and linguistic diversity. Multi-semiotic texts, which involve both linguistic and visual literacy, are part of the new multiliteracies challenge. The New London Group (1996:60) believes that multiliteracies pedagogy can negotiate ‘the multiple linguistic and cultural differences in our society’ and will enable students to achieve literacy and fulfilling employment. It is important to remember that, ‘images (and in fact any kind of semiotic coding used within a cultural sphere) are “culturally bound” in the sense that what makes sense in one culture may not in another, or it may be differently framed’ (Royce 2007b:366). These issues are central to the investigations in this study.

The study of image-language relations is relatively new and there is limited research into how students in different social groupings negotiate multi-semiotic texts (Mills 2006; Martin 2008). However, there is considerably more research about how children comprehend written texts in relation to socio-cultural differences (Brice Heath 1994; Williams 1998), Indigenous background (Yunupingu 1990; Malin 1994; Nakata 2000, 2003; McRae et. al. 2002; Phillips & Healy 2004; Rose 2006; Acevedo & Rose 2007;

Gray 2007; Martin 2008), gender (Alloway & Gilbert 2002; Gilbert 2003; Henderson 2008) and rural and remote school locations (Pegg & Panizzon 2007; Alloway et al. 2004; Arnold 2001). The research about comprehension of written text is important to the current investigation because the way that students comprehend verbal text is an important part of their comprehension of the interaction between images and language.

The next section outlines aspects of global research about socio-cultural differences in literacy achievement and then reviews specific research concerning socio-cultural differences in relation to the literacy of Indigenous students and students in provincial and remote schools in Australia.

#### **4.1 How socio-cultural differences affect literacy development**

Some ways that socio-cultural differences have been found to affect literacy development will be outlined in the next three sections. The first two sections outline research about different literacy practices in different communities and how these practices do or do not relate to teaching practices in schools. In 4.1.1 seminal work in relation to socio-cultural differences in literacy development carried out by Brice Heath (1994) in three different communities in the U.S. is discussed first and then research by Williams (1994) in relation to social class differences in Australia is considered in 4.1.2. The possible influences of poverty, language skills and the educational achievement of parents and their literacy practices are considered in relation to literacy development in 4.1.3. Influences on Indigenous literacy and literacy in different geographic locations are discussed in sections 4.2 and 4.3 of this chapter.

#### **4.1.1 Seminal research from the United States of America**

Brice Heath (1983) found that what adults believe about literacy and how it is learned affects how children learn and display knowledge, which in turn impacts on their literacy learning at school. For example, in a mainstream, middle class community, that Brice Heath (1994) calls Maintown, she found that mothers use ‘a “scaffolding” dialogue’ (p. 75) with their children and ‘adults jump at openings their children give them for pursuing talk about books and reading’ (p. 77). As a result ‘these children learn to use oral and written language in literacy events and to bring their knowledge to bear in school-acceptable ways’ (p. 80) thus becoming successful learners.

By contrast, in a poor white working class community that Brice Heath (1994) calls Roadville, it was found that, ‘Children are not encouraged to move their understanding of books into other situational contexts or to apply it in their general knowledge of the world about them’ (Brice Heath 1994:82). Instead,

Book reading time focuses on letters of the alphabet, numbers, names of basic items pictured in books, and simplified retellings of stories in words of the adult. If the content of the story plot seems too complicated for the child, the adult tells the story in short, simple sentences, frequently laced with requests that the child give what-explanations. (Brice Heath 1994:81)

These children did not compare, transfer or evaluate items or events and, although they did well in the early stages of school, they began to have less success about the time they entered the fourth grade when texts become more challenging and students are required to learn from reading and not just decode texts.

The adults in Roadville viewed children's language learning very differently to the adults in Trackton, a poor black community in the same region. Whereas the Roadville adults teach children 'how to talk' (Brice Heath 1994:80), children in Trackton learn through contextualised experiences, imitating sounds around them, and 'parents do not believe they have a tutoring role in this learning' (p. 87) which is probably why they do not simplify their language. Although Trackton children, unlike Roadville children, are good at linking events and orally making reason-explanations and affective statements, 'Trackton children generally score in the lowest percentile range on the Metropolitan Reading Readiness tests' (p. 90). As 'there are no reading materials especially for children (with the exception of children's Sunday School materials), and adults do not sit and read to children' (p.85), it is not surprising that many Trackton children lacked basic decoding skills.

The Brice Heath (1994) study showed how different literacy practices in the home affected the understandings students brought to school and how this could affect their progress where there was a mismatch with school literacy practices. However, a study of London primary schools (Mortimer et al. 1988) found that student background (social class, race, sex) was not a good predictor of the growth that students made over the four years of the research. In relation to growth in student reading, the London schools were four times more influential than student social background characteristics. Similarly, studies in Victorian schools (Hill 1995:13) found from that, 'The empirical evidence suggests that variation due to differences in student background and ability is considerably less important than variation associated with school and class membership', the latter being a reference to school class not social

class. These studies show that it is important NOT to adopt a deficit perspective or to assume schools cannot bring about change.

#### **4.1.2 Social class differences in language practices in Australia**

Williams (1998:41) also found ‘significant variation in a range of language practices associated with participants’ social class locations’ in Sydney. These social class locations were related to parents’ education levels and the degree of autonomy in their work positions. Like Brice Heath, Williams found similarities between the reading practices of middle-class families and the reading practices used by teachers in classrooms, which suggests that children of educated parents from a middle-class background are more likely to understand classroom literacy practices than children of less educated parents from a working class background. Brice Heath and Williams do not identify deficits or blame parents as it would be unreasonable to expect parents with low levels of education to have the same literacy practices as highly educated parents. These researchers identify differences which middle class professional teachers need to consider in order to adjust their teaching practices to meet the varied needs of students who have experienced different types of language practices before entering school.

#### **4.1.3 Possible causes of differences in literacy levels between social groups**

There has been much debate about whether the cause of lower literacy levels for students from low socio-economic backgrounds is poverty itself, different language skills, cultural differences or lower education levels of parents. Williams was careful to categorise the social classes in his study according to education levels and degree of autonomy in the work place so that income was not a crucial factor. By contrast, in A

*Framework for Understanding Poverty*, Payne (2005) uses the term, economic class which is a conflation of two constructs.

#### **4.1.3.1 Poverty**

While Payne's critics accuse her of deficit thinking (Bomer, Dworin, May & Semingson 2008) and of attributing the cause of literacy failure to being poor, she claims her purpose was to 'use the lens of economic class' to understand and teach students in the classroom and to build capability and knowledge bases (Payne 2009:1).

Payne (2005) puts the onus on teachers to understand the socio-cultural circumstances of children living in poverty, so that their needs can be met and appropriate lessons provided. However, by developing a framework specifically for people in poverty, Payne (2005) over-generalises and there is always a possibility that the framework could lead to a deficit mindset, against all poor children, in those who are not willing to change their teaching. In fact, there are many factors that are related to low literacy levels, so Bomer et al. (2008, 2009) also overgeneralise when they argue that, 'the problem to be addressed is poverty – economic inequality – not its children'. As it is not within the power of teachers to eradicate poverty, it seems unreasonable to use this argument to attack a framework (Payne 2005) that aims to assist teachers to ameliorate some of the consequences of poverty. Many of the arguments against Payne have been about terminology and this debate shows the importance of using specific definitions and of not assuming that generalisations are without exceptions or that they imply causal relations.

Payne's (2005) use of the terms 'economic' and 'poverty' to describe class situations in the US has led critics to claim that she is demonising the poor. In response to these critics, Payne (2009) cites an Australian study which followed 8,556 children for 14 years, where 'the researchers found they could predict with reasonable accuracy the verbal reasoning scores of 14-year-olds based on the maternal grandfather's occupation' (Najman, Aird, Bor, O'Callaghan, Williams & Shuttlewood 2004) and her position here seems close to that of Williams (1994, 1998). She goes on to say, 'This stunning statistic points to intergenerational transfer of knowledge' (Payne 2009:1) and, while Payne's term 'knowledge' might be too broad and it could be more accurate to specify a transfer of 'language skills', the important point here is that the dependent variable in this study was occupation not income. Even though occupation is often dependent on education level, it does not always lead to a higher income.

#### **4.1.3.2 Language skills**

Hart and Risley (1995) found that a 3-year-old in a professional household has a larger vocabulary than an adult in a welfare household and by age four, children in professional households had heard 45 million words compared with 13 million words in welfare households. Although Hart and Risley's (1995) findings about poor families were based on 'only six cases, all African-American, all in Kansas City, all on welfare' (Bomer, Dworin, May & Semingson 2009:2), which is a genuine criticism, the contention of Bomer et al. (2009), that parents do not use their entire vocabularies when talking to their children, seems to miss the point that parent-child interchange is what counts in literacy development (Williams 1994; Heath 1982). A collaborative, conversational approach (like the parent-child interchange) is the best form of instruction for comprehension (Scull 2010).

The benefit of conversational approaches are likely in view of Beron and Farkas' (2004:125) finding that 'the child's skill at auditory processing is a key mediating variable for the effect of class and race effects [sic] on reading achievement.' Beron and Farkas used data which was collected to provide U.S. national norms for tests of cognitive performance that included 'measures of *auditory processing*, which directly tap the child's ability to extract meaning from standard English speech' (Beron & Farkas 2004:112) and they considered this ability was likely to be influenced by the oral language that the child takes from family and community. Other research studies also suggest that there is a link between linguistic competence at school and prior to school in relation to: class (Goodman 1990), differences between teacher language and home language (Evans 1994), and more specifically differences in vocabulary on entry to kindergarten are related to cumulative vocabulary deficits in less advanced children as they progress (Biemiller 2003).

Hill and Launder (2010:243) developed a 'tailored oral language intervention program designed to develop oral language structures and vocabulary in rich play contexts.' However, no sequential relation was detected when only vocabulary and reading were assessed. The researchers noted that written text syntax is embedded with more adjectival and adverbial sentence clauses than spoken language and they suggested 'future research may benefit from analysis of the relationship between children's use of complex oral language structure and early reading' (Hill & Launder 2010:251).

A study by Hay, Elias, Homel, Freiberg, Ernst and Jensen (2003) found that 44% of the children, in a disadvantaged multicultural community with a substantial

Indigenous population, had language development delays and 38% had a delay in receptive vocabulary. Syntax was also found to be relevant and the researchers suggested that ‘teachers should concentrate on strategies that enhance children’s vocabulary development and facilitate their use of more advanced and complex syntax’ (Hay et al. 2003:44). Recent research concerning children in pre-school and the first years of school supports the notion of oral language competencies underpinning children’s transition into literacy (Hay & Fielding-Barnsley 2009:158).

Painter (1996:79-80) suggests that there is a dynamic and ‘symbiotic relation between learning through language and developing language itself.’ The New London Group take this idea further by identifying linguistic differences as one of the fundamental issues for equity in literacy learning when they contend that,

...the most important skill students need to learn is to negotiate regional, ethnic, or class based dialects; variations in register that occur according to social context; hybrid cross-cultural discourses; the code switching often to be found within a text among different languages, dialects or registers; different visual and iconic meaning... (Cope & Kalantzis 2000:14)

This quote suggests that learning needs to occur at the level of language and also with regard to the meanings created by other semiotic resources such as visual images, codes and gestures. It also implies that unfamiliarity with different cultural meanings should not be seen as a deficit but rather a skill yet to be negotiated and learnt.

#### **4.1.3.3 Educational achievement of parents and literacy practices**

There is ample evidence in the US and Australia that lower economic status is related to lower educational achievement, however, there is also evidence that there is a range of achievement within economic groups with some students living in poverty achieving high results (Erebus International 2005). The relevance of the educational

attainment of parents is established in research by the RAND Corporation in 65 Los Angeles neighbourhoods which found that ‘the two factors associated most strongly with school readiness are the educational attainment of mothers and neighbourhood poverty’ (Lara-Cinisomo, Pebley, Vaiana, Maggio, Berends & Lucas 2005:9). The research found the positive effect of the educational attainment of mothers could cut across the negative effect of neighbourhood poverty. The positive effect of educational attainment is probably because educated mothers use home literacy practices that are similar to school literacy practices (Brice Heath 1994; Williams 1994), however, Rose (2006a) suggests the literacy practices cause a transfer of even more specific skills.

Rose (2006a), an Australian researcher who has introduced his *Reading to Learn* program in many countries, contends that a major factor in the variation in children’s literacy levels is ‘the cultural background of literacy, that is, whether or not learners have acquired pattern recognition skills in the context of reading in the home and school’ (Rose 2006a:12). He goes on to claim that, ‘in progressivist/ constructivist pedagogies that currently dominate teacher education in developed nations...explicit teaching of language patterns is devalued’ and ‘learners from oral cultural backgrounds can be severely disadvantaged, including Indigenous students and many others who have not been prepared by reading in the home’ (Rose 2006a:12).

Rose uses the term ‘hidden curriculum’ (also used by Bernstein 1996) to refer to the consequences of this pedagogy which are ‘practices that construct, maintain and evaluate inequalities between learners’ (Rose 2006b:32). By making visible possible reasons for these inequalities, Payne (2005) was trying to address them but Rose (2006a:22) suggests an alternative pedagogy that is associated with Vygotsky’s

(1962/1933) social psychology and uses a social semiotic instructional discourse. This pedagogy overcomes disadvantage by targeting Vygotsky's 'zone of proximal development' in the belief that 'learning takes place when teachers support students to do learning tasks that are beyond their independent assessed abilities' (Acevedo & Rose 2007). The pedagogy is concerned with a focus on the explicit transmission of skills by the teacher and 'with achieving equality in the classroom and society by redesigning its regulative discourse' (Rose 2006a:22).

The regulative discourse is reproduced unconsciously by teachers who use initiation, response, feedback (IRF) style of interaction with students. Rose claims that, 'The pervasive instructional discourse of schooling described as "IRF" or "triadic dialogue" is embedded in a regulative discourse that emerges from and functions to reproduce stratified order, relations and identities' (Rose 2004:100). The least successful students, who most need positive interaction and feedback, rarely respond to teachers' questions, because they do not have the same preparatory socialising experiences to enable them to produce successful answers and early errors followed by negative feedback teach them that the situation will be less threatening if they avoid responding.

A different type of regulative discourse proposes that socio-cultural differences can be built upon in classrooms that encourage students to generate knowledge through participation in authentic practices (Gee 2008:92). In this community of practice, participation is scaffolded but students are treated as active generators of knowledge not just as passive recipients of information (Gee 2008:93). Gee (2008:92) also contends that 'members of the community of practice are affiliated with each other

primarily through a common endeavour and shared practices and only secondarily through ties rooted in shared culture, race, class, gender, or ability'. Within this authentic practice, Gee (2008) argues that the meanings of words and signs must be situated in familiar experiences; models of language in specific situations must be provided; mastery of academic language is required and 'interactive, inter-subjective dialogue with more advanced peers and masters appears to be crucial' (Gee 2008:99) for children to learn how words and grammar express particular perspectives on experience. However, a key concern for equitable opportunities to learn is 'that different forms of talk and social interaction lead to different affordances and constraints for different learners' (Gee 2008:94). Such differences in language and social interaction will be further outlined in relation to Indigenous students in the next section of this chapter.

## **4.2 Indigenous literacy**

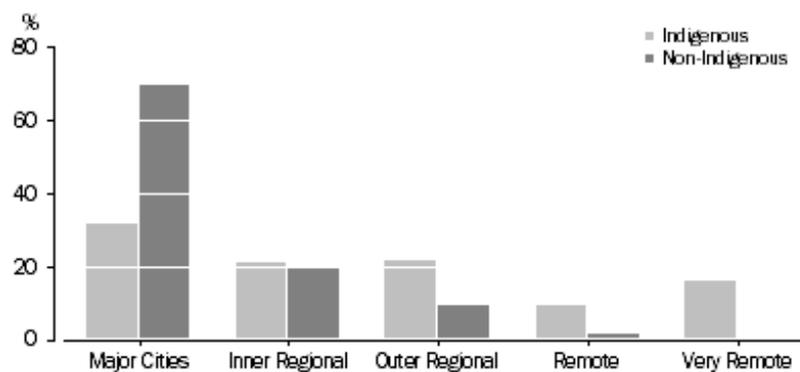
This section provides an overview of research into differences between Indigenous and non-Indigenous populations that have been purported to contribute to differences in literacy development, with a focus on reading comprehension. Australian population statistics for Indigenous people will be outlined first to set the scene and then research relating to home language practices, discourse patterns, dialects, spoken and written language, cultural practices, learning styles and learning strategies will be reviewed.

### **4.2.1 Indigenous population statistics**

Indigenous people are a small minority group in Australia. In 2006, the Aboriginal and Torres Strait Islander population was 455,000, or 2.3% of the total Australian

population (Australian Bureau of Statistics, 2009). Of these, 89.6% were Aboriginal, 6.5% were Torres Strait Islander and 3.9% were both Aboriginal and Torres Strait Islander. Indigenous Australians were more likely to live in remote areas of the country than non-Indigenous Australians according to the 2006 Census counts shown in the graph at Figure 4.1.

**Estimated Resident Population by Remoteness Areas, 30 June 2006**



**Figure 4.1** 2006 Census counts (ABS, 2009)

In 2006, two states, New South Wales (29%) and Queensland (28%), contained over half the Indigenous population and yet much of the research on Indigenous learning and education has been carried out in the Northern Territory, Western Australia and South Australia (Kaldor, Eagleson & Malcolm 1982; Harris, 1984, 1990; Eggington 1990; Rose 1999; Rose, Gray & Cowey 1999; Gray 1990, 1992, 2007). This research is valuable for people in those areas, particularly the Northern Territory where the percentage of people who are Indigenous is 27.8%, which is very high compared to only 2.1% in New South Wales and 3.3% in Queensland, however, there is a paucity of research about the literacy of primary age Indigenous children in New South Wales, the state with the largest number of Indigenous people.

Another population statistic from the 2001 census that is relevant to education is that the Indigenous population is much younger than the non-Indigenous population, for example, nearly 60% of the Indigenous population in Australia are aged under 25 compared with around 34% of the non-Indigenous population (Calma 2005:28) and this is partly a reflection of lower life expectancy and partly of younger parents. There were more one-parent families with dependent children in Indigenous households than in other households and ‘the high proportion of children in the Indigenous population results in smaller proportions of the various types of adult relationships in Indigenous households when compared with other households’ (Australian Bureau of Statistics 2010).

Despite, or perhaps because of, being a younger population only 38% of Indigenous students continued to Year 12 compared with 76% of non-Indigenous students (Calma 2005:30). The reason a younger population could be a causal factor in lower educational achievement is that very young parents often have lower educational achievements because the parents may leave school early to care for and support the children. The lower rates of completion of Year 12 might also be related to income statistics in 2001 showing that the average weekly income for Indigenous people (\$364) was only 62% of that for non-Indigenous people (\$585) and the 2001 unemployment rate was 20% for Indigenous adults compared with 7.2% for non-Indigenous adults (Calma 2005:30). When parents have low incomes and cannot afford tertiary studies, their children might not perceive any value in or possibility of completing Year 12.

The importance of socio-economic aspects of disadvantage to educational outcomes is emphasised by McConaghy (1998) who contends that,

...the central failure of the National Aboriginal and Torres Strait Islander Education Policy and its review is in focusing on the inclusionary aspects of educational policy, it addresses issues of access, without also addressing the contradictory processes of continuing disadvantage that a focus on access so often leaves intact. (McConaghy 1998:352)

Many of these processes of continuing disadvantage, such as economic factors, cannot be addressed from within educational systems but other aspects of disadvantage, such as cultural differences or differences in education levels of parents, might be addressed through provision of specific interventions within schools and their local communities. It is therefore relevant for this study to investigate differences in student strategies and comprehension but only within the awareness of a wider context that cannot be investigated within the confines of this research.

#### **4.2.2 Literacy achievement of Indigenous students**

De Bortoli and Cresswell (2004) examined the performance of Australian Indigenous 15 year old students in an international comparative study, the OECD/ Programme for International Student Assessment (PISA 2000) and found that the mean reading score for Indigenous students was more than one proficiency level lower than the mean for non-Indigenous students (De Bortoli & Cresswell 2004:36). Although home education resources such as the number of books in the home were at a lower level for Indigenous students and they reported spending less time on homework, Indigenous students reported a higher level of family support in helping them with their school work (De Bortoli & Cresswell 2004:36). Another interesting finding that should guide teaching strategies is that Indigenous students reported a preference for a cooperative,

less competitive approach than did their non-Indigenous counterparts. All of these findings, which are similar to those of Heath (1983) in relation to the African-American community in Trackton as outlined in section 4.1.1, reflect socio-cultural differences that schools should be taking into account when planning teaching programs and strategies that will address the learning needs of Indigenous students.

A recent summary of Indigenous students' reading results (ACER 2009) looked at the three cycles of the OECD PISA conducted in 2000, 2003 and 2006 and found that 15 year old Indigenous students performed on average more than 80 score points lower than non-Indigenous students and more than 50 score points lower than the OECD average which represents a gap of around two years between Indigenous and non-Indigenous students (ACER 2009). More than one third of Indigenous students were not able to achieve Level 2 which is the proficiency level in reading considered to be the minimum level necessary to meet the challenges faced in life beyond school (ACER 2009). Despite these differences, and the finding that the average performance of Australian students as a whole had decreased across the three PISA cycles, 'the performance of Indigenous students has not changed significantly in the past nine years' (De Bortoli & Thomson 2009:22).

#### **4.2.3 Economic considerations**

De Bortoli and Cresswell (2004:36) point out in their report on PISA 2000 that the mean socio-economic status (SES) of Indigenous students was lower than that for non-Indigenous students and the range of SES in the Indigenous community was smaller than the range in the non-Indigenous community. Therefore Indigenous students with higher SES are likely to still have much lower SES than non-Indigenous students. In

their study of PISA from 2000 to 2006, the Australian Council for Educational Research found that the distribution of Indigenous students by socio-economic background was ‘substantially skewed, with 44% of Indigenous students classified in the lowest socio-economic group, compared to 25% of students overall in Australia’ (ACER, 2009).

Australian PISA studies showed that lower socio-economic status (based on parents’ education levels) was related to the lower reading literacy levels of remote children (Cresswell & Underwood 2004) and Indigenous children (De Bortoli & Cresswell 2004). Data from three cycles of PISA from 2000 to 2006 showed that,

Fewer parents of Indigenous students compared to non-Indigenous students had attended post-secondary education and many parents of Indigenous students had not completed secondary school. This in itself creates a barrier to further education – without an understanding of the educational system it is difficult for parents to provide adequate levels of support for students to continue their education. (De Bortoli & Thomson 2010:90)

When De Bortoli and Cresswell (2004:17) graphed the reading literacy score against socio-economic status, the scores for the general Australian population were much higher than the scores for the Indigenous population for students who have the same socio-economic index value. Therefore, poverty alone, although a major contributor because a much greater proportion of Aboriginal people have lower levels of socio-economic status, cannot be blamed for the lower reading scores of Indigenous students. In addition, De Bortoli and Cresswell (2004) identified that lower achievement for Indigenous students was related to lower educational attainment of parents, lower educational aspirations, lower engagement with reading, lower

perceptions of self-efficacy, less time spent on homework and fewer books in the home. Students were also less likely to have a dictionary, a desk for study or a computer at home. These are all factors of educational disadvantage that teachers should be aware of and while teachers can attempt to compensate for these factors, it is difficult for them to redress the situation.

In addition, National Benchmark data (MCEETYA 2006, 2007) for students in Years 3, 5 and 7 show lower mean literacy and numeracy achievement for Indigenous students, so it is most likely that there would be less range in educational achievement as well as less range in socio-economic status for the Indigenous students and this could cause lower correlations between these factors than was evident for the non-Indigenous students. It could also have been the case that other relevant factors, such as higher educational attainment of mothers, might not have been associated with higher income, since educated Aboriginal people often choose jobs without high remuneration in order to work with their communities.

#### **4.2.4 Home language practices**

For children whose parents had lower levels of education and less autonomy in their jobs, Williams (1994) found discrepancies between language practices in the home and school literacy practices. Although Williams' (1994) research was not carried out with Aboriginal people, his findings are probably relevant to Indigenous students because census data reveals that Indigenous children are more than twice as likely to have parents who left school early (Scougall 2008).

While Williams (1998) looked at behaviours that were the result of beliefs about literacy development, Torr (2008) directly compared such beliefs held by Indigenous and Anglo-Australian mothers from different educational backgrounds and found that beliefs were related to education level rather than cultural difference.

The tertiary educated mothers, whether Indigenous or Anglo-Australian, held views that were mostly compatible with an emergent literacy perspective. The early school-leaving mothers focused more on the role of memory and repetition of specific skills in learning to read. (Torr 2008:65)

These findings about tertiary educated mothers are similar to those found by Brice Heath (1994) in the community she called Maintown, where many parents were middle class teachers, and the findings about early school-leaving mothers are similar to Brice Heath's findings in the community she called Roadville, where there were many white working class families. However, the findings are not typical of the poor black community called Trackton.

#### **4.2.5 Discourse patterns**

While it is unclear in the quote above whether Torr (2008) is referring to short term or long term memory, Eggington (1990) points out the importance of discourse patterns in written texts on long term memory and he comments on the results of his research as follows:

It would appear that optimum memory recall occurs when the writer and reader share the same discourse framework. When there is a disagreement between these two frameworks short-term memory is not affected, but long-term memory shows a significant decline. (Eggington 1990:155)

Differences between discourse frameworks might be one of the causes of the fourth grade decline noted by Brice Heath (1994) in relation to Roadville children, since textual discourses usually become more academic at this point in schooling. Eggington (1990) provides examples of Aboriginal language discourse patterns to show that they are not as linear as English rhetorical patterns and he considers it likely that this difference would make it difficult for Aboriginal children to gather information through the reading of textbooks. The examples of Aboriginal language discourse patterns in Eggington's research came from the Northern Territory, so it will be interesting to consider this theory in relation to how students in NSW gather information from texts when answering questions in reading assessment tasks.

Gee (1990) argues that 'genres of power' which mark social groups as separate involve 'linguistic triviality' such as phonology and surface grammar which are learnt in 'socially situated practices' (Gee, 1990:149) not in the classroom and these features are difficult to acquire outside of the early years in the home. The categorisation of 'phonology' and 'surface grammar' as 'linguistic trivialities' is appropriate to the differences between Standard Australian English and Aboriginal English or working class English, because these features are social markers that do not often preclude understanding between the dialects.

#### **4.2.6 Dialectal differences**

Most of the linguistic differences in New South Wales between Indigenous and non-Indigenous Australians are dialectal differences between Aboriginal English (AE) and Standard Australian English (SAE). These differences occur in all aspects of language: in the phonology or sounds; in morpho-syntax or grammar; in lexico-semantics or

words and their meaning; and in pragmatics or the way that language is used in socio-cultural contexts (Eades 1993:3). Even differences in phonology can disadvantage Aboriginal students in activities intended to teach reading skills, for example, many speakers of Aboriginal English do not usually sound the letter 'h' because traditional Aboriginal languages have no 'h' sound (Simpson, Munns & Clancy 1999:4).

Differences that are usually more problematic are semantic and pragmatic differences which 'can cause serious misunderstandings, of which teachers are often unaware' (Eades 1993:4). An example of misunderstanding from the Baiyai Research Project concerns semantics. Students had been told not to lift face-down dominoes in a maths game but an Aboriginal boy picked one up to look at the numbers. The teacher thought he was being disobedient, not realising he had understood the word 'lift' to mean 'steal' in his Aboriginal English dialect and therefore had thought it was reasonable to 'pick up' the domino (Simpson, Munns & Clancy 199:5). It seems probable that such differences could also cause confusion in reading lessons, as Connolly (2004:154) contends that 'even skilled, experienced and "good" teachers fail in the first place to recognise or acknowledge that Aboriginal English is the means of communication for their Indigenous students'. In classrooms, where Standard Australian English is used by most teachers, this can result in students misunderstanding instructions and teachers misinterpreting student responses to English tasks.

Semantic differences in home language may be why recent research by Leigh and Gong (2008) has shown that Aboriginal children start kindergarten one year behind their non-Aboriginal peers. One of their tests of cognitive skills, the Peabody Picture Vocabulary Test (PPVT), includes a measure of listening comprehension using words

spoken in standard English and a screening test for verbal ability (Leigh & Gong 2008:13). It seems likely that even parents with high education levels who are capable of code-switching between dialects would use Aboriginal English in the home with young children. The researchers do not mention any consultation with Australian Indigenous people to see if the test was racially biased but instead seem to have relied on US findings about racial bias in testing (Jencks 1998).

The other test they used is the 'Who Am I?' test (WAI), an Australian-designed school-readiness test that assesses a child's ability to perform ten tasks, covering, copying, writing and drawing (ACER 1999). The results of the WAI could be (and might be intended to be) related to different literacy practices in the home, especially since more Indigenous families are in poverty and would probably have fewer books, pencils, paper and games. In fact, the study found that, 'Controlling for socio-economic factors such as income and parental education reduces the Indigenous/non-Indigenous gap by between one-third and two-thirds' (Leigh & Gong 2008:2). It would be interesting to carry out a picture vocabulary test using Aboriginal English to see if this removes the remainder of the Indigenous/non-Indigenous gap.

Some children experience dialogue that prepares them for how most teachers operate in classrooms, but other children experience dialogue at home that is different from the school discourse. Sometimes it is the pragmatics of this dialogue, such as ways of questioning or explaining, that does not align as well with the pedagogic literacy practices in most classrooms, and this has been found among Australian Aboriginal students (Rose, Gray & Cowey 1999; Munns et al. 1999). Pragmatic differences can prevent students from engaging with literacy activities, for example, a student who

withdrew because she was unwilling to be the centre of attention at news time even though she had important news she would have liked to share one to one (Simpson, Munns & Clancy 1999:5). Other differences in pragmatics include the role of silence during interaction, the degree of directness, how questions are asked and answered, how respect is shown and the place of 'shame' (Haig, Konigsberg & Collard 200:8) all of which can impact on how a student engages in literacy activities. Connolly (2004:153) explains that avoiding shame could often be interpreted as classroom misbehaviour and for many students being in trouble was invariably felt to be better than not being able to handle the work.

The National Review of Education for Aboriginal and Torres Strait Islander Peoples (Commonwealth of Australia 1995) includes recommendations for assistance to Indigenous ESL (English as a second language) and ESD (English as a second dialect) speakers to 'at least the same levels of literacy and English as a second language support and assistance provided to non-Indigenous students whose first language is not English' (Commonwealth of Australia 1995: Recommendation 25).

There is a danger that this approach could lead to a view that speaking Aboriginal English within the school is hindering progress in learning standard Australian English. However, another perspective would be to see the problem as being 'the school failing to recognise Aboriginal English as a legitimate English dialect or even dismissing it as 'incorrect' English, which can then threaten the identity of Aboriginal English-speaking students, decreasing their motivation to attend school' (Sharifian 2008:132).

#### **4.2.6.1 Spoken and written language**

While Nakata (2003:11) points out the importance of teachers being aware of cultural differences to enable them to adjust their teaching to the individual differences of their students, he also warns that attributing particular difficulties to problems of cultural difference can inhibit the response of teachers. He contends that, ‘it is one thing to say children prefer visual and aural modes of learning but it is another matter to use this as a rationale for neglecting the written word when we know this is exactly what they need’ (Nakata 2003:10).

Many researchers have noted that Western style of literacy (Australian education) is ‘formal’ (Harris 1984), ‘essayist’ and ‘decontextualised’ (Scollon & Scollon 1981) and involves ‘many kinds of “secret” English which are not made explicit in schools’ (Martin 1990). The reference to ‘secret’ English came from an elderly Aboriginal leader who was asked by a Northern Territory Department of Education official about the type of education the particular community wanted and he answered, ‘Teach them that secret language; the language you write; the language you put in books at school.’

Eggington (1990) comments that he is not sure that the written discourse genres ‘are actually “secret” in the oral language sense, but it is the case that they are restricted and, when mastered, lead to greater opportunity in the dominant culture’ (Eggington 1990:157). One of the features of such discourse genres is a high level of grammatical metaphor, such as nominalisation, that occurs in lexically dense text. This ideational metaphor ‘produces a high level of abstraction in text, making it inaccessible to large sections of the community’ (Martin 1992).

The possible reason why Standard Australian English seems 'secret' to many Aboriginal English speakers could be because, 'While second language learners in a TESL program are well aware of the fact that their mother tongue is different from the language of the school, second dialect learners in a TSESD program may not have such awareness' (Kaldor, Eagleson & Malcolm 1982:197). Aboriginal English speakers also have to memorise fine distinctions between elements of their dialect which are shared by Standard Australian English and others which are not shared. Kaldor, Eagleson and Malcolm (1982:213) consider that for the child, 'it would be an obvious advantage to be able to read material which is written in his dialect at least initially so that dialect differences do not distract the child from the central task of developing reading skills'.

It seems logical that it would be easier to master reading if the words and language structures on the page are similar to those matching the thinking of the learner. In fact, attempts are made to match the level of books to emergent readers' language levels in Standard Australian English and yet the current view in NSW seems to be that to present texts in another dialect, such as Aboriginal English for Aboriginal emergent readers, is lowering the standard. This is a recent change because in the past the *Big Mob Books for little fullas* (NSW Board of Studies 1997), most of which use Aboriginal English, were produced for use in NSW government primary schools. The intention to provide equally challenging texts to Aboriginal and Torres Strait Islander students is laudable and once students can decode texts teachers should definitely be providing explicit instruction about the less familiar language of more challenging complex texts because, 'If children do not start early on the acquisition of academic

forms of language, they are swamped by the later grades and high school and beyond' (Gee 2008:100). However, Gee also points out that,

The specialized forms of language and interaction that the child finds at school can resonate with and bridge to the child's vernacular cultural ways and thereby enhance learning. Alternately [sic], they can lack such resonance or fail to create such bridges, thereby raising the child's affective filter and ensuring that school-based input is not actually intake (Gee 2008:101).

Specific research is needed to investigate whether dialectal or cultural mismatches in emergent reading materials are reasons why some Aboriginal students are having more difficulty learning to read than non-Aboriginal students, leading to an ever enlarging gap between their reading achievements as they progress.

Even at later stages of schooling there is an issue of whether the translation of Aboriginal literacies into standard English forms is disadvantaging students. Karen Martin (2008:70) claims that, 'English approximations tend to diminish Aboriginal meanings' thus stopping Aboriginal students from using their own terms of reference and interfering with natural and automatic processes. She contends that,

Engaging, conceptualising, and analysing sufficiently to provide spoken text and write using Aboriginal terms is an essential process before thinking, viewing, conceptualising, speaking, and writing in English. (Martin 2008:70)

It is important to provide contexts where students can make 'their own deliberations on the two ways of thinking and conceptualising' (Martin 2008:70). Using Aboriginal English or Aboriginal languages to 'think aloud' about texts written in standard Australian English could be an effective way for students to unpack meanings and use their own terms of reference. A 'think aloud' strategy might thus help to explicitly build upon student's diglossic competence as suggested by Walton (1996:105).

Aboriginal English is the home language that most Aboriginal children bring to school and in 1998 the Aboriginal Programs Unit of the NSW Department of Education and Training advised that, 'Teachers need to build on the home language of Aboriginal students to develop literacy and language skills' (Stubbs 1998:25) and stated that, 'it is recognised that the system under which Aboriginal students are labouring, robs them of confidence and self-esteem by imposing a different set of language patterns and values from the outset' (Stubbs 1998:26). In early literacy contexts it has been recommended that teachers scribe for children writing exactly what they say. This acceptance of the children's oral expression 'allows the children to see the relationship between what they are saying and what is written, and it is this connection that helps them to understand print' (Haig, Konigsberg & Collard 2005:5).

There have been positive findings from the Bidialectal Research Project carried out by the Aboriginal Education and Training Directorate of the NSW Department of Education and Training from 2003 to 2004. Although the final report from this project has not become available for citation, Thorne (2005) orally reported improvements in learning conditions, teaching practice and the performance of Aboriginal students as a result of the project. Improvements in student performance included significant improvement in English Language and Literacy Assessment (ELLA) results with a reduction in the gap between Indigenous and non-Indigenous achievement from Year 7 to Year 8. The project was also carried out with primary students but it had not been possible to track performance on the BST which is conducted at two year intervals (Year 3 to Year 5). Students also showed better understanding, were more engaged in learning, initiated and led discussions and remained on task for longer. Two of

Thorne's (2005) recommendations were to explicitly teach about differences between spoken and written language and for teachers to be supported to know more about Aboriginal English and standard Australian English.

One of the key features of the Bidialectal Research Project was the classroom participation of Aboriginal Research Assistants who helped students to understand teacher instructions. The Aboriginal Research Assistants also helped teachers to understand students' Aboriginal English and Aboriginal cultural ways including the different pragmatics in language and social interactions. A similar effect was achieved by employing Aboriginal people as in-class tutors at Narrandera Public School which improved the students' literacy and also resulted in 'a significant Aboriginal presence, language and culture in the classroom in explicit and validated ways' (Letts 2008:378).

Research on the use of Aboriginal English in rural and urban schools in NSW has been limited (Munns, Simpson, Connelly & Townsend 1999; Simpson, Munns & Clancy 1999; Daly 2000, 2004). This limited research has built on research with adults by Malcolm and Kosciielecki (1997) who identified the features of Aboriginal English used by older members of the Aboriginal community at La Perouse, Sydney, and Eades (1993, 1995) who identified common differences between Standard Australian English and Aboriginal English dialects and their implications for communication in the classroom.

A draft position paper by the AECG states that, 'for many Aboriginal students the learning of standard Australian English is like learning a second language' (Stubbs

1998:28). However, Malcolm and Kosciellecki (1997) contend that what is required in schools is a model of two-way bi-dialectal education in which Aboriginal English must be seen as differing from Standard English in terms of ‘underlying cultural imagery’ rather than just linguistic form. This suggests that there might be cultural differences in how students comprehend images as well as language. It is also contended that bi-dialectal education ‘cannot be based on the principle of domain separation, since most Aboriginal students do not live in completely predictable Aboriginal and non-Aboriginal domains’ (Malcolm & Kosciellecki 1997:85).

#### **4.2.7 Indigenous learning styles and cultural practices**

Although there has been limited research into Aboriginal learning styles, when working with Milingimbi Yolngu in northeast Arnhem Land, Harris (1984/1987:7) noted that children learnt ‘by observation, by doing, by imitation, by personal trial and error, by real-life performance’ and Christie (1985:44) similarly contended that everything an Aboriginal child needs to know ‘can be learnt through the day-to-day processes of socialisation’. However, these would seem to be cultural learning practices and not necessarily preferred styles of learning (Gibson 1993). In 1985 there had been limited research on the education of rural and urban Aboriginal populations (Eckermann 1973, 1987; Clark 1978) but Christie (1985:46) asserted that, ‘While most of the data presented are from research with remote Aboriginal groups, they are still relevant to urban and rural populations’.

Halse and Robinson (1999:205) warn against such generalisations saying, ‘The main difficulty with generalisations that draw relationships between learning style and culture is that they fail to acknowledge the diversity within and between different

Indigenous groups'. However, they also recognise the cultural conflict between some students and the typical learning experiences in schools and state that, 'when socialised in ways that are inconsistent with school expectations and patterns, the child needs to make a difficult daily adjustment to the culture of the school and his or her teachers' (Halse & Robinson 1999:203). When there is little encouragement for Aboriginal students to employ their own cultural perception and experience in the classroom the effect is that 'valuable, culturally defined learning experiences for interpreting new ones in another cultural domain are not employed' (Phillips & Healy 2004:95).

On the other hand, research was indicating that one of the learning styles identified by Harris (1984, 1987), learning by personal trial and error, was not proving effective in the classroom where 'Aboriginal learners were reluctant to take risks and this was closely related to the Aboriginal concept of shame' (Munns, Lawson & Mootz 2000:5). It would appear that what was relevant in a community context where 'Aboriginal child rearing practices emphasise independence and autonomy through indirect control and compliance regulation' (Martin 2008:71) might not be culturally relevant or appropriate in a classroom with 'goals that emphasise competition, individual achievement and obedience for achieving these goals' (Martin 2008:71). This shows the need to be cautious about taking observations from one cultural context and assuming that they will apply in another cultural context. It has since been recognised that within classrooms it is important to encourage Aboriginal students to take risks (Walton 1987; Munns, Lawson & Mootz 2000).

Martin (2008) recommends the Learning by Design (Kalantzis & Cope 2005) multiliteracies approach to teaching because it encourages students to take risks and solve problems (Martin 2008). Some of the other Aboriginal learning styles identified by Harris (1984, 1987), that are supported by a multiliteracies approach (Martin 2008), include valuing the group more than the individual; a person-orientated rather than information-orientated approach; context-specific learning; holistic learning and learning relying on visual and spatial skills. It is apparent that learning styles, which can be general approaches, such as global or analytic, auditory or visual, have an influence on learning strategies, which are one of the aspects being investigated in this study. The research in relation to learning strategies will now be examined.

#### **4.2.7.1 Learning strategies**

When comments are sometimes made about some Aboriginal people being visual and oral learners this may be a consequence of cultural experience, for example, more time spent listening to oral stories and less time reading books. However, reading fewer books may well be due to parents' poverty or lower literacy skills or due to a majority of books being culturally irrelevant or inappropriate. It has also been noted that Aboriginal students with hearing impairments have 'very high levels of visual awareness or "vigilance"' (McRae et al. 2002:53). Since greater proportions of Aboriginal students suffer from Otitis Media or other hearing problems than non-Aboriginal students, there may be a high proportion of Aboriginal students who have heightened visual awareness. This would be a logical way to compensate for their hearing loss and consequent difficulty in understanding verbal and phonetic cues. It seems possible that hearing loss could lead a student to rely more heavily on visual cues because of the difficulty in making sense of the world aurally.

However when teachers bypass the difficulties of printed texts by innovating and adapting, 'preferring to capitalise on visual and aural modes which students find easier and are seen to prefer' (Nakata 2000:114) they may be using this as a rationale for neglecting the written word when this is exactly what they need (Nakata 2003:10). Indeed, avoiding printed texts by using the argument that Indigenous students prefer visual modes could be a form of 'silent apartheid' as it is a form of 'intellectual segregation' or racism whereby teachers have lower expectations of Aboriginal and Torres Strait Islanders' and lower the standard of their work (Rose 2007:4-8).

However, if visual modes, such as film and video, are used in tandem with printed texts, to provide contexts for learning or to engage students in learning then they can become valuable multimodal additions to the teaching repertoire. As most paper and computer screen based images are presented in interaction with written language, there is often a need to understand the verbal text to fully comprehend the images.

Some useful learning strategies that are based on Aboriginal learning styles are the eight ways of learning for Aboriginal students (Yunkaporta 2009) which have come from the Western NSW region of the Department of Education and Training. These strategies, which have been developed in consultation with Aboriginal elders in the region, are focused on **how** Aboriginal students learn rather than **what** they learn and can be applied in any learning context with any content. The eight ways focus on story sharing, non-verbal and non-linear learning, land and community links, deconstructing then reconstructing knowledge, learning maps and symbols and images. The symbols and images way of learning addresses the concept of Aboriginal students being

primarily visual-spatial learners (Hughes & More, 1997), ‘but it goes beyond the problematic notion of ‘learning styles’, reframing visual learning as symbolic learning – a strategy rather than an orientation’ (Yunkaporta 2009). The symbols and images pedagogy which focuses at ‘the micro level of content’ is different from the pedagogy of learning maps which focuses on ‘the macro level of processes’ (Yunkaporta 2009).

The non-linear way of learning is also highly relevant to this study because making the connections between written text and images in multimodal texts requires a more associative, less linear, way of reading. The internet in particular requires a more associative way of reading. As it is important for all students to learn to make the necessary connections between written language and images in multimodal texts, this study will investigate the associations made by students. The next section considers the relevance of visual and multimodal literacies to Indigenous students.

#### **4.2.7.2 Visual literacies**

Walton (1996:107) proposes that, ‘When discussions of literacies are broadened to include visual literacies, then Indigenous visual literacies may find their rightful place.’ One of her examples of Indigenous visual literacy is a Pintupi painting from central Australia prepared for a curriculum conference in Canberra in 1989, together with a reading of its significance provided by Keffe (1992). It consists of five panels telling the history of education from before white people came to the future when Yanangu teachers will be working with white teachers (Walton 1996:109). What is particularly interesting in this example is the image-language interaction:

The irony of the Pintupi painting and its translation/reading by Keffe, is that the painting on its own remains a closed text to most non-Indigenous and many Indigenous people. Many of us are ‘illiterate’ in this form of Indigenous visual

literacy. Together with Keefe's commentary and translation it can be 'read' by non-Pintupi, so in this sense it may be best to consider it to be a mixed-media text consisting of both the painting and the written explanations. (Walton 1996:110)

With the current recognition of the need to include more learning about Aboriginal culture in NSW schools, the ability to negotiate image-language relations will be an important aspect of that learning for all students. If this context provides additional engagement in learning tasks for Aboriginal and Torres Strait Islander students then it is particularly important that they are fully supported to learn the skills necessary to engage and not become frustrated by complexities in the texts. Walton (1996:110) concludes that the 'discussion of Indigenous literacies and literatures broadens the construct of literacies to be inclusive of English/ "english", vernacular and visual literacies; and in doing so it undermines the centre's construction of literacy as reading and writing "proper" English in schools.'

Freebody (2007) infers the depth of understanding needed to fully comprehend how Indigenous literacies combine with visual literacy in an Aboriginal artefact, Robert Barton's painting, *My Mother's Country*, which tells the story of the Emu and the Kangaroo. Referring to a selection of iconography explaining some of the textual parts of the painting, namely icons representing kangaroo, dingo, emu and women at a campsite, Freebody (2007) explains that,

...the piece needs to be decoded according to 'non-natural' means; that is by using cultural rather than simply 'natural' visual resources. What that implies is that coming to understand this artefact as a text is coming to acknowledge its significance as language, text and culture, and recognise the need to develop the capabilities to decode and use its narrative and emotional structures as frames for connecting personal and communal activities, histories and identities. (Freebody 2007:3)

Similarly, Karen Martin (2008:65) points out the complexities in an image of North Stradbroke Island which represents the Country of the Noonuccal and Koenpul people and the elements of land, waterways, animals, skies, climate, and plants and is quite different from the representation of North Stradbroke Island in maps. While maps use lines to indicate roads and portray other information about locations for a particular purpose and audience, Martin's image of North Stradbroke 'articulates a personal Ancestral relatedness to Country' (Martin 2008:65) in which each line holds a story of her relatedness to Country and its elements. The image 'serves as a strong and clear reminder that we rarely view things in the same ways' and it 'demonstrates how the visual and spatial are powerful literacies in their own right' (Martin 2008:67). There could also be differences in how temporal concepts are viewed by Aboriginal people in remote locations and this cultural aspect will be addressed in the next section.

#### **4.2.8 Educational differences for Indigenous students in different locations**

Regional differences in educational achievement might be partly due to cultural differences, for example, remote Aboriginal people's concept of time is cyclic (focuses on events) rather than linear (Harris 1990:27) and this could result in Aboriginal students in remote schools experiencing more difficulty in sequencing events in texts. The gap in literacy achievement in Years 3, 5, 7 and 9 is reflected in the proportion of Indigenous people who had completed Year 12 in 2001. This was exacerbated in remote areas where only 8% of Indigenous people completed Year 12 compared with 35% of non-Indigenous people, whereas in major cities 25% of Indigenous people completed Year 12 in 2001 compared with 46% of non-Indigenous people. The relevance of geographic location to educational achievement will be considered in the next section.

### **4.3 Educational differences related to geographic location**

This section of the chapter will commence with an account of how the geographic locations of remote, provincial and metropolitan are classified in this research. Some relevant population statistics are then provided and finally a review of the limited research comparing literacy achievement in different geographic locations of Australia will be presented.

#### **4.3.1 Geographic location classifications**

In an attempt to establish a standard classification, the Ministerial Committee on Employment, Education and Youth Affairs (MCEETYA) agreed in July 2001 to adopt the MCEETYA Schools Geographic Location Classification (MSGLC) developed by Jones (2002) for reporting nationally comparable schooling outcomes. The eight major sub-category criteria of the MSGLC model consider population as well as accessibility /remoteness as follows:

1. Metropolitan Zone
  - 1.1 State Capital City regions State capitals (except Hobart, Darwin)
  - 1.2 Major urban Statistical Districts Pop.  $\geq 100\ 000$
2. Provincial Zone
  - 2.1.1 Provincial City Statistical Districts Pop. 50 000 – 99 999
  - 2.1.2 Provincial City Statistical Districts Pop. 25 000 – 49 999
  - 2.2.1 Inner provincial areas CD ARIA Plus score  $\leq 2.4$
  - 2.2.2 Outer provincial areas CD ARIA Plus score  $> 2.4$  and  $\leq 5.92$
3. Remote Zone
  - 3.1 Remote areas CD ARIA Plus score  $> 5.92$  and  $\leq 10.53$
  - 3.2 Very Remote areas CD ARIA Plus score  $> 10.53$

The first four categories are based on population, while the accessibility/remoteness of smaller locations (pop. < 25 000) is determined with reference to the Accessibility/Remoteness Index of Australia (ARIA) developed by the Australian Bureau of Statistics. Locations are given an accessibility/remoteness value between 0 and 15.3 based on the physical road distance to the nearest town or service centre. The higher the value is, the more remote and inaccessible the location.

The Australian Curriculum and Reporting Authority (ACARA) has added the number of Aboriginal students to the ARIA and SES measures to develop their Index of Community Socio-Educational Advantage (ICSEA) which is used to identify similar schools on the national My School website.

#### **4.3.2 Population statistics for education by geographic location**

In view of the relationship between parents' education levels and children's literacy achievement (Erebus 2005), the statistics for education levels of people over 24 are relevant to this research. In 2006 in major Australian cities 57% of the population aged 25 to 64 had qualifications beyond school. The relatively low proportion of the Australian population in this age group with beyond school qualifications in remote areas (43%) and very remote areas (36%) is in part related to the higher proportion of Aboriginal and Torres Strait Islander people living in these areas and their lower levels of educational attainment (Australian Bureau of Statistics 2008:2) but also due to distance from tertiary education facilities which can mean higher costs in attendance or reduced range of options in more local tertiary facilities. However, the lower rates of the population with qualifications beyond school level outside of major cities could also be related to 'post-secondary education being perceived as less relevant to life and

career opportunities by some people living in rural and remote areas' (Australian Bureau of Statistics 2008:2) and a portion of the gap between the higher education participation rates of urban and rural/isolated people can be attributed to lower school retention rates in country regions (James et al. 1999:7).

In 2006, only 7% of 15-19 year olds were no longer attending high school and had not completed Year 10, however, this proportion was considerably higher within remote (14%) and very remote (36%) areas (Australian Bureau of Statistics 2008:4).

#### **4.3.3 Geographic differences in literacy achievement**

The relatively low percentage of 15-19 year olds participating in education in rural and remote areas is probably partly related to lower literacy achievements that start in primary schooling. The National Benchmarks for reading for Years 3, 5 and 7 in 2003, 2004 and 2005 showed a widening gap between metropolitan, provincial, remote and very remote students by both age and geographic location. The percentage of Year 5 students achieving the reading benchmark compared with Year 3 students across geographic locations shows that,

...there is a general decrease in the proportion of students achieving the benchmarks over the four locations when compared to the younger cohort. This trend is exemplified again in relation to Year 7 students.  
(Pegg & Panizzon 2007:186)

The 2007 National Benchmark results showed that this trend continued (MCEETYA 2007: 6, 20 & 32).

Although figures from the inaugural 2008 National Assessment Program for Literacy and Numeracy (NAPLAN) also show a gap in reading achievement for students in

very remote schools, they are slightly different from the benchmarks data from previous years. It must be noted that the 2008 NAPLAN reading test is reported on a different scale to the earlier state tests and it represented a narrower view of literacy, because there were very few questions about how images interact with written text.

When figures are compared for 2008 and 2007 across different states, there are startling contrasts between results for each year which would suggest that the method up to 2007 of determining the National Benchmark standard for reading, by setting a cut-off point on the achievement scale for each state test, might not have been an accurate method for comparing states. The percentages of all Year 3 students who were at or above national minimum reading standard in the most populous states, NSW and Victoria, were higher in 2008 than in 2007 while the percentages for other states were generally lower than they had been in previous years.

Although the 2007 and 2008 tests are on a different scale, it is of great concern that, on a national test in 2008, the gap between Year 3 reading achievement in very remote areas and other areas is nearly twice as large as previously indicated across Australia, and more than three times greater in Queensland (see Table 4.1). Even though the average gap for Year 3 students in NSW is slightly less in 2008 than it was in 2007, NSW educators should not be complacent as very remote students in NSW have the largest range (+ or - 9.9) in scores of all the states (only the Northern Territory has a larger range of 10.7). It is also concerning that the gap for Year 5 students is greater than the gap for Year 3 students.

	Aus 07	Aus 08	WA 07	WA 08	Qld 07	Qld 08	NSW 07	NSW 08
Metro	94.2	93.6	96.0	91.9	94.2	88.9	94.1	95.6
Provincial	92.6	91.0	94.9	87.6	93.0	85.7	91.6	93.6
Remote	88.8	79.6	91.6	80.0	90.8	76.3	87.7	86.7
V Remote	71.7	51.1	79.9	62.1	85.7	58.7	80.2	83.2
<b>Gap for Metro to Very Remote</b>	<b>22.5</b>	<b>42.5</b>	<b>16.1</b>	<b>29.8</b>	<b>8.5</b>	<b>30.2</b>	<b>13.9</b>	<b>12.4</b>

**Table 4.1** Comparison % of Y3 = or > national minimum standard, 2007\* & 2008\*

\*figures taken from MCEETYA, 2007 National Report on Schooling in Australia: Preliminary Paper and MCEECDYA (2009)

[http://www.mceecdya.edu.au/verve/\\_resources/NAPLAN2008-Reading.pdf](http://www.mceecdya.edu.au/verve/_resources/NAPLAN2008-Reading.pdf)

	Aus 07	Aus 08	WA 07	WA 08	Qld 07	Qld 08	NSW 07	NSW 08
Metro	90.3	92.4	95.0	91.4	82.3	88.5	92.6	93.9
Provincial	87.7	90.0	93.5	88.0	78.8	85.8	90.3	92.6
Remote	79.8	79.7	90.0	82.0	68.6	74.8	80.2	81.3
V Remote	56.2	46.1	71.6	56.5	57.2	57.6	83.6	76.7
Gap for Metro to Very Remote	34.1	46.3	23.4	34.9	25.1	30.9	9.0	17.2

**Table 4.2** Comparison % of Y5 = or > national minimum standard, 2007\* & 2008\*

Educational disadvantage in rural areas is usually believed to result from socio-economic factors many of which are related to isolation, such as the range and level of employment and the educational levels and income of families (James, Wyn, Baldwin, Hepworth, McInnis & Stephanou 1999:8). Many rural schools also have a high proportion of young, inexperienced teachers and high teacher turnover including executive staff (Green & Novak 2008). James et al. (1999:9) suggest that, since socio-economic status is usually allocated by postcode which conflates location and social

class, 'it is important to tease apart, as far as possible, the "distance effect" of rurality and the "encouragement/discouragement effect" of socio-economic status.' Their study about entry to higher education found that rural disadvantage is in the main part related to family and community attributes, principally how much education is promoted and valued and it was claimed there is a cumulative effect (James et al. 1999:10).

The lack of books in homes which was noted as a factor for Aboriginal students was also a factor for students in remote and outer regional areas (Cresswell & Underwood 2004) and these findings are relevant to this research as 'many encounters with picture books are necessary for children to fully experience their possibilities' (Torr 2008b:64). It is extremely difficult for teachers in a class of up to 30 students to compensate for years of lost one-to-one time discussing picture books prior to school. If children miss out on this experience they will start school lacking familiarity with how images and words relate to each other and they will be trying to catch up with their peers who have already gained this and other understandings about books. Another aspect of book reading with pre-school children is the oral interaction. It has been argued that,

...caregivers in low socio-economic status communities need [to] be encouraged to use with their children the types of oral language interaction that should help prepare their children for the instructional demands of the classroom. (Hay & Fielding-Barnsley 2007:193)

This quote is relevant to rural parents as well as Aboriginal parents since, 'the average household income in approximately 80% of Australian rural municipalities is estimated at being at least 10% below the national average' (Pegg & Panizzon 2007:178) and low income is often associated with low education levels. Parents

might themselves have low literacy skills and might not engage in the kind of oral discourse valued in schools. However, schools can take a role in building community capacity and meeting the individual needs of students and their families, for example, an initiative that has been successful in primary schools is the NSW Schools as Community Centres (SaCC) program (NSW Department of Education and Training 2010c).

Hattie (2003:2-4) found that teachers account for about 30% of the variance in student performance and he points out that the effect size of teacher feedback is greater than student prior cognitive ability or parent involvement. He contends that when feedback is combined with effective instruction in classrooms, it can be very powerful in enhancing learning but he points out that, 'With inefficient learners, it is better for a teacher to provide elaborations through instruction than to provide feedback on poorly understood concepts' (Hattie 2007:104). The importance of elaborated explicit instruction and feedback was evident in successful rural primary schools with high Aboriginal populations and low socio-economic status during the Rural Outcomes of Schooling Research Project (NSW Department of Education and Training 2010).

Since teachers account for about 30% of the variance in student performance (Hattie 2003) the high teacher turnover in remote schools and some rural schools is a problem. Boylan (1993) contends that rural development can happen through education when teachers are encouraged to remain in rural communities for extended periods of time. More specific issues are targeted by Scott (1993) who notes that rural education communities are not identical and rural communities within 50 kilometres of each other can have totally different attitudes to educational problems. However, he

contends that in remote rural Australia there are two main issues that need to be tackled. The first issue is ‘a community and parental attitude problem’ (Scott 1993:5) resulting in girls being denied equality of opportunity and the second is a responsibility for developing Aboriginal students’ self-respect and self-esteem and ‘recognising that their Aboriginal identity is something of which they should be proud’ (Scott 1993:7).

Eleven years later the need to address the second issue was still apparent in the 2004 Report of the Review of Aboriginal Education which found that some schools did affirm Aboriginal identity while in others ‘Aboriginality is more often ridiculed, denied, discounted or deemed suspect’ (NSW AECG & NSW DET 2004:195). The report made seven recommendations about fortifying identities of Aboriginal students.

Chris Sarra (2003:9) demonstrated in a rural Aboriginal Queensland community, Cherbourg, how the number of Year 2 students not up to expected standards (85.2% in 1999) could be halved (42.9% in 2001) by adopting a range of strategies which ‘really challenge, at a much deeper level, any negative perceptions that children may have harboured about who they were as Aboriginal children’ (Sarra 2003:7). Chris Sarra is now the director of the Indigenous Education Leadership Institute and his ‘Strong and Smart’ philosophy aims for Indigenous children to be able to contribute and mix in modern society, but Sarra contends this should not be at the expense of their cultural identity and says, ‘We’ve got to explicitly reinforce, nurture, and in some cases, retrieve, that cultural identity’ (quoted in Morgensen 2009:10).

It is clear that the mean differences in reading performance between different socio-cultural groups are not disputed, however, it is less clear as to the factors which contribute to these differences. This research will specifically investigate any relationship between reading strategies and reading scores and whether there are any differences between socio-cultural groups of students in the ways they comprehend the separate modalities of images and written language or in the language they use when speaking about the multimodal texts.

## **Chapter 5 Research design and methodology**

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## Chapter 5 – Research design and methodology

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Educators are increasingly acknowledging that reading comprehension necessarily entails the integrative construction of meaning from images and language in the majority of contemporary texts, and therefore measures of students' reading comprehension achievement will also necessarily entail the negotiation of such inter-semiotic meanings. In most large scale group reading comprehension tests, certain groups, such as Indigenous students and those in provincial/rural and remote areas, have lower mean scores relative to the total student population completing the tests (Thomson & De Bortoli 2007; Pegg & Panizzon 2007; Cresswell & Underwood 2004; De Bortoli & Cresswell 2004). This study seeks to investigate the extent to which the construction of inter-semiotic meaning may constitute a dimension of reading comprehension in which Aboriginal, provincial and remote area students experience particular difficulty compared with the negotiation of such meanings by the overall student cohort in their age level. Accordingly, the main research question to be addressed is:

*How do Aboriginal and non-Aboriginal students in different geo-locations comprehend and talk about a variety of image-language relations in reading tests?*

The four sub-questions to be investigated are stated in the first chapter. The first two sub-questions relate to analysis of the reading assessment items and stimulus materials. The last two questions, which are about students' reading strategies, inferential comprehension and spoken language, relate to data from interviews about the texts, comparing a sample of male and female Aboriginal and non-Aboriginal students in metropolitan, provincial and remote primary schools.

The first section of this chapter focuses on the research design and methods. The second section outlines the rationale for the selection of research methods and materials and then focuses on the methods used to investigate the performance of students according to gender, geo-location and Aboriginal status. The third section outlines the selection of sites and participants and the fourth section outlines the procedures for analysis of test material data and student performance data. The final section of this chapter outlines the procedures for analysis of interview data.

### **5.1 Research design – a mixed method approach**

As this investigation is about how different groups of students read multimodal texts, the research design involves an analysis of the complexities in multimodal reading materials prior to the analysis of students' reading strategies and comprehension of the texts. The complexities analysed in the multimodal texts are the types of relations between images and language, the linguistic complexity and the visual complexity in each text. To gather data about students' inferential comprehension, they were interviewed and asked about the meaning of images and language in multimodal texts. Students next answered questions that targeted understanding of image-language relations and then to obtain data about reading strategies the students were asked how they decided on their answers. The research design included follow-up interviews with each cohort of students across two tests: Year 3 to Year 5 and Year 5 to Year 7. However, second interviews with only the younger cohort are included in this investigation as it is only concerned with primary students not Year 7 students in high school. The data obtained has been analysed in several different ways.

The investigation of the various goals and types of data in this study entails both quantitative and qualitative research methodologies, which have different purposes. Quantitative research tests theories while qualitative research is used to develop theories (Taylor & Trumbull 2005). For example, testing a theory about the relative difficulty of questions targeting image-language relations involves quantitative methods and statistics, whereas determining what strategies students choose or the inferences they make entails the hermeneutic methods of interpretation to construct meaning from interview data. The use of case studies to investigate the ‘how and why’ of student understanding involves ‘specific co-constructed realities’ (Guba & Lincoln 2005:195) because meaning is constructed by the researcher from interview data provided by students. The age of students precludes consultative or collaborative co-construction, as might occur in adult case studies, but the meanings are jointly constructed in that the questions and feedback influence the responses to a great degree. Therefore the findings can be considered to be co-constructed by the researcher’s questions and the students’ responses.

### **5.1.1 Methods for investigating reading strategies and comprehension**

The main research question asks *how* image-language interactions are comprehended by different socio-cultural groups of students and as reading is a complex task, several aspects are investigated. The first aspect, addressed by sub-questions A and B, relates to the complexities in the texts which are investigated through analyses of the BST materials followed by quantitative studies using analysis of variance of test item difficulties.

The second aspect to be investigated concerns the reading *strategies* used by different groups of students when responding to questions requiring comprehension of the different types of image-language interactions. To obtain this data a sample of students was selected as outlined in the last section of this chapter and interviewed. The strategies data were subjected to quantitative analysis through correlation studies, but the interview transcripts were also qualitatively analysed through discussion of examples and identification of any patterns that became apparent.

There were three other aspects being investigated. One aspect was the number of inferences students made about verbal text and another aspect was the number of inferences about images in the multimodal texts during their interviews. In view of the mediating effect of spoken language on the verbalisation of inferences, the third aspect that is being investigated is the linguistic complexity of the students' talk when responding to questions about the meanings in multimodal texts. Although the inferences and linguistic complexity of talk data were also subjected to quantitative analysis through both ANOVA and Pearson's correlation studies, this area of the research will have the strongest qualitative component. The hypotheses being tested and the procedures for carrying out these investigations are outlined in the latter sections of this chapter.

### **5.1.2 Strengths and limitations of the research methods**

The advantage of using mixed research methods is that they serve different purposes and can achieve different outcomes. Quantitative methods require representative

samples based on the central limit theorem<sup>3</sup> and are more reliable across larger numbers but in a study requiring a lot of analysis by an individual it is difficult to have large numbers. While case studies usually involve small numbers that may be idiosyncratic and not representative (Taylor & Trumbull 2005), the analysis of larger numbers for the quantitative aspect of a mixed method research enables the selection of more representative examples for case study.

The intention in this study, to investigate the responses of different groups of students relative to their achievement, led to the inclusion of quantitative methods in order to identify any relationships or differences between or within groups. The difference in reading achievement between boys and girls, between Aboriginal and non-Aboriginal students and between students in remote, provincial and metropolitan schools is evidence-based because it has been identified using quantitative population data. To investigate factors that might impact on those differences it seemed important to apply the same rigour by quantitatively testing null hypotheses. Quantitative methods require the selection of a larger sample of students than is needed for the qualitative aspects of the research. An additional advantage of the larger sample from a qualitative point of view is that the larger sample provides greater diversity of research participants and the quantitative methods can identify what is typical or atypical among them, thus assisting in the identification of the most relevant case studies. The sample was large enough for quantitative methods to be applied to the data set as a whole or to large subsets within it.

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<sup>3</sup> \*The central limit theorem explains the common appearance of the 'Bell Curve', or the normal distribution either side of a centre line on a graph when using real world data. It is also known as the second fundamental theorem of probability.

When dealing with a large number of subgroups defined by multiple criteria, the aggregate instances in the data sets of these subgroups become too few to enable valid application of certain statistical analyses such as Pearson's correlation coefficients. Therefore, a qualitative approach is more apposite for examining a critical sub-grouping, such as male Aboriginal students in remote schools, where there is not a sufficient number of students for conducting statistical analysis concerning how such specific groups performed or chose strategies.

The strength of hermeneutical and dialogic methods is that they produce qualitative data, which include the complex detail that is necessary to investigate issues and develop theories and models of interaction and behaviour. Counts of strategies or correlations with reading scores do not provide information about how and why students make their choices and come to their conclusions. When investigating phenomena rather than testing them, interpretation and logical argument are more appropriate to open up possibilities for future research.

## **5.2 Research sites and participants**

This doctoral study is part of an Australian Research Council Linkage Project between the University of New England (UNE) and the NSW Department of Education and Training (DET), now Department of Education and Communities (DEC). As the DEC has a priority to close the gap in literacy achievement between Aboriginal and non-Aboriginal students and the gap is compounded by the gap in achievement between students in remote schools and students in metropolitan schools, the investigation is focused on these groups. The sites for this investigation are consequently New South Wales government primary schools with significant Aboriginal populations in

metropolitan, provincial and remote locations. Therefore approvals to conduct the research were required by the NSW Department of Education and Training's State Education Research Approval Process (SERAP) as well as the University of New England's Human Research Ethics Committee. The interview protocols were approved by both of these bodies.

To assist with the selection of sites and participants, the Educational Measurement and School Accountability Directorate (EMSAD) of the NSW Department of Education and Training provided access to the Basic Skills Test (BST) results for all schools through the SMART (School Measurement Assessment and Reporting Toolkit) software program which has since been converted to an online facility with password access for teachers.

### **5.2.1 Selection of sites and participants**

The selection of sites for the collection of data was primarily determined by the geographic location component of the research, which involves comparisons of students in metropolitan, provincial and remote schools. These three categories (together with a fourth category, very remote) and the term 'geo-location' are used to report National Benchmark results in the Australian Government's *National Report on Schooling in Australia 2006* (MCEETYA 2006). The categories are based on the MCEETYA (Ministerial Council on Education, Employment, Training and Youth Affairs) School Geographic Location Classification, which was adopted in July 2001 for reporting nationally comparable schooling outcomes. The categories are identified using the Accessibility/ Remoteness Index of Australia (ARIA) scores, which consider both population and accessibility/remoteness (Lyons et al. 2006).

The second consideration in the selection of sites was whether there were sufficient numbers of Aboriginal or Torres Strait Islander students who had completed the 2005 Year 3 and Year 5 Basic Skills Tests, to obtain comparable numbers with non-Aboriginal (or Torres Strait Islander) participants. From here on, unless specifically referring to the one Year 3 metropolitan male Torres Strait Islander student, this group of students will be referred to as Aboriginal.

The third consideration was the intention to have a range of reading achievement (high, medium and low scores) for Aboriginal, non-Aboriginal, male and female students in each geo-location to ensure balance in the research sample. Reading scores were categorised as high if BST results were in the top reported band for reading (Band 5 in Year 3 and Band 6 in Year 5), which was approximately the top quartile of the State. The reading scores were categorised medium if results were in the next two reported bands (Bands 3 and 4 for Year 3, and Bands 4 and 5 for Year 5), which was approximately the middle 50% of the State and the scores were categorised low if they were in lower bands for reading (around the bottom quartile of reading results).

The final consideration of reading level narrowed the choice of schools because it could not be met by a single school in any location. Accordingly, the final choices were three schools close to each other in the east of Sydney, three schools in a provincial town and two schools classified as remote that were within two hours' drive of each other. The remote and provincial schools were in the north of NSW.

The targeted student numbers for both cohorts were two Aboriginal boys, two Aboriginal girls, two non-Aboriginal boys and two non-Aboriginal girls with BST

reading scores in low, medium and high bands in metropolitan, provincial and remote schools or 72 students in each cohort. When the schools were visited, it was discovered that two of the high scoring students were not Aboriginal, even though they had selected Aboriginal in the personal details section of the BST, and another high performing Aboriginal student had stopped attending school. This left no Aboriginal students who had achieved a high score in the 2005 Year 5 BST reading in any of the provincial or remote schools visited. From the provincial schools there was only one Year 4 Aboriginal girl, who had a score in the top band for reading and from the remote schools there was only one Year 4 Aboriginal boy. This left the provincial sample slightly skewed with larger proportions of Aboriginal students with low reading scores and non-Aboriginal students with high reading scores.

The remote samples for Aboriginal and non-Aboriginal students were similarly skewed because there were only two non-Aboriginal girls in Year 4 and one non-Aboriginal girl (and no boys) in Year 6 who scored in the top band for reading. Although the intention had been to have a similar number of students at all levels of ability, the final situation created a much more representative sample of the achievement levels in the state-wide remote and provincial areas. The state-wide differences between geo-locations were not published for the BST, however, they are evident in the percentages of students in reading bands in the 2008 Year 3 NAPLAN results (MCEECDYA 2008). Although there is one extra band for Year 3 in NAPLAN, the percentages of Year 3 metropolitan students in the top band, next two bands and the bottom bands are similar to the percentages in the five Year 3 BST bands on which the high, medium and low categories were based. The disparity between geo-locations in 2008 for all Year 3 students is shown in Table 5.1 and for

Year 3 Aboriginal students in Table 5.2. A comparison of the tables shows the gap in achievement between Aboriginal and all students, which would be even greater if only compared to non-Aboriginal students.

<b>Geo-location</b>	<b>Exempt</b>	<b>Low (Bands 1 - 3)</b>	<b>Medium (Bands 4 – 5)</b>	<b>High (Band 6)</b>
<b>NSW Metro</b>	1.0%	28.8%	47.7%	22.5%
<b>NSW Provincial</b>	0.8%	37.4%	45.4%	16.4%
<b>NSW Remote</b>	1.9%	53.1%	34.4%	10.7%

**Table 5.1** Percentages of all Year 3 students in 2008 NAPLAN reading bands

<b>Geo-location</b>	<b>Exempt</b>	<b>Low (Bands 1 - 3)</b>	<b>Medium (Bands 4 – 5)</b>	<b>High (Band 6)</b>
<b>NSW Metro</b>	1.4%	56.6%	36.2%	5.7%
<b>NSW Provincial</b>	1.1%	66.4%	28.8%	3.7%
<b>NSW Remote</b>	3.2%	75.5%	19.1%	2.2%

**Table 5.2** Percentages of Year 3 Aboriginal students in 2008 NAPLAN reading bands

The details of students who agreed to participate in the first stage interviews is shown in Table 5.3 for Year 4 and in Table 5.4 for Year 6.

<b>Y4 2006</b>	<b>Aboriginal (28)</b>			<b>Non-Aboriginal (30)</b>			<b>Total 58</b>
<b>2005 BST results</b>	<b>Low</b>	<b>Medium</b>	<b>High</b>	<b>Low</b>	<b>Medium</b>	<b>High</b>	
Metro (20)	3 boys 2 girls	1 boy 2 girls	1 boy 0 girls	2 boys 2 girls	2 boys 2 girls	1 boy 2 girls	10 boys 10 girls
Provincial (18)	2 boys 3 girls	0 boys 2 girls	0 boys 1 girl	1 boy 2 girls	2 boys 2 girls	2 boys 1 girl	7 boys 11 girls
Remote (20)	1 boy 2 girls	3 boys 4 girls	1 boy 0 girls	2 boys 2 girls	2 boys 1 girls	0 boys 2 girls	9 boys 11 girls
	13	12	3	11	11	8	

**Table 5.3 – Breakdown of Year 4 Participants in 2006**

<b>Y6 2006</b>	<b>Aboriginal (24)</b>			<b>Non-Aboriginal (28)</b>			<b>Total 52</b>
<b>2005 BST results</b>	<b>Low</b>	<b>Medium</b>	<b>High</b>	<b>Low</b>	<b>Medium</b>	<b>High</b>	
Metro (20)	1 boy 1 girl	2 boys 1 girl	1 boy 1 girl	3 boys 2 girls	1 boy 3 girls	2 boys 2 girls	10 boys 10 girls
Provincial (18)	3 boys 2 girls	2 boys 3 girls	0 boys 0 girls	0 boys 1 girl	1 boy 2 girls	2 boys 2 girls	8 boys 10 girls
Remote (14)	2 boys 0 girls	3 boys 2 girls	0 boys 0 girls	2 boys 1 girl	2 boys 1 girl	0 boys 1 girl	9 boys 5 girls
	9	13	2	9	10	9	

**Table 5.4** – Breakdown of Year 6 Participants in 2006

Not all of these students remained in the study as some were absent, had changed school or withdrew from the study when the researcher revisited the schools in 2007. Despite the attrition from the group in 2007 there was still a range of ability in all gender, geo-location and Aboriginal status groups, which contained a representative sample of students with a normal distribution. However, although only one non-Aboriginal provincial student with high reading ability remained in the study in 2007, there was still an imbalance in the ratio of Aboriginal to non-Aboriginal provincial students with reading scores in low BST bands (4:2) and medium BST bands (1:4).

It was actually necessary to skew the sample overall with regard to Aboriginal status and geo-location. An approximately equal number of Aboriginal and non-Aboriginal students was needed in each of the social groups, even though Aboriginal students are less than 5% of the metropolitan population, about 10% of the provincial population and 30% of the remote population. A similar situation exists with regard to metropolitan, provincial and remote students, as there are many more metropolitan students than provincial students and more provincial students than remote students in the state of New South Wales. In a small study it is not possible to replicate state

proportions but within the categories of Aboriginal status, gender and geo-location a representative range of ability with a normal distribution was achieved. However, the Index of Community Socio-Educational Advantage (ICSEA) values released on the My School website in 2010 showed unexpected similarities between schools in different geo-locations, especially metropolitan and provincial, as shown in Table 5.5.

Geographic location of study schools	School ICSEA value	Aboriginal students as % of school	Number of 2006 Year 4 students interviewed		Number of 2006 Year 6 students interviewed	
			ATSI	Non-A	ATSI	Non-A
Remote	803	41%	6	6	7	6
Remote	657	77%	5	4	-	1
Provincial	835	52%	2	1	4	-
Provincial	1017	11%	4	9	4	8
Provincial	1018	8%	2	-	2	-
Metropolitan	948	29%	8	11	4	3
Metropolitan	1009	9%	1	-	1	9
Metropolitan	1006	14%	-	-	2	1
			<b>28</b>	<b>31</b>	<b>24</b>	<b>28</b>

**Table 5.5** 2010 ICSEA values, % Aboriginal students and students in study

ICSEA is based on family education and occupation data and the possible effect of these similarities on the research findings will be discussed in the final chapter.

## 5.2.2 Ethics considerations and approvals

The inclusion of Aboriginal and Torres Strait Islander students in the research required referral of the ethics application to the Panel on Ethical Research Involving Aborigines and Torres Strait Islanders (PERATSI), a sub-Committee of the University of New England's Human Research Ethics Committee (HREC). Local Aboriginal Community

Elders were consulted via Aboriginal Education Assistants or Aboriginal Education Consultative Groups or directly through the local Aboriginal Land Council, according to the usual custom in the school. Written approval for the research to proceed with Aboriginal students in each community was obtained and forwarded to PERATSI and HREC and both committees gave ethics approval for the research.

An application was made through the NSW Department of Education and Training's State Education Research Approval Process and approval was given for the research to proceed on the condition that a local Aboriginal person either conduct or be present at all of the interviews with Aboriginal students. The local Aboriginal person who was present at these interviews was usually an Aboriginal Education Officer or an Aboriginal Education worker at the school.

All of the school principals were informed about the research, gave their approval and were very supportive of the study. The principals gave students information sheets and permission notes to take home. A contact telephone number was included but only one parent took up the offer to discuss the research. Most parents gave consent for their children to participate in the study, although a few refused permission and some students declined to participate in the interviews.

### **5.3 Data selection and rationale**

As this research is concerned with how primary students in New South Wales comprehend texts, it was appropriate to use textual materials that were used to assess reading comprehension across the state of New South Wales in Australia, namely the reading sections of the NSW Basic Skills Tests (BST). These test materials are also

highly suitable for use in this research because they include multimodal reading texts, they are used to compare the performance of socio-cultural groups and their results are analysed using Rasch analysis (see further details in section 5.4.2.1). The Rasch analysis provided a measure of the difficulty of test items which was applied on a common scale across different age cohorts of students who completed the BST.

### **5.3.1 Using BST materials to analyse complexities in multimodal texts**

The BST is particularly suited to an investigation of interaction between images and language in multimodal texts as the tests have always included images which are integral to the meanings targeted by some of the reading comprehension questions (Daly & O'Donnell 2008). Previous research has also shown that the materials are suitable for researching image-language relations (Unsworth, Thomas & Bush 2004).

Although this investigation is concerned with the reading of primary school students the analysis of texts (sub-questions A and B) included texts from the secondary English Language and Literacy Assessment (ELLA) as it was part of the ARC 'linkage' project analysis which followed up students after two years. The analysis also includes texts from the 2007 BST reading assessment for Year 3 students as it requires a substantial number of test questions for valid statistical analysis of the image-language relations. Although the ELLA for Years 7 and 8 students has a different name to the primary reading tests, it is similar to the Year 3 and Year 5 BST and the difficulty of items can be easily compared with the BST because the results are reported on the same common scale of difficulty for literacy items.

During identification of differences in mean item difficulty for questions involving different types of image-language relations, it was apparent that there was a wide range of difficulty for items within each type of image-language relation. Another feature of the stimulus texts was the varied levels of complexity in the language and images, so the next step was to investigate whether there were any differences in item difficulty for different levels of image and language complexity. This investigation was to identify whether complexity factors are associated with differences in difficulty of items involving image-language interaction, independently of the type of image-language relation. Once the types of the image-language relation and complexities in the related images and verbal text segments were identified, it was possible to use the Rasch analysis to investigate any differences in the difficulty of the test items associated with these factors.

An understanding about the nature of the image language relations within the texts in the 2005 and 2007 assessments assisted in confirmation of the reading strategies that students were expected to use when answering the questions. The analysis of BST texts also helped to identify the parts of texts where students needed to infer, explain or associate meanings in order to answer questions, and therefore when they might use more linguistic complexity to explain those meanings when talking about the texts. The analyses of strategies, inferences and linguistic complexity were carried out across socio-cultural groupings of students and the rationale for using BST data for that purpose will now be elaborated.

### **5.3.2 Using BST materials across socio-cultural groupings of students**

The National Benchmarks results for reading that were referred to in Chapter 4 were calculated from test data across each state for Years 3, 5 and 7 from 2003 to 2007 (for example, MCEETYA 2007: 6, 20 & 32). The New South Wales state tests for Years 3 and 5 from 2003 to 2007 were the Basic Skills Tests. These tests have been the source of data identifying differences in the mean reading achievements between Indigenous and non-Indigenous students and among students in metropolitan, provincial and remote locations. Therefore the BST is a highly suitable research material for an investigation of factors that might have impacted on the widening gap in reading comprehension between Aboriginal and non-Aboriginal students and among metropolitan, provincial and remote students in NSW.

The use of a common scale for reporting BST results enables achievements to be compared as students progress, that is, it is possible to ascertain the amount of growth in reading comprehension from Year 3 to Year 5 because the results of both tests are reported on a common scale of difficulty. The results are also reported within ability bands ranging from Band 1 for the lowest level of performance to Band 5 as the highest level of achievement for Year 3 students and Band 6 as the highest level of achievement for Year 5 students. The top bands in Year 3 and Year 5 usually represent approximately the top quartile of the state results in reading, for example in 2005, 21% of Year 3 students achieved Band 5 and 29% of Year 5 students achieved Band 6 for reading. The next two bands usually approximate the next two quartiles of state results and the lower bands contain the lowest quartile of reading results. It is therefore easy to use BST band results to select a sample of students that is representative of the range of reading achievement in the NSW population.

In summary the Basic Skills Test contains multimodal stimulus texts with a range of features that vary in their complexity. This research identifies complexities within the language, the images and the relations between images and language through sub-questions A and B. These factors can be compared with regard to the difficulty of the comprehension questions that target these segments of the texts. Sub-question C investigates the strategies that students use to answer the questions and sub-question D investigates the inferences students make and the linguistic complexity of their talk about textual meanings. In all of these investigations, one common thread is the BST texts and another is the test item difficulty which is objectively ascertained through Rasch analysis. The Rasch statistics are based on the numbers of students who answer correctly and incorrectly across the whole test (Wright 1967; Bond & Fox 2001).

#### **5.4 Procedures for analysis of BST data – texts and student performance**

To determine how images and language interact to construct meaning in the reading sections of the 2005 Basic Skills Tests (BST), it was necessary to identify and then analyse the texts that involve image-language interaction and identify which parts of the texts were relevant to the assessment tasks. The relations constructed between written text and images in the multimodal texts were analysed using a proposed model of image-language relations (Unsworth 2006b, Chan 2010) derived from the semiotic systemic-functional frameworks of Functional Grammar (Halliday 2004/1994) and Visual Grammar (Kress & van Leeuwen 1996).

#### **5.4.1 Analysis of image-language relations – sub-question A**

Sub-question A: *How do images and language in reading materials interact to construct meaning and how do reading questions address students' comprehension of the image-language interaction?*

To investigate this question it was necessary to identify the linguistic and visual units of text and then identify the interaction between them using a frame-work of image language relations. The definitions used for that identification are outlined below.

##### **Identification of linguistic units of text**

The assessed linguistic segments of multimodal texts were classified as either main text or supplementary text. All units of linguistic meaning are expressed through clauses consisting of participants (things or nominal groups), circumstances (phrases and adverbs) and processes (material, behavioural, verbal, mental, relational or existential verbs).

**Main text** is defined as verbal text comprising a complete stretch of discourse and it is usually the 'central body of the text, including headings and subheadings' (Unsworth et al. 2004:49). However, titles and headings within the text have been considered as supplementary to the main text as these are read separately and are often used when skimming text for meaning. Labels, captions, legends and brief textual notes printed as part of the figure have also been considered as supplementary to the main text (following Lemke 1998).

**Supplementary text** is brief verbal text which accompanies the main text in a multi-semiotic text or component parts of it, such as a frame, an image or other non-verbal semiotic component. These elements of supplementary text are defined as follows:

**title** –the main heading capturing the overall theme of the main written text or whole multi-semiotic text

**subtitle** – a heading marking a sub-section of the text

**label** – word or phrase identifying or naming part of an image (nominal group)

**key** – a set of symbols and their meanings for interpreting the corresponding symbols found within an image (identifier/ identified are represented by symbol/word)

**caption** – **descriptive caption** – a description appearing with an image  
(clause: relational, clause complex)

**caption heading** – a heading appearing with an image (nominal group)

**commentary** – action, explanatory or ‘instructional’ (Henderson 1999:24)  
statement which reinforces the process/es shown or implied in an image  
(clause: material, clause complex).

### **Identification of visual units of text**

Only texts in the BST reading stimulus materials that included images which had a role in the construction of meaning related to assessment items in the BST were pursued in this study.

The visual units of text are analysed according to their role in the text and the type of image. The image roles are consistent with linguistic text roles, either main images or images embedded (supplementary) within the main image. It is appropriate to classify all images as signs because they convey ‘meaning or content (the signified) manifested

through some form of expression or representation (the sign)' (Harrison 2003:47). Semiotics, or the 'study of signs' (Harrison 2003:47), encompasses much more than Arnheim's (1969) definition of 'sign', which seems too limiting by stating that 'an image serves merely as a sign to the extent to which it stands for a particular content without reflecting its characteristics visually' (p. 135). The term 'sign' has therefore been used in this research as applicable to all images and the analysis uses the different functions of signs identified by Harrison (2003) as categories of signs. The following definitions of each visual element were used for the analysis.

**main image** – image/visual element which carries the main meaning content of a multi-semiotic text (simplex)

**embedded image** – a discrete image associated with or located inside another image within the same semiotic frame (complex)

**icon** – an image which 'bears a similarity or resemblance to what we already know or conceive about an object or person' (Harrison 2003:50). There is some degree of visual correspondence between sign and signified and the relationship between representation and represented is not arbitrary.

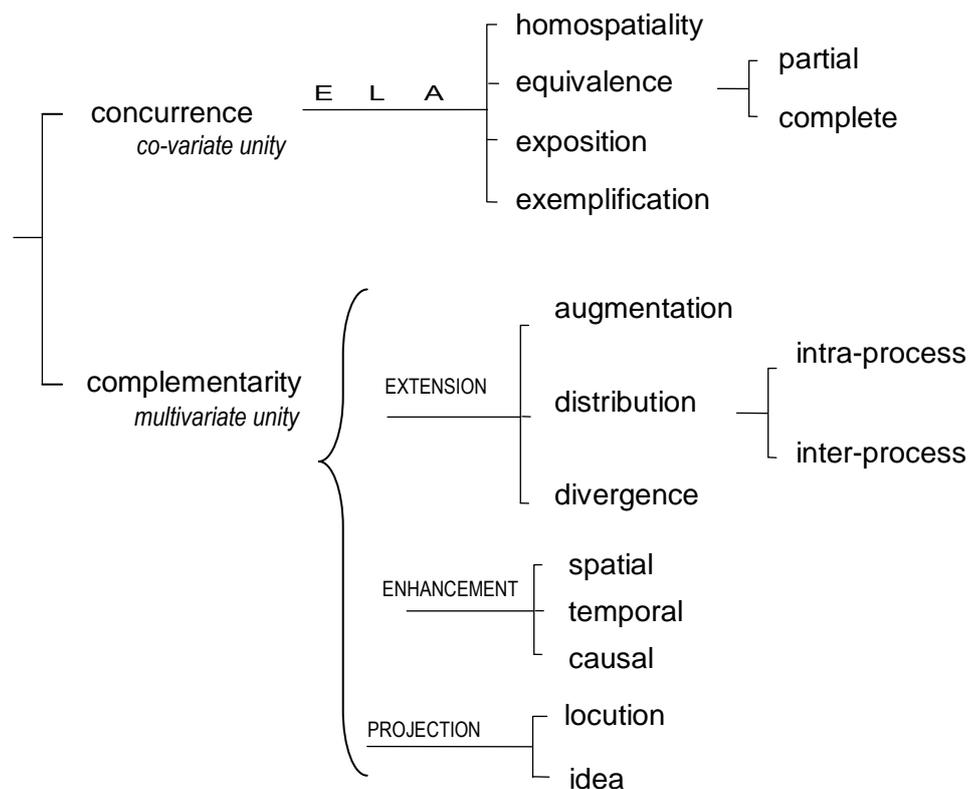
**index** – an image that is 'recognizable, not because of any similarity to an object or person, but because we understand the relationship between the image and the concept that it stands for, such as a weathervane' (Harrison 2003:50).

**symbol** – an image which 'has no visual or conceptual connection to an object or person...it does not resemble what it stands for, nor does it have any indexical relationship to what it signifies' (Harrison 2003:50).

The images were also analysed for their basic ideational content in accordance with Kress and van Leeuwen's (1996, 2006) Visual Grammar, as either conceptual representations, where the participants usually appear to be static and the image is concerned with analytical or relational processes, or as narrative representations which are about actions and happenings or material processes. Following identification of units of text using these definitions, interaction between the language and image units was analysed using a framework of image-language relations, which is outlined next.

#### 5.4.1.1 Framework for analysis of image-language relations

The framework of image-language relations developed by Unsworth (2008) and Chan (2010), which is shown in Figure 5.1, outlines the way image-language interaction creates ideational meanings in texts.



**Figure 5.1** Summary of the framework for intermodal relations (Chan 2010:157)

The following definitions were used to identify the different types of image-language relations shown in the framework.

**Concurrence** is a relationship where one mode elaborates on the meaning of the other by further specifying or describing it while no new element is introduced by the written text or image. The elaboration can take four forms:

- **exemplification**, where the image may be an example or instance of what is in the text, or the text may include an example of what is depicted more generally in the image;
- **exposition**, which refers to the re-expression or reformulation of the meanings of the image or the text in the alternative semiotic resource with both the written text and image representing the same level of generality;
- **equivalence**, where there is ideational redundancy since the ideational content corresponds across semiotic resources; and
- **homospatiality**, as discussed by Lim (2004), which refers to texts in which two different semiotic resources co-occur in one spatially bonded, homogenous entity.

**Complementarity** is a relationship where a new element (participant or process) is introduced by either the written text or image. Complementarity can be an **extension** of meaning in the form of augmentation, distribution or divergence as follows:

- **augmentation** is where a new participant is introduced in one semiotic resource, for example, where a noun in written text is not shown in the image or a represented participant in the image is not mentioned in written text;

- **distribution** is where a new process or action is introduced in one semiotic resource, for example, an action or relation represented by a verb in the written text is not shown in the image or conversely an action could be represented by a vector in the image but not mentioned in the written text;
- **divergence** is where the two semiotic resources convey different meanings, for example, advertisements often mention their product in the verbal text but show an image of something different which they want the reader to associate with their product, such as dancers leaping through the air above the ocean on the cover and throughout the *BigPond Broadband User Guide* (no date, commercial booklet with no publication details).

Relations of complementarity can also be in the form of enhancement or projection:

- **enhancement** is a relationship of conjunction whereby an element in one semiotic resource is enhanced by information in the other semiotic resource showing spatial, temporal or causal details;
- **projection** occurs where meaning in one semiotic resource is projected by the other semiotic resource. Usually verbal text is projected by image, for example, speech in a bubble projected by a participant in an image, as in comics. Projection may also occur in network or tree diagrams where sub-groupings are projected from more inclusive categories.

#### **5.4.1.2 Identification of items involving image-language relations**

All of the image-language relations that were targeted by the test items about the reading texts from the 2005 and 2007 Year 3 and Year 5 BST and the Year 7 ELLA

(English Language and Literacy Assessment) were identified by using the definitions in the last section (5.4.1.1). The reading test items associated with those texts were examined to determine which were assessing comprehension of image-language relations. The identified questions were categorised by the researcher and the Research Fellow (employed on the larger study of which this study is a part) according to the type of image-language relation that needed to be comprehended in order to provide the correct answer and then coded independently to establish inter-rater reliability of 80-90 percent.

#### **5.4.2 Data analysis procedures, item difficulty – research sub-question B (i)**

Sub-question B (i): *Does reading difficulty differ according to the nature of various image-language relations in multimodal texts?*

To investigate whether the previously identified variance in item difficulty is related to the type of image-language relation involved, item thresholds (also known as facility indices or logits of difficulty) for all of the questions about image-language relations were obtained through Rasch analysis of the state-wide BST results. The Rasch analysis data, which was provided by the NSW Department of Education and Training, is calculated from the test results of all Year 3 and Year 5 students across the state of New South Wales. The validity of the BST has been demonstrated in a comparison of 1200 teacher assessments and BST assessments which found a correlation coefficient of 0.66 (Bond & Caust 2005: 12). This correlation was made possible through an analysis of teacher assessments using the Rasch model which provided a way of converting teacher ratings of student achievements into measures (Bond & Caust 2005:12).

#### **5.4.2.1 Rasch analysis of state-wide test data**

The Rasch model is widely used in educational assessments with a right or wrong answer format. The model is an item response theory model in which the outcome of a person encountering a test item ‘... is governed by the product of the ability of the person and the easiness of the item’ such that, ‘The more able the person, the better his chances for success with any item’ (Wright 1967: memo 1).

When measurement is governed by this model, it is possible to take into account whatever abilities the persons in the calibration sample happen to have and to free the estimation of item easiness from the particulars of these abilities. The scores persons obtain on the test can be used to remove the influence of their abilities from the item analysis. The result is a person-free test calibration. (Wright 1967: memo 1)

The reverse is also true, as the relative abilities of two persons are not dependent upon the details of the test items used. Masters (2001) claims that this ‘possibility of objective comparison is the key to objective measurement’ (p.2). In fact, Bond and Fox (2001:8) state the Rasch model is, ‘the only model to date that provides the tools for approximating objective reproducible additive measures in the human sciences’.

The Rasch model is a simple form of item response theory having one parameter for persons (ability) and one parameter corresponding to each test item (facility or difficulty). If the test items and persons being assessed are placed against each other on a grid and both are arranged from those with most correct responses to those with least correct responses, that is, easiest to hardest items and most able to least able persons, this creates an order. From the logic of this order ‘the Rasch analysis software programs perform a logarithmic transformation on the item and person data to convert the ordinal data to yield interval data’ (Bond & Fox 2001:29). This data produces person ability and item difficulty estimates which ‘are displayed in computer output

along a logit (log odds unit) scale (Bond & Fox 2001:29) on which positive logits indicate greater difficulty because fewer students answered correctly and negative logits indicate less difficulty'. In this way, the Rasch model enables item difficulty and person ability, to be placed on the same linear scale using 'probabilistic equations' (Bond & Fox 2001:7).

Locating persons and items on the same scale provides a better understanding of the performance of persons in relation to the difficulty of the test items. Different groups of people can be compared in relation to the performance of each other on the scale. The Rasch model has therefore been widely used for analysis of large scale educational assessment programs such as the NSW Basic Skills Tests and National Assessment Program for Literacy and Numeracy (NAPLAN).

Student performance on different tests can also be compared when the tests are equated to the same scale. There are two forms of equating. Common person equating involves a representative sample of students completing the current test as well as an earlier test so that the logits for items in the current test can be adjusted to align with the logits on the scale of the former test. Common item equating uses a set of items that appear in both tests as applied each year with the BST and now the NAPLAN. The difficulty levels of the items are fixed from one test to the next, providing a 'ruler' against which performances of students can be measured (Griffin & Callingham 2006). Either of these methods establishes 'connectedness' (Linacre 1997). The current research is able to compare the facility of items from tests for different ages and years because the tests have been equated and the items have been located on a single scale of relative difficulty.

Cut-off points (specific logits) on the ‘item difficulty’ scale are used to determine bands of difficulty in which the test items are located. The same cut-off points are used on the ‘person ability’ scale to determine the student achievement band levels in the BST, such that students with results in band 4 were likely to correctly answer items with a band of difficulty between 1 and 4 but unlikely to correctly answer items with a difficulty band of 5 and 6. As previously mentioned, achievement in the top BST reading band (band 5 for Year 3 and band 6 for Year 5) is being used to categorise students as having high reading scores, students in the next two bands are classified as having medium reading scores while students scoring in other bands are in the low reading score category.

Although Rasch analysis can detect systematic bias in items, and also at test level, towards specific groups, such as male or female, it cannot explain any bias found because it cannot take into account differences in social settings, background, understandings or other reasons for differential performance. Accordingly, any explanatory information is being sought through case study interviews in which students are asked to state their understandings about texts and identify their reasons for choosing answers to comprehension questions.

#### **5.4.2.2 Statistical analysis of categories of image-language items**

For each of the five types of identified image-language relations the mean of the item facility indices (logits) was calculated. A univariate analysis of variance (ANOVA) was then conducted across these means for the different types of image-language relations. An ANOVA is used when there is a normal distribution and the data are

divided into groups according to only one factor in order to decide if there is a significant difference between the groups and, if so, which groups are significantly different from others. This test is appropriate to see if the normally distributed mean difficulty thresholds (dependent variable) for items that assess specific categories of image-language relations (independent variable) are significantly different in order to justify the use of these separate classifications of image-language relations in association with different levels of facility/difficulty. Post hoc tests were also conducted to identify the location and nature of significant differences found by the ANOVA. However, as this test only looks at mean thresholds, it is important to also look at the range of thresholds for each type of item.

Where there is a large range of logits of difficulty for questions assessing similar types of image-language relation, the questions require further analysis to identify any other features of the texts that need to be comprehended for students to correctly answer test questions at various levels of difficulty within each category of image-language relation. For example, students might need to comprehend a complex diagram, difficult vocabulary (lexical complexity) or grammatically complex text in addition to negotiating an image-language relation of complementarity. Research sub-question B (ii) and (iii) addresses the issue of complexity in images and verbal text in a similar manner to the way research sub-question B (i) addressed image-language interaction.

#### **5.4.3 Data analysis procedures, complexity – research sub-question B (ii) & (iii)**

Sub-question B: *Does reading difficulty differ according to the linguistic complexity of the multimodal texts (grammar and vocabulary) or the visual complexity of the multimodal texts (images)?*

To compare the relative difficulty of test questions involving image-language relations with the level of complexity of the corresponding written text segments and images, it was necessary to first identify the segments of language and image in texts that students needed to understand to answer those questions. The image segments are identified as those parts of an image containing all the key information that could be used to answer a question. The segment can be a whole image, a participant in the image or the background of the image. The linguistic segments were identified as only the sentences, clauses or labels in the text that contained all the key information needed to answer a question. The relevant clauses in the segment could be separated by extraneous clauses in the text if there were no cohesive links in the extraneous clauses needed to maintain meaning. After identifying the segments, the following categories for linguistic and image complexity were used to analyse the texts.

#### **5.4.3.1 Categories for linguistic analysis of texts**

Lexical complexity was identified by the presence of non-core vocabulary (Carter 1987:33), as opposed to core vocabulary, that is, core items are generally seen to be the most basic or simple word choice. A test for core and non-core vocabulary is by using substitution, such that ‘in the lexical set, gobble, dine, devour, eat, stuff, gormandize each of the words could be defined using “eat” as a basic semantic feature but it would be inaccurate to define eat by reference to any other of the words in the set (i.e. dine entails eat but eat does not entail dine)’ (Carter 1987:35). The examples of lexical complexity could also involve class shifts, where a non-core verb is used as an adjective, for example, the capsized boat, or nominalisations, where verbs are transformed into non-core nouns, such as indication, or other forms of grammatical

metaphor. However, all non-core words have been treated equally even though some may involve other aspects of complexity. The scoring of non-core words will take into account the density of those words in the relevant text segment by dividing the number of non-core words by the number of clauses and then multiplying this density (the quotient) by the number of non-core words as shown in the following equations:

$$2 \text{ non-core words} \div 3 \text{ clauses} \times 2 \text{ non-core words} = (2 \div 3) \times 2 = 4/3 \text{ or } 1.33$$

$$2 \text{ non-core words} \div 2 \text{ clauses} \times 2 \text{ non-core words} = (2 \div 2) \times 2 = 2$$

$$2 \text{ non-core words} \div 1 \text{ clause} \times 2 \text{ non-core words} = (2 \div 1) \times 2 = 4$$

Therefore, when the number of clauses is the same as the number of non-core words, that will be the score but the score decreases if there are more clauses than non-core words and increases if there are fewer clauses than non-core words. This accounts for the number of non-core words in the text segment without reducing the score simply to a score of density regardless of the number of non-core words.

Grammatical complexity was measured by the presence of three grammatical features (dependent clauses, the use of the passive voice and the ellipsis of redundant words) in the text segments previously identified as relevant to each question. To identify the dependent clause aspect of grammatical complexity, each identified clause was first classified as independent or dependent. Independent clauses can be on their own in simple sentences, or within examples of parataxis (compound sentences) where all clauses in a sentence are equal, none being dependent on any other, or within hypotaxis (complex sentences). Dependent clauses occur only within examples of hypotaxis where clauses are unequal, one being dependent on another. Hypotaxis includes non-defining relative complexes but embedded defining relative clauses have

also been counted as examples of grammatical complexity even though ‘hypotaxis does not include embedding’ (Halliday 1985:83).

Embedded defining relative clauses were included because earlier BST results (2003, 2004) show that questions requiring students to find answers in embedded clauses were more difficult than questions requiring students to locate information in simple and compound sentences without embedded clauses. In the following examples both questions assess only written text, not images. The first question asks about information in an embedded clause and the second about information in independent clauses in a compound sentence. A reading question with a positive difficulty threshold of 0.51 asked students, ‘What did Arone mix with clay to make paint?’ This question required students to directly locate information in the following non-finite embedded defining relative clause (square brackets added):

He used ochre and gouache on rag paper and paint [made from clay/ mixed with berries] to bring to life the lush rainforest... (2003 Year 3 BST)

The other question about information in a compound sentence was easier, having a negative threshold of -0.44. This question asked students, ‘Which cross in the night sky has pointers to identify it?’ The answer was identified by locating information in the following independent clauses:

There are two other crosses in the sky, the False Cross and the Diamond Cross, but the Southern Cross is the only one with pointers. (2004 Year 5 BST)

The dependent clauses identified for the analysis include adverbial and relative adjectival clauses, finite and non-finite clauses and clauses that precede or follow the clause on which they are dependent but all are counted equally as dependent or embedded clauses. Noun clauses have not been separately recorded in this analysis so

direct and indirect (reported) speech has been categorised as the object or projection of the verbal process, even though Halliday (1985:83) classifies them as a form of hypotaxis. That is, reported and quoted clauses were left with the projecting or reporting clause, for example:

Dad says [Rick will be in for a bit of a shock].

Similarly, the noun clause in square brackets below was left as the object with the independent clause as its object:

but Rick wanted to see [how far we could rock the boat]...

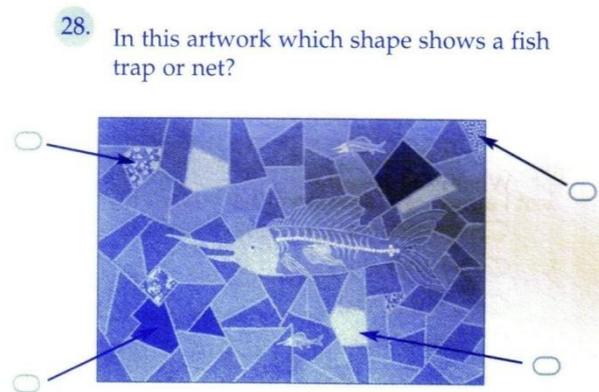
To ensure the amount of clause complexity within sentences was acknowledged as well as the number of complex sentences in the relevant text segment, the number of dependent clauses was divided by the number of sentences and then multiplied by the number of dependent clauses. The rationale for this formula is similar to that explained above for the formula used to score non-core words, that is, it takes into account both number and density and doesn't allow one to reduce the impact of the other.

The passive voice and ellipsis have also been included as indicators of complexity because reversible passives and ellipsis of the verb or object in compound sentences are two of the many grammatical constructions not fully understood when a child starts school and some types of ellipsis are not frequently produced in oral language until adolescence (Perera 1984:156). Accordingly, each instance of passive voice or ellipsis of verb or object has been given a score of one as part of the grammatical complexity score.

For each question about image-language relations, the following information about the linguistic text segment has been scored.

Number of Dependent Clauses ÷ sentences x Dep. Clauses	Instances of Passive Voice or Ellipsis	Number of Non-Core Words ÷ clauses x Non-CW	<b>Total Verbal Complexity for question</b>
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The Total Verbal Complexity is a total of the scores for grammatical complexity (dependent or embedded clauses, passive voice and ellipsis) and lexical complexity (non-core words) as outlined above. For example, to answer Question 28 in the 2005 Year 5 BST (see Figure 5.2) students needed to relate the image to an accompanying descriptive caption.



**Figure 5.2** Question 28 about ‘Tobwabba Art Gallery’ in 2005 Year 5 BST

The segment of the verbal text that needed to be comprehended is bolded and elided words are added in square brackets in the following sentence:

The sailfish is believed to be a cunning fish,  
 [which is/ because it is] **able to feed amongst the various fish traps and nets**  
 [that are] **shown by the dark areas**,  
 without being caught.

Both of the bolded clauses are non-finite clauses (the first is dependent and the second is embedded) involving ellipsis of the words shown in square brackets. The passive voice is used in the clause, ‘shown by the dark areas’. The words in italics are non-

core as they could be replaced by the simpler core words, among, different and parts (areas is a technical term for a child). The text segment was thus scored as follows:

Number of Dependent Clauses ÷ sentences x Dependent Clauses	Instances of Passive Voice + Ellipsis	Number of Non-Core Words ÷ number of clauses x Non-Core Words	<b>Total Linguistic Complexity for question</b>
$2 \div 1 \times 2 = 4$	$1 + 2 = 3$	$3 \div 2 = 1.5$	$4 + 3 + 1.5 = 8.5$

#### 5.4.3.2 Categories for visual analysis of texts

To identify different types of complexity that needed to be understood in images to answer the identified questions, three features were selected and scored 0 for simple or 1 for complex against each category, giving a possible score of 0 to 3 for an image.

- a score of 0 for naturalistic style or a score of 1 for abstract style of representation;
- a score of 0 for commonsense/everyday content or a score of 1 for technological content;
- a score of 0 for a represented participant or process or a score of 1 for an inferred/implicit feature not directly represented.

The first feature has been based on two of Kress and van Leeuwen's (1996:170) coding orientations (a term used by Bernstein 1981), namely 'abstract' and 'naturalistic'. It must be acknowledged that coding orientations are concerned with the modality, reality or 'truthfulness' of representation in images but for the purposes of this research these features have been adopted to represent dimensions of complexity and lack of complexity. The reason that the abstract coding orientation has been selected to indicate complexity in images is, as Kress and van Leeuwen (1996:170)

state, ‘the ability to produce and/or read texts grounded in this coding orientation is a mark of social distinction, of being an “educated person” or a “serious artist”’.

The naturalistic coding orientation, ‘which remains, for the time being, the dominant one in our society,’ (Kress & van Leeuwen 1996:170) has been adopted as the opposite of abstract complexity in images. Kress and van Leeuwen (1996:170-171) refer to this as ‘the one coding orientation all members of the culture share when they are being addressed as “members of our culture”, regardless of how much education or scientific-technological training they have received.’

The latter quote implies that the interpretation of ‘technological’ content also requires education and has a degree of complexity. However, Kress and van Leeuwen’s ‘technological coding orientation’ is different from the meaning ascribed in this research because their reference is to a ‘blueprint’ style of pictorial coding whereas the term ‘technological’ in this research is concerned with complex technical (including scientific or mathematical) ideational content. The opposite of this type of complexity is ‘commonsense’, or everyday, ideational content.

The third aspect chosen to measure visual complexity is implicit or inferential aspects of images. This aspect has created difficulty for students during past BST reading assessments, for example, in 2003, a reading question in both the Year 3 and Year 5 BST with a positive logit of difficulty (1.04), required students to identify whether a picture showed Alice ‘on the jetty’, ‘under the water’ or ‘diving into the water’. At first glance the image (see Figure 5.3) might have represented any one of these: the distant head and shoulders of Alice could have been either above or below the water

with her hand reaching either into or out of the water. The following words explained the context: ‘Some mornings Alice lay on the jetty to watch the real dolphins swim by. She stretched an arm through the big smooth planks to touch them, but she couldn’t reach’ (Winton 1998). However, to interpret the image without reading the words, students would need to recognise that the hand is reaching into the water because that is where the fish are and Alice is not diving because only one hand is going into the water. Only 48% of Year 3 students in NSW selected the correct answer.



**Figure 5.3** Image as reproduced in the 2004 BST, originally from ‘The Deep’ by Tim Winton © 1998, illustrated by Karen Louise © 1998

Another question that involved inference from a visual image is in the reading section of the 2005 ELLA for Year 7 students, where a question required students to infer when Dorothy (a mouse) stopped growing, by using a graph in the text, Dorothy’s Growth Chart. The graph in the text rose from birth until 8 weeks and then the line became horizontal. This question was ‘difficult with only 39 per cent of students being successful in identifying the point at which the graph stopped rising (eight weeks of age) as the time when Dorothy stopped growing’ (Daly & O’Donnell 2008:278). Most of the other students identified the time when the horizontal line stopped as they were

unable to infer the information that was implicit in the graph. The graph is also an example of an image with technological coding orientation and technical (mathematical) complexity.

To answer the question shown in Figure 5.2 about the image in ‘Tobwabba Art Gallery’, the part of the picture which needs to be understood is the abstract background. As the nets are not directly represented in an iconic recognisable manner, students can only guess or infer what the shapes represent without reading the accompanying verbal text. When the text segments are analysed for the aspects of visual complexity (abstract, technological and inferential) and for the aspects of linguistic complexity (grammatical and lexical), the scores are recorded as follows:

Number of Dependent Clauses ÷ sentences x Dep. Clauses	Number of Instances of Passive Voice/ Ellipsis	Number of Non-Core Words ÷ clauses x Non-CW	<b>Image Complexity Total Verbal Complexity for question</b>	T=technical A=abstract I=inference	<b>Total Image Complexity for question</b>
2 ÷ 1 x 2 = 4	1 + 2 = 3	3 ÷ 2 = 1.5	<b>8.5</b>	A + I	<b>2</b>

Two independent coders identified the text segments and scored them and the inter-coder reliability of 90% agreement was established on 40% of the data (text segments from two out the five tests). Following discussion of the reasons for decisions, 100% agreement was reached between the coders.

#### 5.4.3.3 Statistical analysis of text complexity data

The items were categorised according to whether the text segments that related to the items, had high, medium or low scores for linguistic complexity, for visual complexity

and for combined complexity scores for language and images combined. Low complexity was a score of less than 1, medium complexity was a score of 1 or 2 and high complexity was a score of 3 or more.

A measure of ‘essential’ text complexity was also identified because, for some items involving equivalence between image and verbal text, it was only ‘essential’ for students to comprehend either the verbal text or the image, but not both, in order to correctly answer the question. For the items where the information in either the image or the verbal text segment alone could provide the answer, only the lower complexity score, whether for the image or verbal text, was counted in the combined ‘essential’ text complexity score. The higher of the two complexity scores was not counted as it was predicted students would access the part of the text that was less complex and easier to comprehend, thus making the more difficult and complex part of the text less relevant to the students’ ability to comprehend the question. As students were asked during interviews where they found their answers to questions in three of the tests, it was possible to investigate and report on the accuracy of this prediction for most items.

For combined text complexity and combined ‘essential’ text complexity, the cut off points for identifying medium and high complexity on the scale of scores were adjusted by the amount of the average scores for image complexity and for verbal complexity in order to reflect the additional complexity when combining complexity from two semiotic resources. The amount of the adjustment was eventually one score point, so the cut offs for combined scores were 2 and 4, that is, a score of less than 2

for low levels, 2 or 3 for medium levels and 4 or more for high levels of combined text complexity and combined 'essential' text complexity.

An analysis of variance was conducted across the mean logits of difficulty (dependent variable) for items in each low, medium and high complexity grouping (independent variables) to ascertain any significant differences between them and post hoc tests were conducted to ascertain the direction of any differences. As this is the same statistical procedure that was conducted across the items assessing the various categories of image-language relations in the texts, it provided a similar basis for establishing differences in difficulty.

### **5.5 Procedures for conduct of interviews and analysis of data**

Interviews were required to obtain data about students' reading strategies and their separate comprehension of the images and written words in each text. The interviews, which were conducted on school sites in interview rooms, were intended to take 35 to 40 minutes. They were recorded with a small digital recorder that utilised the software program Digital Voice Editor 2 which was turned off while students were silently reading or thinking. The voice files were transcribed under a contract arrangement and then they were formatted into separate clauses so they could be pasted into Excel files. This made it possible to code strategies and other responses on the same file. Each student's interview transcript was coded for reading strategies, literal statements, inferential statements and linguistic complexity. After coding, data were extracted from each individual student record and transferred to a single worksheet ready for statistical analysis of various groupings of students.

### **5.5.1 Interview protocols**

Interview protocols developed in conjunction with the overarching ARC linkage project (Unsworth, O'Donnell, Barnes, Chan & Daly 2009) were used to establish consistency in questioning procedures across interviews (see appendices A1, A2 and A3). Students were asked to read each selected multimodal text in the original BST stimulus magazine and then they were asked to answer the BST questions about the text. The targeted questions from the BST were reproduced on double-sided sheets for Year 4 students (see appendix B) and Year 6 students (see appendix D) in 2006 and for Year 5 students in 2007 (see appendix F). These questions were extracted in the same format as they appeared in the original BST.

The interviewer asked students how they chose their answers and which questions were easy or hard before moving on to the next text and its questions. Students were also asked at the end of the interview which texts they liked best and least and which they thought were easiest and hardest to read. This information was requested to support case study data to see if student engagement or perception of difficulty was related to individual student answers to specific items. In the 2006 interviews students were asked to read aloud in order to gauge their fluency and to follow a 'think aloud' protocol to gauge their comprehension of the whole text. The 'think aloud' procedure involved reading the 2005 BST texts one part at a time and stating what they thought that part of the text meant before reading the next part. As fluency and overall comprehension had already been established during the 2006 interviews the Year 5 texts were read silently in 2007.

### **5.5.2 Data collection and analysis procedures – sub-question C**

*Sub-question C: Are the strategies that students use to read multimodal texts related to reading comprehension test scores and, if there is a relationship, is there any variation according to gender, geographic location or Aboriginal status?*

As stated in the section on research design, one of the purposes of the interviews was to identify the reading strategies used by two cohorts of students in various socio-cultural groups. The first stage of interviews was in 2006, a year and two to four months after the Year 3 and Year 5 2005 BST, when students in Year 4 and Year 6 were interviewed about targeted questions from the tests. The students in the younger cohort were interviewed again two to four months after the 2007 Year 5 BST about targeted questions in the 2007 test.

#### **5.5.2.1 Content analysis and coding of interview data**

The strategies identified by Unsworth, Thomas and Bush (2004:51) while researching test materials were initially adopted as categories for coding the interview transcripts. Coding was conducted on a 20% random sample of the data by two independent coders to ensure inter-coder consistency and the suitability of the categories for use with the student interview data. There were numerous examples of seven of the following eight categories with the exception being Text Structure, for which there were no examples, but this category was not removed in case any examples arose in the remaining 80% of interview transcripts:

1. Read main text
2. Read supplementary text
3. Read main text and supplementary text

4. Read main text and image
5. Read supplementary text and image
6. Read image
7. Read text structure (layout and/or linguistic features), as when identifying a type of text, for example, an interview can be identified through types of sentences and/or question and answer format.
8. Other

A specific breakdown of the Other category included prior knowledge, identified by Unsworth et al. (2004:51), and additional strategies encountered in the data. The following breakdown of the Other category to enable more specific comment to be made during case study analyses was applied in this study.

- |    |   |
|----|---|
| PK | Prior Knowledge                                 |
| M  | Memory  |
| G  | Guess   |
| E  | Elimination                                     |
| O  | Other specified, for example, logical reasoning |

Systematic criteria for the labelling of text parts (outlined in section 5.4.1.1 and 5.4.1.2) were used during the coding of strategies. Inter-rater agreement was sought on the twenty-five transcripts (twenty percent of the sample) that were scored against these categories by two independent coders, aiming for within 80-90% using the percentage agreement method as recommended by Trumbull (2005:121). After all of the transcriptions were coded into the relevant categories against the text on Excel worksheets, a second random 20% sample was selected and scored by a second coder using the same criteria.

Cross tabulations with Pearson's chi square test were to be used to identify any significant differences in the strategies chosen by students to answer individual questions. However, a limitation of this statistic is that the approximation to the chi-square distribution breaks down if expected frequencies are too low. If more than 10% of the events have an expected count of less than 5, then results will not be reliable and this was the case. A more general analysis of the students' choice of reading strategies was then carried out using Pearson's correlation coefficients across all questions instead of individual questions to see how choice of strategy correlated with reading success for each of the socio-cultural groups. The procedures followed are outlined in the next section.

#### **5.5.2.2 Statistical analysis of strategy choice – Pearson's $r$**

The Pearson correlation coefficient ( $r$ ), represented by the Greek letter rho, is used to reflect the degree of linear relationship between two variables. The relationship can be positive or negative. A correlation cannot be validly used to infer a causal relationship between the variables. Consequently, establishing a correlation between two variables is not sufficient to claim causality (in either direction).

Pearson's correlation is a parametric statistic and is likely to give distorted results when distributions are not normal. A sample of 144 Year 4 and Year 6 students with a range of ability matching the state-wide population that completed the BST was invited to participate in the research and 118 accepted the invitation. Even though some students did not accept the offer and others were absent when the interviews were scheduled, representative normal distributions were obtained within each social grouping of students each time they were interviewed. Data were obtained from 58

Year 4 students and 52 Year 6 students in 2006 and 47 of the younger cohort of students were interviewed in 2007 when they were in Year 5.

In order that Pearson's correlation coefficients could be calculated it was necessary to obtain a 0/1 score on a single factor across all questions instead of a range of successful strategies that varied for different questions. Accordingly, two researchers from the ARC Linkage Project team identified the strategies they expected students to be able to use to select the correct answer for each question. The researchers first looked at the item descriptor in the report package and then carefully examined the text from the point of view of each strategy. For example, before identifying the image only strategy, the researchers had to be careful to ignore all the information in the linguistic text and determine the aspects of image/s that answered a question. The student's choice of strategy was then classified as to whether it was an 'expected strategy'. Pearson's correlation coefficients could then be calculated across all questions between the number of expected strategies each student used and their reading score for each grouping of gender, geo-location and Aboriginal status, in order to identify if any relationship was indicated between these factors for each grouping.

It was hypothesised that both the post-test and BST reading scores would correlate with choosing an expected strategy because obtaining correct answers required the use of particular strategies. In order to determine whether actual BST scores and post-test BST scores correlated, Pearson's correlation coefficients were calculated between the number of expected strategies used by students and three different reading scores: the overall reading score for the BST (a more robust measure), the score on the selected visual items during the original BST and the score on the selected visual items during

the post-test interview when the strategies were identified. The three scores were used in order to justify the use of scores from the actual BST as a defensible method for investigation of students' strategies data which were identified one year after the BST during a post-test, not the actual BST, and only across targeted items not all of the BST items.

As choice of expected strategy and obtaining the correct answer to questions are two different events that do not necessarily align, a further break down of the data was carried out. The scores were then correlated with four different options relating to choice of strategy (expected or other) combined with choice of answer (correct or incorrect). The four combinations were coded as follows:

- 0 for incorrect answer while not using an expected strategy,
- 1 for correct answer while using an expected strategy,
- 2 for correct answer while not using an expected strategy and
- 3 for incorrect answer while using the expected strategy.

It was expected that codes 0 would correlate negatively and code 1 would correlate positively with reading scores. Code 2 could be the result of guessing and was not expected to correlate and a significant negative correlation with code 3 could suggest a problem with comprehension of either text or images, which might be explained through 'think-aloud' responses and the analysis of data from sub-question D.

To confirm whether or not these expectations were met for all gender, geo-location and Aboriginal status groups, the null hypothesis for each of these conditions was that the dependent variable, reading score, would a) not correlate positively with the number of expected reading strategies used to select correct answers and b) would not

correlate negatively with number of unexpected strategies used to select incorrect answers.

Taylor (2005:95) recommends that samples in correlation research, based on the central limit theorem, consist of at least thirty individuals. However, although it would be better to have 30 or more pairs for a correlation, even with as few as 15 a highly significant result would be acceptable. This is because, as sample size decreases, a much higher correlation is required for it to be significant, so the statistical measure caters for lower numbers. The final analysis involved over 50 students in Year 3 and over 50 students in Year 5. Among the socio-cultural sub-groups only the Year 3 non-Aboriginal and Y3 female groups had more than thirty students. Most sub-groups of Aboriginal status and gender were in the high twenties but because there were three geo-location groups, there were around 20 students in most geo-location groups but only 14 students in the Year 5 remote schools group in 2005. After attritions in 2007 there were only 12 Year 5 students in provincial schools. Significant results for these remote and provincial groups would therefore need to be at the 1% or 0.01 level of probability and very carefully considered before any decision to accept them as being useful.

### **5.5.3 Data collection and analysis procedures – sub-question D**

Sub-question D: *When students talk about images and verbal text, are there any differences according to gender, geographic location, Aboriginal status or reading ability*

*(i) in the number of inferences made about the verbal text and images*

*(ii) in the amount of linguistic complexity in their spoken language*

*If there are differences according to reading ability, are there significant relationships between reading score, the number of inferences made and the amount of linguistic complexity in students' talk about images and verbal text?*

Part (i) of sub-question D requires investigation into student comprehension of the verbal and visual segments of texts and part (ii) involves an analysis of the students' spoken language when discussing text meanings. The last part of sub-question D involves relating the separate aspects of making inferences and the linguistic complexity of talk to student success in answering questions about image-language relations (post-test score) and the overall BST reading score. The procedure for identifying linguistic complexity in the students' talk was the same as the procedure used to identify verbal complexity in the written language segments of the BST texts.

In order to determine how much students comprehended about the different aspects of the texts, the researcher asked students to 'think aloud' about the meaning of verbal and visual parts of texts during their reading in 2006. Transcripts of the 'think-aloud' responses were subject to content analysis and statistical analysis was conducted to establish whether there was any significant correlation between the coded results and the BST and post-test reading scores. The same procedure was followed with regard to the students' responses to targeted reading questions from the 2007 BST except that the texts were read silently by students in 2007.

### **5.5.3.1 Content analysis and coding of think-aloud data**

A 'think-aloud' protocol was used to identify students' unmediated comprehension of the images and language across the whole of each text, not just the segments targeted

(and possibly mediated) by the BST assessment items. By asking students to think aloud as they read, they would not need to rely as heavily on working memory to recount what the text was about at the end of a silent reading. The high reliability of the ‘think-aloud’ protocols as measures of text comprehension, compared to responses obtained after silently reading through the texts, has been indicated in a study that simultaneously collected eye movement data. The study showed that, ‘the type of processing indicated by the reader’s verbal response was related to the amount of processing time invested in the probed sentence,’ suggesting that deeper processing was done ‘during the initial encounter with a sentence’ (Kaakinen 2005:255).

As Kaakinen’s research was with adults, it was decided to base the response categories on Laing and Kamhi’s (2002) ‘think-aloud’ research with third-grade children. Their response categories were two types of literal statements (exact repetition and paraphrase) and three types of inferential statements (explanation, prediction and association). In the current research one category was added to the literal statements (summary) and one category was added to the inferential statements (main idea/purpose) to more accurately capture global comments made by students. Compared to Kaakinen’s (2005:255) categories of ‘deeper level comprehension activities (self-explaining and elaborative questioning)’, the categories selected for the current research are more closely aligned to NSW English K-6 Syllabus (NSW DET 1998) outcomes for students in Year 3 and Year 5. For example, making inferences, identifying text purpose and identifying overall message are indicators of achievement of Stage 2 outcomes in the NSW K-6 English Syllabus. Any inferences were also scored correct or incorrect as in Laing and Kamhi’s (2002) research.

As the current research is about images as well as written language, students were asked what the images were showing and the inferential categories used for verbal text were also used for coding what students thought about the images. However, literal responses about the images require different categories, and in keeping with the ideational semiotic framework of Kress and van Leeuwen’s (1996) Visual Grammar, it was appropriate to record, for each clause spoken, the number of participants (nouns) identified, the circumstances (aspects of location, reason etc) identified and the types of processes (relational, material, verbal, mental, behavioural or existential verbs) used when talking about the image.

The identification of participants, processes and circumstances represented in the images, for categories of literal responses, reflects aspects of the systemic functional framework, which is used to analyse the visual texts (see 5.4.3.2). In the following extract from a transcript taken from one of the data analysis worksheets, the represented participants have been bolded.

**Clauses**

Interviewer: What’s the picture showing?

Student: It’s showing what looks like a **swordfish** with **two other fish** swimming in **water** around **dark coloured nets**.

No. of participants	Process	Circ.
2	relational	cir*
2	material	cir*

Asterisks have been used to indicate circumstances that contain represented participants (RPs). In this example, the student’s identification of ‘dark coloured nets’ shows that he is making connections with the verbal commentary (an associative inference) to describe the image beside it (see Figure 5.4).



*Escaping the Nets*

Artist: Moe Cunningham

The sailfish is believed to be a cunning fish, able to feed amongst the various fish traps and nets shown by the dark areas, without being caught. This art highlights the use of long lines and nets that are destroying our coastal fish.

**Figure 5.4** Text segment in ‘Tobwabba Art Gallery’ from 2005 Year 5 BST

After it was collected and recorded, the coded interview data was analysed using statistical tests which are outlined in the next section.

### **5.5.3.2 Statistical analysis – ANOVA, MANOVA and Pearson’s r**

A multivariate analysis of variance (MANOVA) and one-way analyses of variance (ANOVA) were conducted in relation to the Year 4 and Year 6 data in 2006 in order to investigate whether there were any differences between student groups in the number of inferences or the amount of complexity in spoken language. In stage one of the research (2006), the ANOVAs were conducted for the independent variables of Aboriginal status, gender, geo-location (metropolitan, provincial and remote) and reading ability (low, medium and high) in respect of the dependent variables. The hypothesis being tested was that there was no significant difference in any of the dependent variables between any of the categories of the independent variables, for example, between the Aboriginal and non-Aboriginal groupings. The dependent variables investigated were the amount of complexity in students’ spoken (oral)

language and the total number of statements, correct inferences, explanatory inferences and incorrect inferences about images and about verbal text.

When ascertaining whether there was any interaction between groups, the additional dependent variables of BST scores and post-test scores were included in the multivariate analysis of variance (MANOVA). Levene's test of homogeneity of variances was also conducted across both the 2006 data and the data from stage two in 2007 in order to test for the assumption of equal variances.

As a MANOVA and ANOVAs for single factor independent group variables had already been conducted in 2006, no MANOVA was conducted in stage two of the research in 2007. In order to investigate the differences between more specific groupings in 2007, a one-way analysis of variance (ANOVA) was conducted between six independent variable groupings for combinations of Aboriginal status and geographic location, that is, Aboriginal and non-Aboriginal students in each of the three locations. A one-way analysis of variance (ANOVA) was also conducted between ability groupings. The dependent variables in 2007 were the same as in 2006 except that incorrect inferences and linguistic complexity of the students' talk were not included and the additional dependent variable, associative inferences, was included in 2007 due to differences in frequencies when compared with the 2006 data.

The null hypothesis tested by the ANOVA across the Year 5 inference data in 2007 was that there would be no significant differences in the dependent variables between any of the independent variable categories, that is, the three ability groupings (low,

medium and high) or between any of the six of Aboriginal and non-Aboriginal groupings in each geo-location.

To answer the last part of research sub-question D, Pearson product moment correlation coefficients were calculated separately for all Year 4 and Year 6 students in 2006 between the 2005 BST reading scores, post-test scores, complexity of spoken language, total number of statements and correct, incorrect and explanatory inferences about images and about verbal text in the BST. In 2007 Pearson's correlations were calculated across all Year 5 students between the 2007 BST reading and post-test scores and the same inferences with the exception of incorrect inferences and the addition of associative inferences. These correlations were calculated to probe for relationships between reading scores and comprehension of images, comprehension of written language and comprehension of interaction between images and language in multi-semiotic texts as indicated in the post-test score.

### **5.5.3.3 Qualitative analysis – selection of case studies**

Case studies were selected to be representative of the range of abilities and socio-cultural groups and to exemplify the findings from statistical analyses. The few Aboriginal students with high reading scores for the 2005 BST were balanced with low performing Aboriginal student case studies and with non-Aboriginal boys and girls who had high and low reading scores from all geo-locations. The selection of the case studies has been made to exemplify the statistical findings and provide evidence for logical arguments in the discussion of the results.

## **Chapter 6 - Results of research: Analyses of assessment texts & items**

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### **6.1 Results of analyses of image-language relations in reading assessments**

- 6.1.1 Types of image-language relations involved in the five tests**
- 6.1.2 Year 3 items involving image-language interaction in 2005**
- 6.1.3 Year 5 items involving image-language interaction in 2005**
- 6.1.4 Year 3 items involving image-language interaction in 2007**
- 6.1.5 Year 5 items involving image-language interaction in 2007**
- 6.1.6 Year 7 items involving image-language interaction in 2007**
- 6.1.7 Difficulty in comprehension of image-language relations**
  - 6.1.7.1 Facility of items involving relations of equivalence**
  - 6.1.7.2 Difficulty of items involving relations of augmentation**
  - 6.1.7.3 Items involving relations of distribution and exposition**

### **6.2 Results of analyses of verbal and image complexity**

- 6.2.1 Validity of combined ‘essential’ text complexity measure**
- 6.2.2 Facility variance between different levels of text complexity**
- 6.2.3 Image complexity and item difficulty**
- 6.2.4 Verbal complexity and item difficulty**
- 6.2.5 Combined and ‘essential’ text complexity and item difficulty**

## **Chapter 6 - Results of research: Analyses of assessment texts & items**

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In this chapter the results of analyses of multimodal texts and related questions in reading assessments will be reported. Results of analysis of the types of image-language relations are reported first in answer to sub-question A: *How do images and language in reading materials interact to construct meaning and how do reading questions address students' comprehension of the image-language interaction?*

Next this chapter identifies and analyses the mean difficulty of test items assessing comprehension of the different types of image-language relations in order to answer research sub-question B (i): *Does reading difficulty differ according to the nature of various image-language relations in texts?* Finally, the complexities of images and verbal text are analysed in order to answer research sub-question B (ii) and (iii): *Does the reading difficulty differ according to the linguistic complexity (grammar and vocabulary) and visual complexity (images) of the multimodal texts?* Results of analyses of interview data which were the basis for investigating research sub-questions C and D are reported in Chapter 7.

### **6.1 Results of analyses of image-language relations in reading assessments**

Every text in the BST reading stimulus materials included at least one image, however, some of the images had a very minimal role in the construction of meaning and so were not assessed in the BST or pursued in this study. These will be briefly discussed before outlining analyses of the texts where image-language relations were assessed.

In the 2005 Year 3 BST, the text, *When the River Rose*, included an image of the cover of the book, *River Murray Mary*, from which the extract was taken. It shows a paddle-steamer stranded on land and although the image is relevant, in that it shows the source of the extract and shows an effect of flood, it does not relate to events in the extract, which are about animals fleeing a flood. The image-language relation was not pursued in the test questions about the extract.

A stylized image of a painted snake accompanying *Rainbow Snake* and an iconic naturalistic painting of a frog accompanying *Tiddalik the Frog* could be considered to have concurrence with meaning in the verbal parts of these texts, which are about creation beings from the Alcheringa or Aboriginal Dreaming. Such drawings of creatures from a European perspective (a snake with rainbow coloured dots) express divergence from the meaning in the written words which are about a creation spirit that brings lightning and rain to fill water sources. This divergence in meaning was not pursued in test questions about the extract and so was not pursued in the study.

A painting of a beach accompanying the poem, *Until I Saw the Sea*, represents two words, “sea” and “shore”, from the poem. It does not represent the participants, “sun” or “wind”, or the processes, “wrinkle”, “splinter”, or “breathes in and out” which are the figurative verbal images assessed by three comprehension questions. This partial concurrence only has minimal relevance to the fourth question which asks students to identify the descriptive purpose of the poem. The text and item assessing understanding of the purpose therefore have less relevance to image-language relations than other texts so the poem and question were not selected in the research materials.

The reading test items were carefully analysed to identify those which could be answered by reference to images, verbal text or a combination of both. These items were then analysed to see if the targeted textual segments contained images and language where meaning was concurrent, complementary or there was a relation of connection such as projection of words from images as in a cartoon.

### **6.1.1 Types of image-language relations covered in five reading tests**

Prior to identifying the types of image-language relations that were involved in answering assessment items, the images and language elements of the 2005 BST texts were analysed in terms of their representational/ideational meanings, compositional meanings, interpersonal or interactive meanings and the relations within and between these different kinds of meanings. The analyses of language were based on the systemic functional linguistic analyses of Halliday (1994) and the analyses of images were based on the account of the meaning-making resources of images by Kress and van Leeuwen (1996/2006). The purpose was to gain a wholistic understanding of the different semiotic resources and how they related to each other within each text.

These analyses support the identification of three main ways that images and language interact in the texts, that is, in relations of concurrence, complementarity and connection. The different types of image-language relations within each of these categories have been defined in Chapter 5 at section 5.4.1.1. However, in the five tests there is only one question that concerns a relation of connection. The connection relation, in the form of projection, is in the ‘Puddles’ text (see Appendix 1) from the 2007 Year 5 BST. The question asks who projected words in a speech bubble, however, the question is actually assessing comprehension of a complementarity

relation of **augmentation** because the projector of the words is not shown in the image as the speech bubble points to a doorway into another room where the speaker is hidden. Students therefore have to infer that the participant, Grandma, who is named in an introductory text box (All was quiet in Grandma's house...) but not shown anywhere in the images, is the speaker.

As a consequence of the lack of questions about relations of connection which specifically target projection or enhancement, the current research has been confined to the specific relations of *concurrency* and *complementarity* that were assessed. Amongst the assessment items in these five tests there are no questions assessing comprehension of a complementarity relation of 'divergence' or a concurrency relation of 'homospatiality'. In order to answer assessment items, the types of concurrency between image and language that students need to comprehend are relations of *exposition* and *equivalence* (both complete and partial) and the types of complementarity involved are relations of *augmentation* and *distribution*. The types of image-language relations identified and the specific questions assessing comprehension of the relations are outlined in the next sections.

### **6.1.2 Year 3 items involving image-language interaction in 2005**

All of the 2005 Year 3 Basic Skills Test (BST) texts containing image-language relations that were the focus of reading assessment questions are conceptual factual texts. Six questions assessed comprehension of image-language relations of concurrency (equivalence and exposition) in 'Water Animal Records' (appendix a) which is an information text providing factual descriptions. Three questions assessed comprehension of image-language relations of distribution in 'Telling the Time Using

Water’ (appendix b) which is an explanatory text with diagrams, where main text and labels identify a sequence of actions that explain how the water clocks work. Two questions assessed comprehension of the complementary image-language relations of distribution in ‘The Water Cycle’ (appendix c) which is also a diagrammatic text with explanatory labels but with arrows as well to show sequence. There was one question about equivalent image-language relations between main text and images in each of the texts, ‘Water Safety at the Beach’ (appendix d) and ‘Don’t Waste Water’ (appendix e) which are factual information texts.

The reading questions assessing comprehension image-language relations in ‘Water Animal Records’ and ‘Telling the Time Using Water’ are at appendix B. Questions that assessed comprehension of image-language relations in the other three Year 3 BST texts are at appendix C.

### **6.1.3 Year 5 items involving image-language interaction in 2005**

There were five texts containing image-language relations that were the focus of reading assessment questions in the 2005 Year 5 Basic Skills Test (BST). ‘Telling the Time Using Water’ (appendix b) was a link between the Year 3 and Year 5 2005 BST reading assessments and therefore the same questions are in both tests although they have different numbers according to their positions in each test.

There were five questions assessing comprehension of concurrent image-language relations in ‘Mapping Islands’ (appendix f) which is primarily a visual information text showing an aerial photo of an island and a map of it with a key to identify its features. Three questions involved image-language relations of distribution in the narrative

extract, ‘Two Summers’ (appendix g), which included two images from the original picture book. Two questions assessed comprehension of concurrent relations in the procedural text, ‘Water Movement in Plants’ (appendix h), a science experiment with photos representing each step of the instructions. This text also included a paragraph explaining how water travels up stems of plants through capillary tubes. One question assessed comprehension of an image-language relation of augmentation in ‘Tobwabba Art Gallery’ (appendix i) and another two questions about this text involved concurrent image-language relations of exposition. All of the 2005 Year 5 reading questions involving image-language relations are at appendix D.

#### **6.1.4 Year 3 items involving image-language interaction in 2007**

Four questions assessing comprehension of image-language relations in the 2007 Year 3 BST were about extracts from narrative picture books. One question was about distribution of meaning in *Mr Archimedes Bath* (Allen 1980) where students need to interpret both the picture (overflowing water) and the words, (‘Where did all this water come from?’ bellowed Mr Archimedes) to know that he is annoyed because the water is overflowing. One question about *Big Dog* (Gleeson 1991) assessed comprehension of augmented meanings where students needed to interpret the words to identify which picture shows the narrator.

Four questions involved concurrent meanings in the procedural text, ‘A Hole in Your Hand’ and three questions were about equivalent meanings in ‘Tangrams’, an information text with labelled images. A question about augmented meaning required students to identify on an egg image in the test booklet where you would find an air pocket, a participant which is mentioned at the end of an explanation in the text,

‘Eggs’. Scans of the 2007 Year 3 BST reading stimulus magazine which includes these five texts are at appendix j and the reading questions are at appendix E.

### **6.1.5 Year 5 items involving image-language interaction in 2007**

Of the six texts with reading questions involving image-language relations in the 2007 Year 5 BST, three were narratives: ‘Zoo’, ‘Puddles’ and ‘Dragon Quest’. There were four questions about an extract (appendix k) from the picture book, *Zoo* (Browne 1994), that involved image-language relations. Two of the questions involved equivalence between the image of a tiger which is ‘just walking along a wall of a cage’ and the inference that this is boring. The other questions involve exposition of the father’s bad ‘mood’ by having cloud resemble horns on his head and augmentation of meaning through a chocolate wrapper beside the father in an image implying that he has eaten the chocolate that he said the children could not have.

There were also four questions about the cartoon, ‘Puddles’ (appendix l), which involved equivalence, distribution and augmentation. The two questions about augmented meanings concern the words spoken by Grandma, a participant who cannot be seen in the cartoon because she is speaking from another room in the house. The question about augmentation in ‘Dragon Quest’ (appendix m) requires students to recognise that the boy in the picture is responding to the narrator’s call, ‘Hey you!’

‘Eggs’ (appendix n) appeared in both the Year 3 and Year 5 tests. The other two factual texts, the ‘Mirror Mirror’ part of ‘Drama Games’ (appendix o) and ‘Double, treble or not’ (appendix p) describe rules or procedures for games. The question about ‘Mirror Mirror’ required students to select the action in a photo that had a caption

stating the action, therefore involving an image-language relation of equivalence. One of the questions about ‘Double, treble or not’ requires students to select the image that is a counter. The answer can be located in the main text which refers to a ‘shell counter’ or the image of the shell in the text which is located above the words, ‘Current player is: Shell,’ from which students can infer the shell is a counter. The other question about ‘Double, treble or not’ involves distribution of mathematical processes across the text by requiring students to recognise the addition symbol in the image and infer multiplying from the words, ‘the player can decide to double or treble the answer’. The reading questions, assessing comprehension of image-language relations in these texts, are at Appendix F.

#### **6.1.6 Year 7 items involving image-language interaction in 2007**

Ten assessment questions (see appendix G) in the 2007 Year 7 English Language and Literacy Assessment (ELLA) that involved image-language relations were associated with five factual information texts, four of which contained a variety of conceptual images. Only two of the ten questions involved image-language relations of complementarity: one concerned distribution and the other augmentation of meaning. The distribution question asked why the cow symbol was used in ‘Dairy Farm’ (appendix q) which was a primarily visual text showing a map of a farm with a key accompanied by a short verbal description of the farm. To answer the question students needed to connect the cow symbol labelled natural pasture in the key with words from the main text: ‘The dairy cattle graze on the natural pasture.’ Two other questions about ‘Dairy Farm’ addressed equivalence of meaning in the key and the fourth question involved exposition through comparison of the map’s spatial elaboration of meanings provided in the key and main text.

The question about ‘Secret Life’ (appendix r) involved equivalence as it asked students to identify an image of a bush food which was labelled in the text but the question about ‘Early Greek Theatre’ (appendix s) involved elaboration because students had to interpret a key as well as compare the spatial elaboration of the relative positions of two numbers on a diagram. The question about augmentation of meaning in ‘Japanese Noh Theatre’ (appendix t) asked students to identify that the actors’ costumes are traditional. The photo of the actors is augmented by information in the main text, ‘Noh theatre began in Japan around AD 1300’ which helps students to infer that the costumes are traditional if they do not know already. The two questions about ‘Ten Years of Recycling’ (appendix u) involve equivalence where meanings stated in the main text are also represented in graphs.

### **6.1.7 Difficulty in comprehension of different image-language relations**

The use of statistical (Rasch) analysis to determine logits of difficulty for BST assessment items was outlined in Chapter 5. The 63 assessment items involving image-language relations had logits that ranged from -2.92 (easy) to +2.04 (difficult). Appendix H contains tables listing the identified reading questions from the four BST and one ELLA papers, the types of image-language relations that needed to be comprehended, the Rasch logits of difficulty and the resultant band levels of difficulty (starting at one for easy items and up to six for difficult items). The tables show a range of difficulty amongst items but relations of concurrence tended to be easier than relations of complementarity.

To determine whether this tendency represents a significant difference in difficulty between different types of image-language relations, the mean logit of difficulty was determined for each type of relation across 63 items. A one-way analysis of variance (ANOVA) test was conducted to investigate whether the mean difficulties (dependent variable) for the five image-language relations (independent variable) were significantly different from one another (see Table 6.1).

Dependent Variable: Logit

				95% Confidence Interval	
IMAGE-LANGUAGE RELATION	N	Mean	Standard Error	Lower Bound	Upper Bound
Augmentation	9	1.449	.286	.878	2.021
Distribution	15	.482	.221	.040	.925
Exposition	14	-.080	.229	-.538	.378
Equivalence (partial)	13	-.876	.238	-1.352	-.400
Equivalence (complete)	12	-1.356	.247	-1.851	-.861

**Table 6.1** ANOVA: image-text relations mean item difficulty

The one-way between conditions ANOVA showed a significant difference between the effects on logit difficulty at the  $p < .05$  level for the five image-language relations [ $F(4, 63) = 18.182, p < .001$ ]. Multiple comparisons in a post-hoc Fisher's Least Significant Difference (LSD) test analysis (SPSS output is at Appendix I) indicated that the mean difficulty of items involving relations of augmentation was significantly higher (at the .01 level of probability) than the mean difficulty of items involving each of the other image-language relations. The mean difficulty for distribution items was

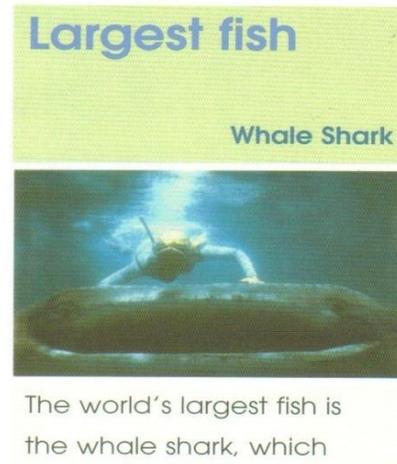
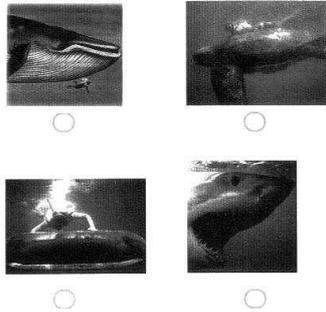
also significantly higher (at the .01 level) than the means for items involving complete equivalence and partial equivalence but was not significantly different from the mean for items involving exposition. The means for items involving partial and complete equivalence were not significantly different from each other but they were significantly lower (at the .05 level) than the mean difficulty for items involving image-language relations of exposition, distribution and augmentation.

BST items targeting relations of equivalence and augmentation will now be reported to exemplify differences in difficulty between these two image-language relations and then BST items targeting exposition and distribution will be discussed to exemplify the similarity in difficulty for these two relations.

#### **6.1.7.1 Facility of items involving relations of equivalence**

The items targeting relations of equivalence were evenly distributed across the tests, there being five in each of the five reading tests analysed. It was not surprising that the image-language relations of equivalence were easy for students because the images and language reinforced each other. Many of the items targeting relations of equivalence were assessing the ability to comprehend keys on maps or labels and simple captions such as the text segments from 'Water Animal Records,' which are shown on the right of the items assessing comprehension of them in Figure 6.1.

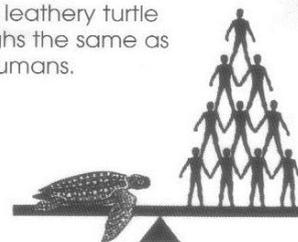
3. Which picture shows the whale shark? Colour in a bubble to show your answer.



2. One leathery turtle weighs the same as

- 3 brachiosaurs
- 7 elephants
- 10 humans
- 30 African elephants

One leathery turtle weighs the same as 10 humans.



**Figure 6.1** Questions 3 and 2 and parts of the ‘Water Animal Records’ text in the 2005 Year 3 BST (extract from *Animal Records* by David Drew)

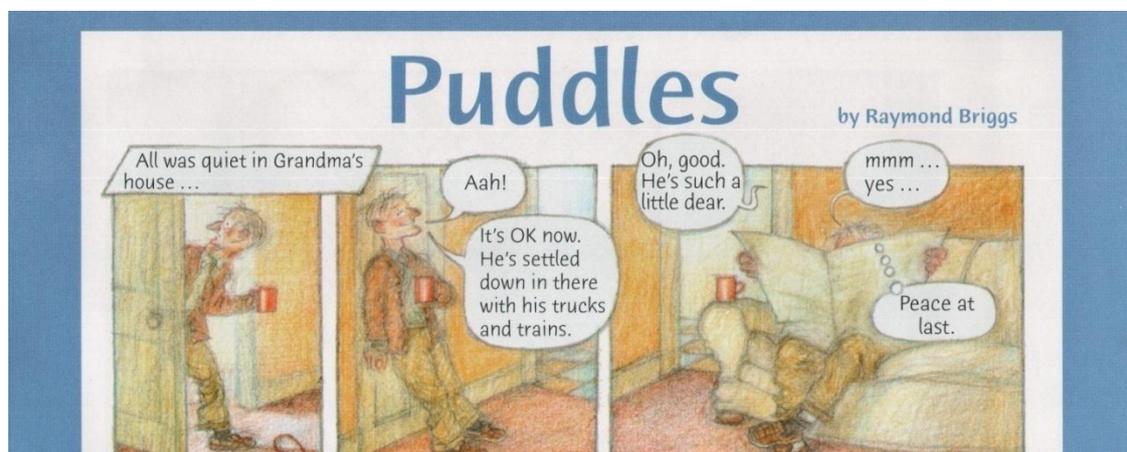
The threshold logits were negative for 23 out of the 25 items targeting relations of equivalence. The only items targeting equivalence which had positive thresholds were Question 24 in the 2005 Year 5 BST which involved sequencing events and Question 3 in the 2007 Year 7 ELLA which asked why a key was included in a map.

### 6.1.7.2 Difficulty of items involving relations of augmentation

There were no items targeting relations of augmentation in the 2005 Year 3 BST reading assessment and there was only one in the 2005 Year 5 BST about ‘Tobwabba Art Gallery’, one in the 2007 Year 7 ELLA and two in the 2007 Year 3 BST. However, there were five items targeting relations of augmentation in the 2007 Year 5 BST: two about the text, ‘Puddles’, and one about each of the texts, ‘Zoo’, ‘Eggs’ and

‘Dragon Quest’. This difference will be taken into account when considering the results from other aspects of this research, for example, students are likely to select different reading strategies and make different inferences to access augmented intermodal meanings than they would to access concurrent intermodal meanings.

To access meaning from image-language relations of augmentation students must be able to infer that a participant that is represented in one semiotic resource has relevance to events depicted in the other semiotic resource. For example, Question 7, which is about the ‘Puddles’ text from the 2007 Year 5 BST, asks who projected words in a speech bubble but the projector of the words is not shown in the image as the speech bubble points to a doorway into another room where the speaker is hidden. Students therefore have to infer that the participant, *Grandma*, is the speaker by making a connection from the third frame of the cartoon, which has the speech bubble and doorway, to words in a text box in the first frame, “All was quiet in *Grandma’s* house”(see Figure 6.2). It is therefore not surprising that this question, which concerns comprehension of a relation of **augmentation**, has a positive Rasch logit of 1.79.



**Figure 6.2** First three frames of ‘Puddles’ from 2007 Year 5 BST

Question 11, which asked how many characters are in this text, required the same understanding of augmentation but it was even more difficult with a Rasch logit of 2.04. The higher difficulty might be because this question does not draw students' attention to a specific part of the text which provides evidence for the existence of the third character in the way that Question 7 does.

### 6.1.7.3 Items involving relations of distribution and exposition

The lack of significant difference between the mean difficulty of relations of distribution and exposition reflects a similarity in the range of Rasch thresholds (logits of difficulty) for these items. It is possible that a reader with an understanding of the scientific and technical concepts in the diagram (see Figure 6.3) might not consider the meaning to be distributed across the text, 'Telling the Time Using Water', because such a reader might infer the existence of a process (action) which is not overtly represented in the image.

30. The water in the Greek water clock makes

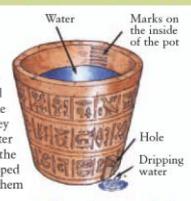
- marks on a pot
- the clock hand turn
- marks on a clock face
- the clock hand balance

31. Order these steps to show how a Greek water clock works. Write a number from 1 to 4 in each box to show the order.

- water drips into a container
- a float rises in the rising water
- cogs moving up turn a clock hand
- the float makes cogs move upwards

TELLING THE TIME USING WATER

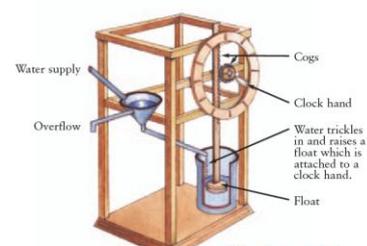
Long ago in a country called Egypt the people used water to help them tell the time. They marked the inside of a pot at measured spaces and made a small hole near the bottom of the pot. Then they filled it with water. As the water dripped through the hole, the water level inside the pot dropped below the marks. This told them how much time had passed.



An Egyptian water clock

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The ancient Greeks also developed a water clock (clepsydra).



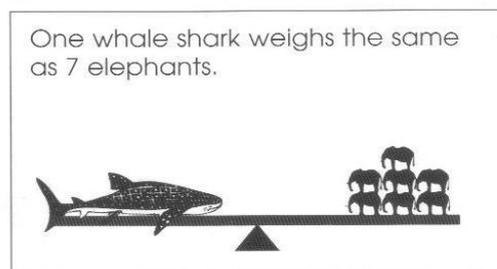
A Greek water clock

**Figure 6.3** Q30 & Q31 and 'Telling the Time Using Water', 2005 Year 3 BST

A reader who easily infers the processes (*raises* and *attached* in the label) from the image has background knowledge but such knowledge is not expected from young students. As the processes are not represented in the image and are only stated in the explanatory caption, a relation of distribution was identified. This decision was vindicated when many students said they needed the commentary in the label to understand how the clock worked. The decision also seemed to be justified by the positive logits 0.84 and 1.55 for the two questions which reflect the level of difficulty of other items involving image-language relations of complementarity.

An example of an item assessing a relation of exposition in 'Water Animal Records' (2005 Year 3 BST) asked, 'In the diagrams, what does this triangle  $\Delta$  represent?' In order to select the correct answer, 'the centre of the balance,' students had to recognise that the triangle images are part of balances (see example in Figure 6.4).

Categorisation of the image-language relation as exposition (a reformulation of processes) is appropriate because the same meaning applies to both processes. The caption uses the process, 'weighs', and the image shows the process, 'balances', to imply weighs. It does not represent an activity sequence of different processes which would denote distribution.



**Figure 6.4** Extract from *Book of Animal Records* by David Drew (2005 Year 3 BST)

The question involving this image had a Rasch logit of +0.17 and student responses in interviews indicated most students did not have difficulty with the word ‘weighs’ being reformulated in the balance scale image.

A hierarchy of difficulty in the image-language relations has been established, however, there was also a range of difficulty among items that involving each image-language relation, so the complexity of the language and images were separately analysed for all items to see if these factors were also related to item difficulty.

## **6.2 Results of analyses of verbal and image complexity**

The complexity of the verbal segments of texts that students needed to comprehend in order to answer items was identified as low, medium or high based on the number of instances of dependent clauses, non-core vocabulary, ellipsis and passive voice. The image complexity, which was also identified as low, medium or high, was based on whether each relevant image had abstract, technical or inferential content. Scores of 0 were identified as low complexity, scores of 1 to 2 were identified as medium complexity and scores of 3 or more were identified as high complexity. For the variables of combined text complexity and combined ‘essential’ text complexity scores, scores of 0 to 1 were low, scores of 2 to 3 were medium and scores of 4 or more were high. All of the textual data were scored by the researcher. A second coder independently scored 40% of the data and the inter-judge reliability was 94% using the percentage agreement method. However, after explaining judgements to each other, 100% agreement was reached between scorers.

To establish whether there was a significant difference in difficulty between levels of text complexity, a one-way ANOVA was conducted between the mean logits of difficulty (dependent variable) for items with low, medium and high levels of image complexity, verbal complexity, combined image and verbal complexity and combined 'essential' text complexity (independent variables). A multivariate ANOVA (MANOVA) was not performed because two of the variables were combinations of the other two variables. For combined text complexity, scores for all language and image complexity were combined before identifying levels of complexity (low, medium and high). For combined 'essential' text complexity it was predicted that most students in a test situation would tend to access text segments that were less complex so in these instances it was decided that only the mode with the lower complexity would be counted. The validity of this decision will now be checked against the strategies data for items in the post-test.

### **6.2.1 Validity of combined 'essential' text complexity measure**

Five of the items, where combined text complexity was reduced for the combined 'essential' complexity measure, were in the post-test. It was therefore possible to check the strategies data on these items to identify whether students accessed the more complex aspects of the text and to verify the appropriateness of the decision to not count the complexity in one mode (the higher complexity) when identifying combined 'essential' text complexity. Question 29 in the 2007 Year 5 BST asked 'Which of the following is a counter?' and while the main text refers to 'the shell counter,' the game board shows the shell counter image next to the words 'Current player is: Shell'. Nearly four times as many students used image only as used verbal text only strategies, so the decision to discount verbal text was vindicated. With regard to

Questions 2 and 4 in the 2005 Year 3 BST and Question 1 in the 2005 Year 5 BST, the complexity was higher for image than for verbal text and, as predicted, fewer students chose the strategy of interpreting image only than interpreting verbal text only to select answers. For the fifth of these questions, fewer students said they used images only to answer Question 2 in the 2005 Year 5 BST even though text complexity was higher, so for this question alone the lower complexity in the image was changed to zero. However, the level of combined ‘essential’ text complexity did not change as a result and remained at the medium level as for combined text complexity.

Of the other five equivalence questions that were not in the post-test material, image complexity was changed to zero for the ‘essential’ measure on only one item, Question 16 in the 2007 Year 3 BST, where students only needed to read a single word label and did not need to interpret the abstract tangram image. In the other four questions verbal complexity was changed to zero for the ‘essential’ measure. To answer Year 3 Question 19, ‘How should paths be cleaned?’ students could read the main text which states, ‘Paths should be swept with a broom’ or refer to the image of a person sweeping leaves. In the same test, Question 24 asks, ‘Which picture shows the sign for the area set aside for surfboard riders?’ but the sign shows a person on a surfboard so there was no need for students to read the words beside the image in the text.

Questions 22 and 24 in Year 7 ELLA asked students to find information that is in the main written text and also shown in graphs. Question 22 required students to complete the sentence, ‘The only country in the study that produced more waste per person than Australia was...’ and the answer USA was clearly shown on a column graph of countries and the waste they produced. Question 24 also required students to complete

a sentence, 'Between 1993 and 2004, the rate of recycling of newspapers has...', and the answer 'increased' was clearly visible in the slope of a line graphing newspaper recycling against years. Of course the ability to easily interpret the image would be dependent on students having mathematical skills to understand line graphs and other students would have to try to find the answer in the verbal text.

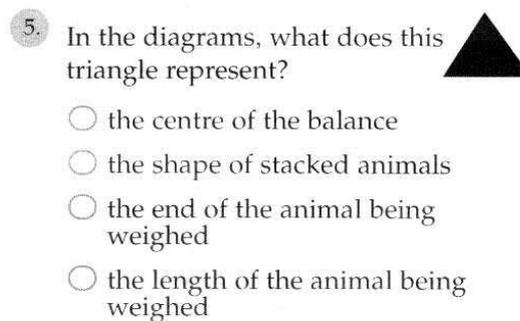
### **6.2.2 Facility variance between different levels of text complexity**

The results for the ANOVAs (see Appendix J) show that differences in item facility/difficulty for different levels of image complexity were not significant ( $p = .306$ ) but differences between the difficulty of items with different levels of verbal complexity were significant [ $F(2, 63) = 3.142, p = .039$ ]. There were also highly significant results for both combined text complexity [ $F(2, 63) = 5.122, p = .009$ ] and combined 'essential' text complexity [ $F(2, 63) = 13.829, p < .001$ ]. The lack of significant difference in difficulty for items involving different levels of image complexity will be considered first, and then the post hoc test results for verbal complexity, combined text complexity and combined 'essential' text complexity will be considered.

### **6.2.3 Image complexity and item difficulty**

The lack of significant difference in difficulty between different levels of image complexity (see the Analyses of Variance at Appendix J) could be related to a number of factors. There might not have been a sufficient range of complexity in the images for differences in difficulty. Alternatively, the complexity measure which has not been previously tested might not have been well enough calibrated, might not have focused on all of the relevant aspects of images or might have focused on irrelevant aspects of

images. In fact, it is likely that several of these factors are relevant. The complexity scores for images were mostly 0, 1 or 2 with two scores of 3 and one of 6 while the scores for language ranged from 0 to 10. There were no highly complex images and the question with the highest score for image complexity was a Year 3 question of average difficulty (see Figure 6.5).



**Figure 6.5** Q5 in 2005 Year 3 BST which had the highest score of image complexity

This question scored high on image complexity because the triangle was both technical and abstract and the score was tripled because it occurred in three similar images of balance beams (see example in 6.4).

In hindsight it would seem inadvisable to triple a score for three images representing the same concept where they each require the same understanding and only have different additional participants (different animals being weighed on the same balance scale).

#### **6.2.4 Verbal complexity and item difficulty**

The ANOVA revealed significant differences in the difficulty of items involving different levels of verbal text complexity [ $F(2, 63) = 3.412, p = .039$ ]. The LSD post hoc tests revealed that items with high levels of verbal complexity had significantly

greater mean difficulty than items with low levels of verbal text complexity (Mean Difference = 1.026, Standard Error = .402,  $p = .013$ ).

The range of difficulty for equivalence items was from -2.92 to +0.61 and as mentioned in section 6.1.7.1 only two of these items had positive logits of difficulty. However, there was also a range of difficulty for items assessing image-language relations of augmentation from +0.67 to +2.04. The hardest question about ‘Puddles’ seemed to involve difficulty within the image as discussed in section 6.1.7.2 but the next hardest question about ‘Tobwabba Art Gallery’ involved comprehension of complexity in the language structure.

The difficult question about ‘Tobwabba Art Gallery’ indicated four coloured shapes in the abstract background of a painting (see Figure 6.6) and asked students to identify which shape showed ‘a fish trap or net’. The ‘fish traps and nets’ are abstract participants named in the caption but not apparent in the image without the information in the caption, so to identify the correct shape students had to first understand the complex sentence shown in Figure 6.6.



*Escaping the Nets*

Artist: Moe Cunningham

The sailfish is believed to be a cunning fish, able to feed amongst the various fish traps and nets shown by the dark areas, without being caught. This art highlights the use of long lines and nets that are destroying our coastal fish.

**Figure 6.6** Segment of ‘Tobwabba Art Gallery’ relating to Q28 in 2005 Year 5 BST

In the following grammatically complex sentence, the dependent clauses are in italics and are described in parentheses, non-core words are bolded, the passive verbs are underlined and the ellipsis is indicated by square brackets containing words probably elided but other words are possible:

The sailfish is **believed** to be a **cunning** fish,  
*[that is] able to **feed amongst** the **various** fish traps and nets* (relative clause)  
*[that are] shown by the dark areas,* (embedded relative clause)  
*without being caught.* (adverbial clause modifying ‘able to feed’)

Students would probably have found the passage easier to understand without the non-core words, passive voice and ellipsis, for example, if the text had been, ‘We think the sailfish is a clever fish. It is able to eat around many fish traps and nets. The dark areas in the painting show the fish traps and nets. The fish avoid them.’ Although such a spoken-like version might be more accessible to some students, it would lose much of the textual meaning and authenticity afforded by the more ‘written’ grammar of the original. It is important that such complexity is included in tests of reading as long as the source of difficulty is acknowledged.

Compared with other augmentation questions, Question 4 in the 2007 Year 5 BST was a relatively easy question requiring students to understand sentences with low verbal complexity which can be seen in the following text segment from ‘Zoo’. Students needed to comprehend the dialogue in order to correctly answer a question about a picture in the text which showed an empty chocolate wrapper beside Dad. There are only independent clauses (no complex sentences) and no passive voice or ellipsis. The only non-core word is ‘whined’.

Mum had brought some chocolate  
and Harry and I were starving.  
“Can we have it now?” I asked.  
“No, not yet,” said Dad.  
“Why not?” whined Harry.  
“Because,” said Dad.  
“Because what?” I asked.  
“Because I say so,” said Dad.

From these examples of items targeting relations of augmentation in the BST texts it would appear that complexity in the verbal segments could be related to higher difficulty of the assessment items as well as the type of image-language relations involved. However, the mean difficulty of items with a medium level of complexity was not significantly different from the mean difficulty of items with low levels or high levels of verbal complexity. This lack of significant difference was partly because five questions were easy, even though they were about verbal segments with medium linguistic complexity. As the images and verbal text conveyed equivalent meaning, the students could access the answer from images alone without needing to access the verbal text which had medium complexity. These questions were described in section 6.2.1 of this chapter in relation to validity of the measure of combined ‘essential’ text complexity. The results of analyses of combined text complexity are reported next.

### **6.2.5 Combined and combined ‘essential’ text complexity and item difficulty**

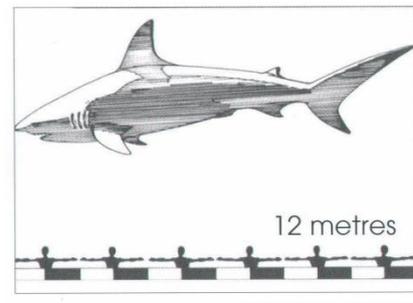
As for verbal complexity, there was a significant difference between the mean logits of difficulty for items involving different levels of combined text complexity [ $F(2, 63) = 5.122, p = .009$ ]. The Fisher LSD post hoc tests showed greater mean difficulty for items involving high levels of combined text complexity than for items involving low levels of combined text complexity (Mean Difference = 1.125, Standard Error = .357,

$p = .003$ ). The lack of significance in the difference between logits of difficulty for items involving a medium level of combined text complexity and those items involving low or high levels of combined text complexity is probably affected by similar issues of equivalent textual meanings which were mentioned in relation to verbal complexity. This is borne out by the ANOVA results for combined 'essential' text complexity measure which was adjusted for items involving image-language relations of equivalence.

The ANOVA showed that between different levels of combined 'essential' text complexity, which considered image or verbal complexity only when comprehension of that text segment was *essential* to correctly answer items, there were highly significant differences in the mean difficulty of items [ $F(2, 63) = 13.829, p < .001$ ]. Post hoc Fisher LSD tests showed significantly greater difficulty for high levels of combined 'essential' text complexity than for low levels (mean difference = 1.77, standard error = .35,  $p < .001$ ), as well as greater difficulty for medium levels of combined 'essential' text complexity than for low levels (mean difference = .90, standard error = .30,  $p = .004$ ) and greater difficulty for high levels of combined 'essential' text complexity than for medium levels (mean difference = .88, standard error = .38,  $p = .023$ ).

As explained in section 6.2.1 of this chapter, when assessing the combined '*essential*' text complexity for items which assessed comprehension of image-language relations of equivalence, the higher complexity score was not counted. *Verbal complexity* was not counted for five items and *image complexity* for another five items. An example of an item where the image complexity score was not counted when assessing combined

‘essential’ text complexity is Question 4 from the 2005 Year 3 BST, where students had to identify the length of a shark that was stated in the main text and was also labelled ‘12 metres’ next to a representational image of the shark. Students did not need to interpret the technical aspects of a scale drawing under the image of the shark (see Figure 6.7).



**Figure 6.7** Scale image originally from *Book of Animal Records* by David Drew

The strong differences in difficulty between items involving texts with low levels of combined text complexity and items assessing both medium and high levels of combined text complexity suggests there could be a relationship between the difficulty of multimodal questions and image and/or verbal complexity but mainly when comprehension of it is essential for successfully answering the questions. However, a measure of text complexity with a more comprehensive scale of interval data, such as the measure of syntactic complexity used by Botel, Dawkins and Granowsky (1973), would be required before correlation statistics could be used to investigate such a possibility.

The significant differences between low, medium and high levels of combined ‘essential’ text complexity also suggest that it is important to consider the inter-relatedness of factors that affect reading facility and to realise that texts and their features do not function in isolation but can be influenced by other factors in their

regard to the reader's ability to comprehend. For example, the complexity of either the language or images in an image-language relation of equivalence might influence the reader to choose different strategies, such as, to interpret the image alone or the language alone or both image and language to access meaning in a text. This issue is considered in the next chapter.

## **Chapter 7 – Results of research: Group analyses of reading strategies, comprehension and complexity of spoken language**

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- 7.1 Results of analyses of strategies used by students in gender, geo-location and Aboriginal status groupings**
  - 7.1.1 Results of correlation studies between scores and strategies**
  - 7.1.2 Results of correlation studies for strategy/answer combinations**
- 7.2 Results from analyses of inferences and linguistic complexity of talk for gender, geo-location, Aboriginal status and ability groupings**
  - 7.2.1 MANOVA interaction: scores, inferences and linguistic complexity**
  - 7.2.2 2006 Analyses of variance for inferences and linguistic complexity**
    - 7.2.2.1 Differences in spoken inferences in socio-cultural groups**
    - 7.2.2.2 Differences in spoken inferences in reading ability groups**
  - 7.2.3 2006 Correlations for scores, inferences and linguistic complexity**
    - 7.2.3.1 Examples of Year 4 inferences & linguistic complexity**
    - 7.2.3.2 Examples of Year 6 inferences & linguistic complexity**
  - 7.2.4 Analyses of variance for inferences in 2007**
    - 7.2.4.1 Differences across Aboriginal/geo-location groups in 2007**
    - 7.2.4.2 Differences across ability groupings in 2007**
  - 7.2.5 Correlations between scores and inferences in 2007**
- 7.3 Summary of results of analyses of strategies, inferential comprehension and linguistic complexity of talk about multimodal texts**

## **Chapter 7 – Results of research: Group analyses of reading strategies, comprehension and complexity of spoken language**

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In this chapter the results of analyses that address research sub-questions C and D are reported. Both questions are concerned with how students read multimodal texts according to their gender, geo-location and Aboriginal status. Results of analyses answering research sub-question C which investigates students' choice of reading strategies are reported first. Then results of analyses answering research sub-question D regarding students' comprehension of multimodal texts and the complexity of their language when speaking about those texts are reported. With regard to both research questions, results of the qualitative analysis of the interview transcripts follows the results of statistical analyses.

### **7.1 Results of analyses of strategies used by students in gender, geo-location and Aboriginal status groupings**

At post-test interviews students were asked how they found answers to the BST reading questions. Six main strategies were used by students to select their answers: referring to image, main text, supplementary text or combinations of these. However, students did not always use the strategy that was expected for particular questions and some reasons for choosing an answer, such as guessing, were categorised under the Other strategy category. The possible strategies for answering each question were identified by the researcher and the students' choice of strategy was categorised as 'expected' if it matched or 'not expected' if another strategy was used.

Pearson's correlation coefficients were then used to find an answer to research sub-question C: Are the strategies that students use to read multimodal texts related to

reading comprehension test scores and, if there is a relationship, is there any variation according to gender, geographic location or Aboriginal status? Both parts of the question were investigated in the one statistical analysis.

### 7.1.1 Results of correlation studies between scores and strategies

In order to investigate the validity of comparing the BST reading score with reading strategies identified more than a year after the event in a post-test, Pearson's correlation coefficients were established across all groupings of Year 4 students between number of expected strategies chosen and three reading scores. These scores were the overall reading score for the BST, the score on the targeted items during the original BST and the score on the targeted items during the post-test interview.

The Pearson's correlations for most Year 4 groups in 2006 (see statistical results at Appendix K) between the post-test reading scores on items involving image-language relations and the number of expected strategies used by students, were significant at the .01 level. The correlation coefficients were moderate for all Year 4 students and the Year 4 sub-groups of non-Aboriginal, female and metropolitan students. They were strong for males and remote students and very strong for Aboriginal students as shown in the summary at Table 7.1.

	All Yr 4	ATSI	Non-ATSI	Metro	Provin	Remote	Male	Female
r	.628**	.921**	.426**	.646**	.348	.793**	.722**	.543**
p	.000	.000	.008	.000	.157	.000	.000	.001
n	65	28	37	26	18	21	30	35

\*\* Correlation is significant at the 0.01 level (2-tailed)

\* Correlation is significant at the 0.05 level (2-tailed)

**Table 7.1** Summary of Pearson's correlations between Year 4 post-test score and number of expected strategies for Aboriginal status, geo-location and gender groups

However, there was no significant correlation with the post-test score or the BST reading score (see Table 7.2) for Year 4 provincial students. Correlations between the BST reading score and the number of expected strategies used by students were moderate and significant at the .05 level for all other groups (see Table 7.2) so there was consistency between the BST correlations and the post-test correlations.

	All Y4	ATSI	Non-ATSI	Metro.	Provin.	Remote	Male	Female
r	.472**	.420*	.555*	.563**	.186	.624**	.424*	.507**
p	.000	.026	.000	.003	.459	.003	.020	.002
n	65	28	37	26	18	21	30	35

\*\* Correlation is significant at the 0.01 level (2-tailed)

\* Correlation is significant at the 0.05 level (2-tailed)

**Table 7.2** Summary of correlations between Year 3 BST reading score and number of expected strategies for Aboriginal status, geo-location and gender groups

Correlations between the number of expected strategies and the number of correct answers to the targeted items during the BST (see Table 7.3) were significant at the .05 level for all groups except the provincial and Aboriginal groups but weaker in all instances. As the number of students and the number of expected strategies was the same in each analysis, the lower strength correlations with score on targeted questions during the BST indicates a difference in students' scores on the items involving image-language relations from the BST to the same items during the post-test.

	All Y4	ATSI	Non-ATSI	Metro.	Provin.	Remote	Male	Female
r	.408**	.344	.488*	.522**	.175	.490*	.421*	.377*
p	.001	.073	.002	.006	.486	.024	.021	.025
n	65	28	37	26	18	21	30	35

\*\* Correlation is significant at the 0.01 level (2-tailed)

\* Correlation is significant at the 0.05 level (2-tailed)

**Table 7.3** Summary of correlations between score on targeted questions in the Year 3 BST and number of expected strategies used by groups according to Aboriginal status, geo-location and gender

The different results for provincial students are probably due to an imbalance in reading ability between the Aboriginal and non-Aboriginal students in the provincial sample of students, which was identified in Chapter 5 (section 5.3.1), compared to the metropolitan and remote samples. Despite inviting students with a similar range of ability, there were more non-Aboriginal students with BST reading scores in high bands and more Aboriginal students with BST reading scores in low bands who agreed to participate in the provincial sample than in other geo-location groups.

The imbalance in reading ability between Aboriginal and non-Aboriginal students in the provincial sample could have also contributed to the different correlation results for Aboriginal students in relation to scores on the targeted questions in the BST.

There were differences between how provincial students with low BST scores performed in the BST and the post-test, and the majority of the provincial Aboriginal students had low BST scores. During the 2006 post-test a similar percentage of both the low and high scoring provincial students reported using unexpected strategies to select correct answers, however, during the original 2005 BST all of the provincial students with high reading scores had selected correct answers to the same questions and seven out of eight provincial students with low reading scores had chosen wrong

answers. This suggests that procedures in the post-test might have supported the students with low BST reading scores to understand the texts.

The procedures in the post-test that differed from BST test conditions included reading the texts out loud and being asked to ‘think aloud’ about the meaning of texts. Other factors that might have improved students’ comprehension were the support of having someone with the student or the lack of test condition pressures during the post-test interview. It is unlikely that these students’ reading ability increased to match the high scorers since the following year only two provincial students improved their reading scores from a low band to a medium band (Band 4) in the Year 5 BST.

Where a correlation is significant it cannot be assumed that choosing an expected strategy is likely to be related to success in answering comprehension questions or conversely that choosing unexpected strategies is likely to be related to the selection of incorrect answers. Therefore, to investigate the relationship between these events a further break down of the data was carried out and other combinations of strategies and answers were correlated with the BST reading score. The BST reading score is being used because the Pearson’s correlation analysis between the three scores and number of expected strategies found there was a significant moderate correlation between the BST reading score and the post-test score ( $r = .612, p < .001, n = 65$ ) across all Year 4 students and the BST score has the greatest range so it is the most robust score. There were also significant correlations between the BST and post-test scores for each of the Year 4 sub-groupings of students ranging from a strong correlation for the provincial group ( $r = .744, p < .001, n = 18$ ) to a low correlation for the Aboriginal group ( $r = .392, p = .039, n = 28$ ).

### 7.1.2 Results of correlation studies for strategy/answer combinations

The students' BST reading scores were analysed with four different options relating to choice of strategy (expected or other) combined with choice of answer (correct or incorrect). The four combinations were coded as follows:

- 0 for **incorrect** answer while **not** using an expected strategy
- 1 for correct answer while using an expected strategy
- 2 for correct answer while **not** using an expected strategy
- 3 for **incorrect** answer while using the expected strategy.

The Pearson's correlations (see Appendix L and summary in Table 7.4) between 2005 BST reading score and these combinations of strategy and answer by Year 4 students show significance for correct answer using an expected strategy (code 1) for the same socio-cultural groups as had significant correlations for number only of expected strategies (reported in sections 7.1.1 of this chapter). The correlations for incorrect answer using an unexpected strategy (code 0) are significant for almost the same groups with one difference being that there is a significant correlation for Year 4 provincial students. As expected there were no significant correlations between reading score and correct answer using an unexpected strategy (code 2) in either cohort, for the Year 4 responses as shown in the summary at Table 7.4. It was interesting that there were positive correlations between reading score and incorrect answer using an expected strategy (code 3) across all students and for non-Aboriginal students. The larger numbers in these groupings has probably increased the number of readers with low skills who looked at the correct parts of a text but did not understand the text or did not make connections between what they read and viewed.

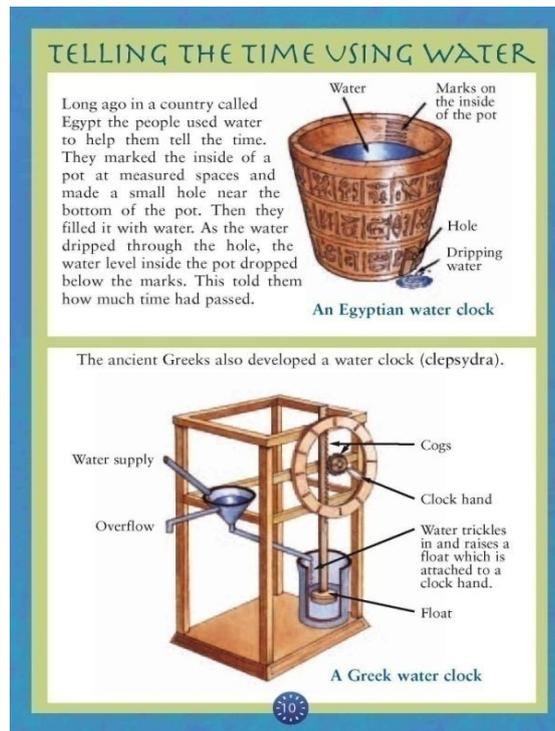
	<b>Total_0</b>	<b>Total_1</b>	<b>Total_2</b>	<b>Total_3</b>
Y4 All	-.583(**)	.577(**)	.038	-.276(*)
Sig. (2-tailed)	.000	.000	.000	.026
N	65	65	65	65
Y4 Metro	-.501(**)	.571(**)	-.046	-.181
Sig. (2-tailed)	.009	.002	.823	.378
N	26	26	26	26
Y4 Provincial	-.570(*)	.406	.209	-.196
Sig. (2-tailed)	.013	.095	.405	.435
N	18	18	18	18
Y4 Remote	-.708(**)	.726(**)	-.011	-.372
Sig. (2-tailed)	.000	.000	.961	.097
N	21	21	21	21
Y4 Male	-.553(**)	.436(*)	.290	-.268
Sig. (2-tailed)	.002	.016	.120	.151
N	30	30	30	30
Y4 Female	-.618(**)	.708(**)	-.210	-.309
Sig. (2-tailed)	.000	.000	.226	.071
N	35	35	35	35
Y4 Aboriginal	-.382(*)	.616(**)	-.233	-.103
Sig. (2-tailed)	.045	.000	.232	.601
N	28	28	28	28
Y4 non-Aboriginal	-.694(**)	.564(**)	.161	-.366(*)
Sig. (2-tailed)	.000	.000	.342	.026
N	37	37	37	37

\*\* Correlation is significant at the 0.01 level (2-tailed)

\* Correlation is significant at the 0.05 level (2-tailed)

**Table 7.4** Summary of Year 4 correlations between reading score and combinations of answer and strategy

For example, several students looked at an image as expected but they looked at the wrong image in ‘Telling the Time Using Water’ (see Figure 7.1). Some other students, including a non-Aboriginal provincial student, looked at the diagram and labels but selected ‘the dripping water,’ when asked in Question 29, ‘What did the ancient Egyptians look at to tell how much time had passed?’ These students did not understand the concept of how the Egyptian water clock worked.



**Figure 7.1** ‘Telling the Time Using Water’ from 2005 Year 3 BST

Some Year 4 non-Aboriginal students with low reading scores who used the expected strategy of referring to both image and words to answer Question 30 did not completely understand how the Greek water clock works. For example, a remote non-Aboriginal female talked about ‘*water going around*’ to make the clock hand move as though it were a water wheel (students’ words are in italics). The following male talked about something pushing down whereas the label states that the water ‘raises the float’:

*Interviewer:*

*Where did you get that answer from?  
was it from the picture, the words or both?*

*Non-ATSI metro male 5:*

*No, because this thing’s pushing down  
and that’s just gone up,  
I got it from both.*

This student is not making the correct connection between the image and the commentary in the label. He is pointing to the image of the float and saying, ‘*this thing’s pushing down*’ and also referring to the commentary in the label and saying, ‘*that’s just gone up,*’ without realising the contradiction in what he has said. Another student made the same error when explaining how the clepsydra works:

*Non-ATSI metro male 4:      The water supply, then it went down the pipe  
and the water dripped,  
and when it was rising  
it made that go... go down  
and it turned the time.*

Amongst the provincial students there could have been problems with the identification of strategies, for example, when one of the provincial students with a Year 3 BST reading score in the top band and another student from a provincial school selected the correct answers for three questions about ‘Telling the Time Using Water’, they only said they looked at pictures to decide on their answers. However, it is possible that these students did not mention the labels because they considered them to be part of the diagram. This could be the case for the five out of nine provincial students who also selected correct answers and said they only looked at the pictures.

For all Year 6 groups except the female group there were significant positive Pearson correlations for correct answer using an expected strategy (code 1) and for all groups except the female and metropolitan groups there were significant negative correlations for incorrect answers using an unexpected strategy (code 0) as shown in Table 7.5. It would therefore seem that selection of strategy could be a factor in the selection of incorrect answers by the low ability readers in all groups except the female group.

This suggests that teaching focusing on how to identify relevant information from images and/or language in multimodal texts might assist these students' reading.

	<b>Total_0</b>	<b>Total_1</b>	<b>Total_2</b>	<b>Total_3</b>
Y6 All	-.549(**)	.555(**)	-.208	-.183
Sig. (2-tailed)	.000	.000	.144	.193
N	51	51	51	51
Y6 Metropolitan	-.420	.554(*)	-.213	-.171
Sig. (2-tailed)	.065	.040	.367	.470
N	20	20	20	20
Y6 Provincial	-.610(*)	.517(*)	-.227	-.297
Sig. (2-tailed)	.012	.040	.398	.265
N	16	16	16	16
Y6 Remote	-.662(**)	.605(*)	-.145	-.056
Sig. (2-tailed)	.007	.017	.607	.844
N	15	15	15	15
Y6 Male	-.693(**)	.766(**)	-.214	-.202
Sig. (2-tailed)	.000	.000	.304	.334
N	25	25	25	25
Y6 Female	-.358	.355	-.113	-.231
Sig. (2-tailed)	.073	.075	.581	.255
N	26	26	26	26
Y6 Aboriginal	-.598(**)	.693(**)	-.332	-.331
Sig. (2-tailed)	.003	.000	.122	.122
N	23	23	23	23
Y6 non-Aboriginal	-.557(**)	.462(*)	-.092	.010
Sig. (2-tailed)	.002	.013	.642	.959
N	28	28	28	28

\*\* Correlation is significant at the 0.01 level (2-tailed)

\*Correlation is significant at the 0.05 level (2-tailed)

0 = Wrong answer, other than expected strategy 1 = Correct answer, expected strategy

2 = Correct answer, other than expected strategy 3 = Wrong answer, expected strategy

**Table 7.5** Summary of Year 6 correlations - score and answer/strategy combinations

The lack of correlation for female students is apparent in the metropolitan non-Aboriginal female sample where the number of correct answers using an expected reading strategy was similar for the two metropolitan non-Aboriginal females with low BST reading scores (11 and 12) and for the two metropolitan females with high BST reading scores (12 and 10). For example, the high and low scoring students who had

respectively eleven and ten correct answers using expected reading strategies both selected an incorrect answer to Question 28 about ‘Tobwabba Art Gallery’ by referring only to the picture, while the other females both found the correct answer by connecting the image to the verbal text. The low scoring student simply stated that she found the correct answer ‘*in the text*’. The reason for selecting the correct answer, stated by the Year 6 high scoring non-Aboriginal female is as follows:

*Non-ATSI female 4: First I didn't know what it was  
So I went back to the paragraph  
And looked at what it said were the nets and the traps.*

The only Year 6 Aboriginal female with a BST reading score in the top band also selected the correct answer and gave the following reason:

*ATSI female 2: It says here, they will...  
'to feed amongst the various fish traps'  
And that's 'shown by the dark areas.'*

Therefore the improvement in score during the post-test for some female students who had low scores in the BST combined with some students with high BST scores selecting incorrect answers or using unexpected strategies has led to the lack of significant correlation for females between BST reading score and selection of correct answer using an expected strategy.

By contrast, not as many male students chose expected reading strategies, for example, there were six metropolitan males who used the unexpected strategy of referring only to the image in at least four questions where it was expected that students would also refer to keys, main text or labels. These students’ responses might have been inclusive of the labels on the water clocks in the text ‘Telling the Time Using Water’, as suggested previously for the Year 4 students. Similarly, they might have been

inclusive of the key below the map for Questions 4 and 5 about 'Mapping Islands' when they only said they looked at the picture. It is also possible that some of the students who selected correct answers but said they looked at the picture could have been using expected strategies but not consciously focusing on them.

The Pearson's correlations for Year 5 in 2007 (see Appendix M) also showed that, as expected, for code 2 (correct answer using an unexpected strategy) there were no significant correlations for any groups. Although there were significant positive correlations for code 1 (correct answer using an expected strategy) across all students in the Year 5 sample and for the metropolitan, remote, male and non-Aboriginal groupings, there were no significant correlations for the provincial, female and Aboriginal groupings as shown in the summary of findings in Table 7.6. Similar results by these groups for incorrect answer using an unexpected strategy (code 0) may be a result of the previously mentioned imbalance between the reading ability of the Aboriginal and non-Aboriginal students in the provincial sample. Although the correlation for male students in relation to code 1 and for female students in relation to code 0 suggests a strong gender difference, this may also be related to the sample imbalance since the only Aboriginal student with a top band reading score was female.

What is particularly different in the 2007 Year 5 results shown in Table 7.6 compared with the Year 4 and 6 results in 2006 are the significant ( $p < 0.05$ ) correlations for incorrect answers using an expected strategy (code 3) for the metropolitan, remote, male and non-Aboriginal groupings of students. This indicates that students with low reading scores are choosing more incorrect answers while using an expected strategy so a significant negative correlation with reading score might be expected from these

students who might have a problem with comprehension of either text or images or the connection between them. Another contributing factor to the significant negative correlations between reading scores and incorrect answers using an expected strategy was that one question about ‘Dragon Quest’ was misread by 40 percent of students so they gave an incorrect answer even though they used the expected strategy.

	<b>Total_0</b>	<b>Total_1</b>	<b>Total_2</b>	<b>Total_3</b>
Y5 All	-.388(**)	.470(**)	.025	-.339(*)
Sig. (2-tailed)	.004	.000	.859	.013
N	53	53	53	53
Y5 Metro	-.323	.620(**)	-.347	-.552(**)
Sig. (2-tailed)	.133	.002	.104	.006
N	23	23	23	23
Y5 Provincial	-.398	.283	.157	-.079
Sig. (2-tailed)	.200	.373	.627	.807
N	12	12	12	12
Y5 Remote	-.649(**)	.697(**)	.280	-.528(*)
Sig. (2-tailed)	.004	.001	.260	.024
N	18	18	18	18
Y5 Male	-.390	.815(**)	-.383	-.703(**)
Sig. (2-tailed)	.054	.000	.059	.000
N	25	25	25	25
Y5 Female	-.408(*)	.316	.225	-.155
Sig. (2-tailed)	.031	.102	.249	.432
N	28	28	28	28
Y5Aboriginal	-.184	.045	.137	.033
Sig. (2-tailed)	.400	.839	.534	.881
N	23	23	23	23
Y5 non-Aboriginal	-.506(**)	.698(**)	-.120	-.635(**)
Sig. (2-tailed)	.004	.000	.527	.000
N	30	30	30	30

\*\* Correlation is significant at the 0.01 level (2-tailed)

\*Correlation is significant at the 0.05 level (2-tailed)

0 = Wrong answer, other than expected strategy 1 = Correct answer, expected strategy

2 = Correct answer, other than expected strategy 3 = Wrong answer, expected strategy

**Table 7.6** Summary of Year 5 correlations between score and answer/strategy combinations in 2007

As the Year 5 students in 2007 are the same cohort as Year 4 students in 2006, except for some attrition, the lack of correlation for female and Aboriginal students might be

related to the different reading materials and/or procedures. There were fewer improvements in the number of correct answers from the actual BST to the post-test in 2007 than there were during the 2006 post-test and one reason could be that the interview procedure of silent reading before talking about the text was less supportive or that the post-test was within three months of the actual test in 2007. There were also more reading items assessing comprehension of image-language relations of augmentation in the 2007 BST than the 2005 BST but these will be considered after the possible effect of the test procedures.

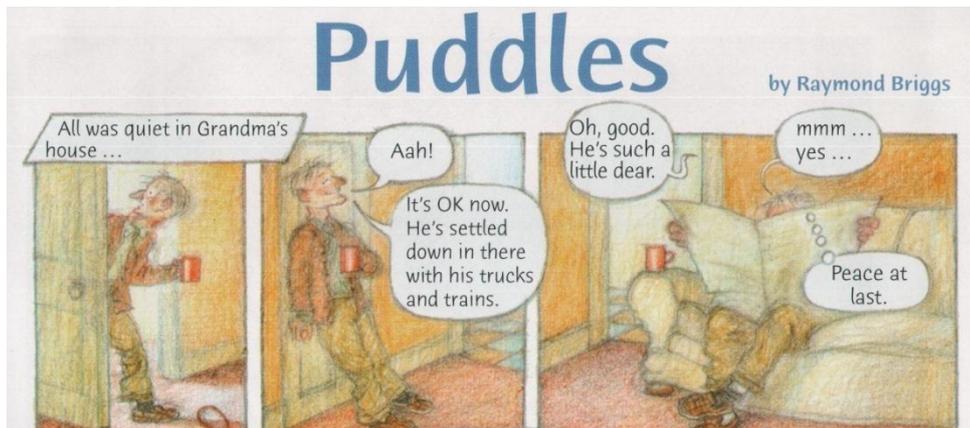
Evidence for the different test procedures affecting the results is indicated by the amount of improvement in reading scores from the BST to the post-test. Some students greatly increased their BST score during the post-test in 2006, for example, four of the provincial Aboriginal students increased their score by 2, 3 or 4 in Year 4. However, none of the Aboriginal provincial students improved their score by more than one in the 2007 Year 5 post-test, when students were asked to silently 'read through' the texts before stating what the images and language meant instead of 'thinking aloud' about them as they read. The 'think aloud' process is further investigated later in this chapter.

A change to this cohort from 2006 to 2007 that could have affected the results of provincial and Aboriginal students differentially to other groups is that three of the provincial non-Aboriginal students who withdrew in 2007 had BST reading scores in the top band whereas the Aboriginal provincial students who withdrew had mid or low band BST reading scores. Another change was two non-Aboriginal provincial students with Year 3 reading scores in medium bands in 2005 achieved Year 5 reading scores

in the top band in 2007 and two Aboriginal provincial students improved their reading score from low bands to medium BST bands in 2007 but groupings remained constant.

No Aboriginal students achieved Year 5 BST reading scores in the top band in 2007, even though three had Year 3 BST reading scores in the top band in 2005 (one in a provincial school, one in a remote school and one in a metropolitan school), and this meant that there was a lower range of BST scores for Aboriginal students in 2007. Overall eleven non-Aboriginal students and six Aboriginal students improved their reading score by two band levels while three non-Aboriginal and six Aboriginal students did not improve their reading band level from Year 3 to Year 5. As the expected growth for students is one band level, it is a matter of great concern that some students did not progress to the next reading band level in 2007.

Regarding the difference in reading texts, there were more questions involving the image-language relation of augmentation in the 2007 BST. It was expected that students would need to refer to words as well as images to correctly answer Questions 7 and 9 about the text, 'Puddles' (see Figure 7.2), and this was borne out for Question 7 because none of the four non-Aboriginal or eleven Aboriginal students who said they only interpreted images selected the correct answer. For Question 9 there were also four non-Aboriginal students who selected the incorrect answer by only interpreting images, but five of seven Aboriginal students who interpreted images only selected correct answers.



**Figure 7.2** First three frames of ‘Puddles’ from the 2007 Year 5 BST

Examples from the transcripts will now be investigated to see what other reasons there might be for the female, Aboriginal and provincial students responding to the 2007 BST questions and texts in different patterns to the way they responded to the 2005 BST questions and texts in 2006. Of the four students who are common to these groups (female Aboriginal students in provincial schools) female 6 had a BST reading score in a medium band; female 1 had a BST reading score in the lowest band in 2005; female 5 had a BST score in a low band but increased her reading score to a medium level band in 2007; and female 3 had a reading score in the top BST band in 2005, but did not complete the BST reading test in 2007. The transcripts for the latter two students will now be considered.

Aboriginal female 5 selected three incorrect answers in the 2007 post-test to Questions 5, 7 and 32 while using expected strategies and female 3 selected incorrect answers to Questions 7 and 11. Question 5 is assessing comprehension of a text segment in ‘Zoo’ which had concurrent meanings inferring that life was boring for the tiger, but when the following student has referred to the picture she has decided that life for the tiger is

‘exciting’. She did not seem to think that walking up and down beside a fence is boring as most other students did.

*Interviewer: Right. And how did you know that life for the tiger is exciting?*  
*ATSI female 5: 'Cause they ... they're not ... probably*  
*because they're not really worried about other animals*  
*and they just keep running around it all.*  
*And when they're hungry*  
*they can just go get something to eat.*

Question 7 was assessing understanding of augmentation of meaning between the words and images in the cartoon, ‘Puddles’ (see Figure 7.2 above). The question asks who is speaking the words in a speech bubble that is pointing to a doorway into a room where the speaker is hidden from view. This speech bubble is next to another speech bubble coming from a man on a lounge. Many students did not notice the slightly different direction of the speech bubble projector and more importantly did not realise the incongruence created if the same person speaks the words in the second bubble which are responding to the comment in the first speech bubble (see Figure 7.2). Even a provincial Aboriginal student who had a Year 3 reading score in the top BST reading band in 2005 made this error:

*Interviewer: How did you get your answer to question seven?*  
*ATSI female 3: Well if you have a look at the speech marks here,*  
*it's ... and you have a look at the pictures down here,*  
*there's a man*  
*then you have a look here*  
*and he's just saying oh good he's such a good dear.*

Some students were convinced that the image showed a female, and in the following instance a female Aboriginal student with a BST reading score in a low band seems to rely on the first sentence of the text to confirm her interpretation of the image:

*Interviewer: How did you know that that was the grandma?*  
*ATSI remote female 1: Because it says, all was quiet in grandma's house  
and then there's only two characters,  
the little boy and grandma and she ...  
and she says 'oh good, he's such a little dear'.*

*Interviewer: And so is this grandma?*  
*This picture of the person reading the paper?*  
*ATSI remote female 1: Yeah.*

Even though the female selected the correct answer she obviously did not understand the text as she thinks that there are only two characters, that the speech bubble is coming from the person on the lounge and that the man on the lounge is a grandma. What is interesting about this instance is that the expected strategy of referring to the first sentence in the text as well as the image has assisted this student to select the correct answer but for the wrong reasons. The student thinks the person on the lounge is speaking the words and does not realise that the speech bubble is coming from another room and is spoken by a person hidden there. It is the interpretation of the image of an elderly white male as a female that has led to the student to select the correct answer. It is also possible that the student did not understand the culturally unfamiliar term, grandma, since most Aboriginal students call their grandparents Nan and Pop. She may even have confused the similar terms, grandma and grandpa.

Some other students, both Aboriginal and non-Aboriginal, referred only to the image and misinterpreted the direction of the speech bubble thus selecting the incorrect answer. For example, the following male Aboriginal student in a remote school, who had a BST reading score in the top band, responded as follows:

*Interviewer:* How did you get your answer to question seven?  
*ATSI remote male 4:* When I was reading along  
 I seen this here. I seen this here,  
 And it was coming from the man.  
*Interviewer:* It's coming from the man is it?  
*ATSI remote male 4:* Yeah.

The last two quoted responses are from an Aboriginal male with a high BST reading score who selected an incorrect answer and an Aboriginal female with a low BST reading score who selected a correct answer even though she misinterpreted the image. It is therefore not surprising that there was no significant correlation for Aboriginal students between the BST score and correct answers using an expected strategy or that there were different correlations by gender for code 1 and code 0.

With regard to Question 11, which is also about augmentation because it asks how many characters are in the text, 'Puddles', the provincial Aboriginal female with a BST reading score in the top band is aware of the verbal reference to Grandma in the first frame of the cartoon but she discounts this person as a character in the story because Grandma is not shown in the pictures:

*Interviewer:* For question eleven, how did you know there were two?  
*ATSI prov. female 3:* Well up here it says it's quiet at grandma's house,  
 and it says it's her house but  
 it doesn't actually show her in the pictures at any time.

Like the male mentioned previously, this provincial Aboriginal female, seems to be experiencing a kind of cognitive dissonance whereby she cannot accept that a character would not be visually depicted in a cartoon. She has therefore decided that there are only two characters in the text, the man and the boy. In answer to Question 14 about 'Eggs' this student said she had guessed the air pocket was in the middle of

the egg in both the BST and the post-test because she *'didn't get it'*. She thought the text looked too long and difficult but when she was offered time to look carefully she found the correct answer in the verbal text. In contrast, a provincial Aboriginal female who had a Year 3 BST reading score in the lowest band said she guessed the answer *'because there're some hard words in there we can't understand.'* These responses show the effects of language complexity in 'Eggs' on students' answers, particularly the grammatical structure which includes two dependent clauses (in square brackets) and the passive voice (in italics) in the final sentences: 'In a really fresh egg it's very small but [as the egg gets older] the air pocket becomes larger. This air pocket *can be clearly seen* at the wide end of a hard-boiled egg [when you remove the shell]'

Many students, both Aboriginal and non-Aboriginal, misread Question 32 by overlooking the preposition 'to' and consequently chose an incorrect answer. However, when the students became aware of the correct words in the question while justifying how they chose their answer most of them were able to select the correct answer. Responses to this question and other questions that were differentially interpreted by students are investigated further in the next chapter.

The quantitative results showed that for most socio-cultural groupings use of an expected strategy was related to reading success and where groups differed there was no consistent pattern. However, the examples in this section show that students often inferred different meanings from the same texts whether they used expected or unexpected strategies, especially where contexts were culturally unfamiliar or images or language were complex. In the next section the results of analyses of students' inferential comprehension and the linguistic complexity of their talk are reported.

## **7.2 Results from analyses of inferences and linguistic complexity of talk for gender, geo-location and Aboriginal/non-Aboriginal groupings**

In order to investigate overall comprehension of the texts, students were asked to think aloud about the meaning of the words and images as they read the 2005 BST texts during interviews in 2006. The transcripts were coded in order to count the number of literal statements (clauses), incorrect inferences and correct inferences (including explanatory and associative inferences) made about verbal text and about images. The overall linguistic complexity of students' talk throughout the interviews was also scored using the same measures as those used for the analysis of the written language in reading texts. Data from this process was used to answer the first part of research sub-question D, When students talk about images and verbal text, are there any differences according to gender, geographic location, Aboriginal status or reading ability, (i) in the number of inferences made about the verbal text and images or (ii) in the amount of linguistic complexity in students' spoken language?

A multivariate analysis of variance (MANOVA) was conducted across the dependent variables (types of inferences, linguistic complexity and scores on targeted questions in the BST and post-test) to test for any interaction between the independent variables of gender, Aboriginal status and geo-location. One-way analyses of variance (ANOVA) were conducted separately for the independent variables of gender, Aboriginal status, geo-location and reading ability groupings to test for differences in numbers of various inferences and the amount of linguistic complexity in students' talk. BST scores were not included in the ANOVA as they are the basis for reading ability groupings and state-wide analysis has continuously shown differences in BST scores according to gender, geo-location and Aboriginal status.

In 2007 ANOVAs were again conducted for inferences between different ability groupings and gender groups but instead of the separate variables of Aboriginal status and geo-location a more specific independent variable was investigated. As explained in Chapter 5, the new independent variable was a combination of Aboriginal status and geo-location which consisted of six groupings, that is, non-Aboriginal and Aboriginal students within each of the three geo-locations. Pearson's correlations between reading scores and the dependent variables were also conducted across each cohort.

The results from analyses of the first stage of the research in 2006 will be reported first and then results from the second stage analysis in 2007 will be reported. Linguistic complexity of talk was not analysed in the second stage as it was not expected to vary in relation to the different assessment materials. As a single assessment was adequate for the Year 6 cohort, the same was considered to be sufficient for the Year 4 cohort.

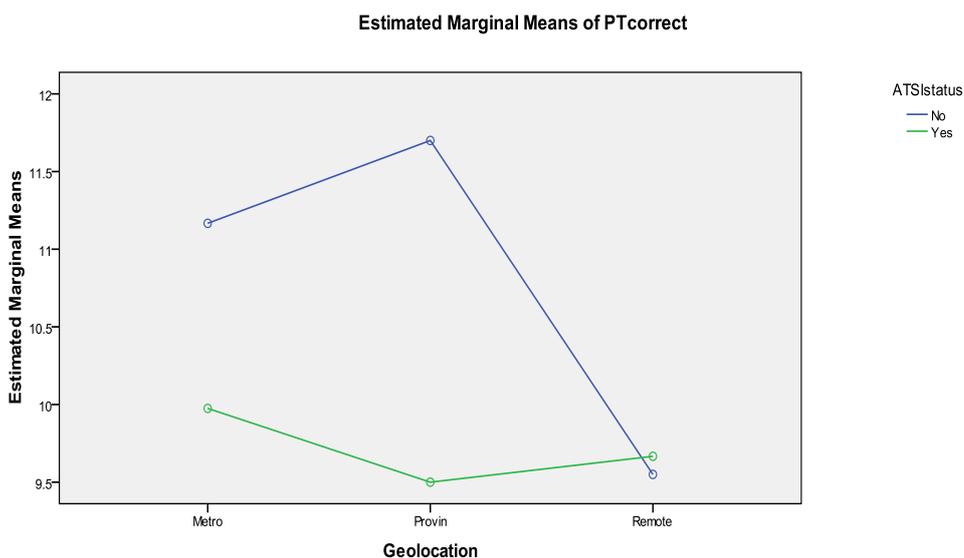
### **7.2.1 MANOVA interaction for scores, inferences and linguistic complexity**

Before conducting a multivariate analysis of variance (MANOVA), Levene's test of equality of error variances (see appendix N) was conducted to see if assumptions of equal variance had been met. Levene's test revealed that these assumptions had not been met in respect of two Year 4 dependent variables, namely, number of correct inferences about images [ $F(11, 46) = 2.083, p = .041$ ] and number of explanatory inferences about images [ $F(11, 46) = 2.109, p = .039$ ]. With regard to the Year 6 data, Levene's test revealed that assumptions of equal variance had been met for all independent variables except the number of correct inferences about verbal text [ $F(11, 50) = 2.451, p = .019$ ].

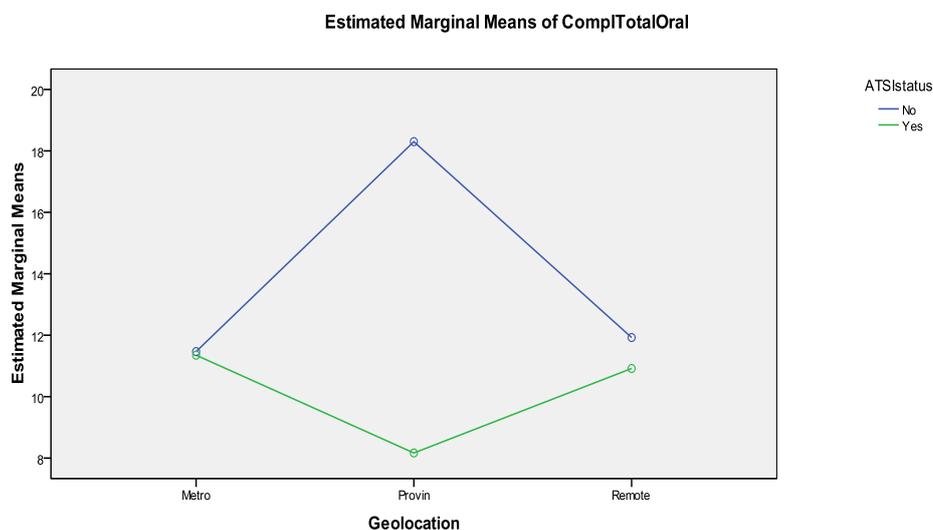
When a MANOVA (appendix O) was conducted across the Year 4 gender, geo-location, and Aboriginal status groupings a significant interaction (Wilks' Lambda  $F = 2.309$ ,  $p = .010$ ) was identified between geo-location and Aboriginal status. The MANOVA graphs (see Figures 7.3 and 7.4) of estimated marginal means produced by SPSS (Statistical Package for the Social Sciences) show unweighted means for unequal variables. The graphs reveal disparities between Year 4 non-Aboriginal and Aboriginal students in the provincial schools that were not evident in the metropolitan and remote schools with regard to post-test score means (Figure 7.3) and the mean amount of linguistic complexity in the students' talk (Figure 7.4). Differences between the number of correct inferences about images and explanatory inferences about images will not be reported in the light of Levene's test results noted above.

The difference between provincial Aboriginal and non-Aboriginal students in the estimated marginal means in relation to the post-test scores is probably related to the imbalance in BST reading achievement between the Aboriginal and non-Aboriginal students in provincial schools. The nature of the imbalance in reading ability between Aboriginal and non-Aboriginal students was that there were five Aboriginal students and only three non-Aboriginal students with reading scores in low bands and there were three non-Aboriginal students but only one Aboriginal student with reading scores in the top band.

The similar pattern in the two graphs (Figures 7.3 and 7.4) suggests the possibility of a relationship between post-test score and linguistic complexity of talk particularly for provincial and remote students. This possibility is investigated through correlation analyses and the results are reported in section 7.2.3 of this chapter.



**Figure 7.3** Year 4 means for BST image-language items post test score in each geolocation for Aboriginal students (green) and non-Aboriginal students (blue)



**Figure 7.4** Year 4 means for amount of linguistic complexity of talk in each geolocation for Aboriginal students (green) and non-Aboriginal students (blue)

The results of analyses of variance (ANOVA) conducted to test for differences in inferences and linguistic complexity between students of different gender, Aboriginal status, geographic location and reading ability groupings, in answer to the first part of Question D, are reported in the next section.

### **7.2.2 Analyses of variance for inferences and linguistic complexity in 2006**

The ANOVA for Year 6 students' responses to the Year 5 BST texts (appendix P), showed no significant differences in any of the inferential or linguistic complexity factors between Aboriginal and non-Aboriginal students, between males and females or between students in different geographic locations. The Levene's test for Year 6 groups (see appendix P) indicated that all dependent variables met the assumptions for homogeneity of variances for Aboriginal status. However, the Levene's test for Year 4 groups (see appendix Q) found unequal variances for the number of correct inferences about verbal text for Aboriginal groups [Levene Statistic (1,56) = 4.079,  $p = .048$ ] and ability groups [Levene Statistic (2,55) = 3.611,  $p = .034$ ]. While the assumption of equal variances was met for all other groups in respect of correct inferences about verbal text and for all groups in respect of correct inferences about images and linguistic complexity, the Levene's test found unequal variances in the number of:

- incorrect inferences about images for Year 6 geo-location groups and Year 4 and Year 6 reading ability groups
- incorrect inferences about verbal text for Year 4 gender, geo-location and reading ability groups
- explanatory inferences about images for Year 4 Aboriginal status, geo-location and reading ability groups and Year 6 gender groups
- explanatory inferences about verbal text for Year 4 gender and Year 4 and Year 6 reading ability groups.

As there were many nil and low scores for incorrect and explanatory inferences, the numbers were not considered robust enough to make it worthwhile conducting non-parametric tests on these dependent variables for which equality of variance was not evident. It was considered more useful to qualitatively analyse the transcripts to identify where students made explanatory or incorrect inferences. Prior to presenting

the qualitative findings, the results of the ANOVAs are presented for gender, geo-location and Aboriginal status groupings first and then for reading ability groupings.

### **7.2.2.1 Differences in spoken inferences within socio-cultural groups**

The ANOVAs for Year 4 students' responses to the BST texts (see statistical analysis at appendix Q) indicated no significant difference in relation to gender but for variables that passed the Levene's test for assumptions of homogeneity of variances there was one significant difference in relation to geo-location and two in relation to Aboriginal status. The significant difference for geo-location concerned the total number of statements about verbal text [ $F(2, 55) = 3.76, p = .029$ ]. Fisher's LSD post hoc tests revealed that metropolitan students made fewer statements about verbal text ( $M = 10.45, SD = 3.72$ ) than provincial students ( $M = 14.56, SD = 6.60$ ) or remote students ( $M = 15.10, SD = 6.75$ ). While this is an interesting finding, it does not answer research sub-question D which is concerned with the number of inferences made about multimodal texts, not the number of statements made.

The Year 4 ANOVA for Aboriginal status showed significant differences in relation to the number of statements about images [ $F(1, 56) = 4.20, p = .045$ ] and the number of correct inferences about images [ $F(1, 56) = 4.58, p = .037$ ] and both of these variables passed the Levene test for homogeneity of variances. Fisher's LSD post hoc tests reveal that significantly ( $p < .05$ ) fewer statements about images were made by Year 4 Aboriginal students ( $M = 34.79, SD = 9.55$ ) than Year 4 non-Aboriginal students ( $M = 40.87, SD = 12.70$ ) and fewer correct inferences about images were made by Year 4 Aboriginal students ( $M = 6.82, SD = 4.07$ ) than Year 4 non-Aboriginal students ( $M = 9.37, SD = 4.92$ ). There is a possibility that these ANOVA results reflect the

imbalance in the reading ability between Aboriginal and non-Aboriginal students in the Year 4 sample that was not evident in the Year 6 student sample. There were only slightly more Aboriginal students with low reading ability in Year 4 than in Year 6 and there are similar findings for the reading ability groupings which will be reported in the next section of this chapter.

A more surprising result in relation to correct inferences about images was that fewer were made by Year 6 non-Aboriginal students ( $M = 7.25$ ,  $SD = 4.006$ ,  $N = 28$ ) than Year 4 non-Aboriginal students ( $M = 9.37$ ,  $SD = 4.916$ ,  $N = 30$ ) but more correct inferences were made by Year 6 Aboriginal students ( $M = 8.29$ ,  $SD = 5.077$ ,  $N = 24$ ) than Year 4 Aboriginal students ( $M = 6.82$ ,  $SD = 4.065$ ,  $N = 28$ ). This suggests that Aboriginal and non-Aboriginal students might have responded differentially to the different reading texts.

It is also possible that the different Year 6 result, where a slightly higher number of correct inferences about images was made by Aboriginal students (8.29) than by non-Aboriginal students (7.25), could have been because students responded differentially to the images that were in the Year 6 post-test: four photos describing steps in an experiment, a photo and map of an island and two Aboriginal paintings. The contexts of the photos and Aboriginal images might have been more familiar than the contexts of the diagrams in the Year 4 texts.

The images in 'Water Animal Records' which were only in the Year 4 test might have elicited fewer inferences from Aboriginal students than non-Aboriginal students because non-Aboriginal students with BST reading scores in high and medium bands

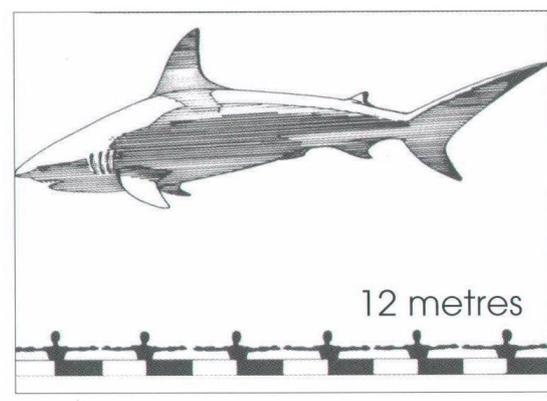
made more correct inferences about this text. Many of the inferences related to comparisons of size in the photographs and mathematical concepts in a symbolic image representing a length scale (see Figure 7.5), for example, the Year 4 non-Aboriginal provincial student who made the most inferences about images said, *'It's got people linking arms making like a ruler, compared to the great white shark'* and she could identify that each arm span represented two metres. Aboriginal and non-Aboriginal students with low reading scores made similar numbers of correct and incorrect inferences about the scale image in 'Water Animal Records', for example, an Aboriginal student in a provincial school said, *'It's got a wall there, like a little wall back at the pool,'* and a non-Aboriginal student in a remote school responded to the scale image with linked arms as follows:

*Remote male 1: It's showing us how long the shark is on a cinema screen.*

*Interviewer: How did you know it's on a cinema screen?*

*Remote male 1: 'Cause there's people sitting down in the chairs.*

However, as the difference between number of inferences about images by Aboriginal and non-Aboriginal students was particularly evident in provincial schools, it seems likely that it was mostly due to the imbalance in reading ability between Aboriginal and non-Aboriginal students in the sample of provincial students.



**Figure 7.5** Scale image from 'Water Animal Records' text in 2005 Year 3 BST

There was a greater range of reading ability in the Year 4 provincial non-Aboriginal group of students (4 students in the top band and 3 in the lowest two bands) compared to the Year 4 provincial Aboriginal group (one student in the top band and five in the lowest two bands). This imbalance between the groups' ability was compounded because one provincial non-Aboriginal student with a BST reading score in the top band made fifty percent more correct inferences about images than any other Year 4 student. The imbalance in range of reading ability was further compounded by the four Year 4 provincial non-Aboriginal students with BST reading scores in medium bands who made as many correct inferences about images as were made by two provincial students with BST reading scores in the top band. In order to investigate the disparity between the average number of inferential statements about images made by Year 4 Aboriginal and non-Aboriginal student groups in provincial schools, extracts from the transcripts of interviews with these students will now be considered in relation to 'Telling the Time Using Water', which was common to both the Year 4 and Year 6 post-tests.

In the transcript that follows a Year 4 Aboriginal female, with a BST reading score in a medium band, has made a connection to the noun, 'overflow' in a label to infer the process, 'go out', but she has not commented on the processes in the commentary, 'raises' or 'attached', to show whether she has understood other distributed meanings in the text. Although this student gave the correct answer to Question 30 by recognising that the water makes the clock hand turn, she was not able to provide the correct sequence of events for Question 31.

*ATSI provincial female 6: Well water drops into this little thing ...  
And if it gets too flooded,  
it'll go out there.*

*Interviewer: Yes, at the overflow.*

*ATSI provincial female 6: Yeah, and it will drip down into that  
which makes that float  
to make the time.*

Year 4 Aboriginal female 2, with a BST reading score in a medium band, also made a connection to the commentary, which she read directly from the text. Midway through reading the sentence she attempted to use her own words but then reverted to the written text. Although she has inferred a turning process, it is possible that she does not completely understand the sentence she has read because she selected the incorrect sequence of events for how the clock works in answer to Question 31.

*ATSI provincial female 2: Water goes in there ...  
... and some comes out there  
and drips down there.  
That turns.*

*Interviewer: Okay, and how does that turn  
as a result of that dripping in there?*

*ATSI provincial female 2: "The water trickles in ... in  
and it raises a float" to which is a ...  
"which is attached to a clock hand."*

Year 4 non-Aboriginal female 7, with a reading score in a medium band, also inferred turning but indicated more understanding of the verbal commentary by being able to restate it using different words. She has subsequently answered Question 31 with the correct sequence of events. In the following transcript extract she makes a causal connection between the rising float and the turning clock hand, with the inferential explanatory clause, ‘*which turns the clock*’.

*Non- ATSI provincial female 7:      The water supply goes in there  
and if it overflows,  
it comes out here ...  
... and the water trickles in here  
and it raises a float,  
which turns the clock.*

One of only two Year 4 male provincial students with a reading score in a medium band also selected the correct sequence in answer to Question 31. He has provided a more thorough explanation about how the clock works by including the role of cogs:

*Non- ATSI prov. male 3:      And every time that gets higher,  
that would go higher too  
'cause it floats  
which would make the cogs turn some, eventually  
and the hand would move.*

Even though this student was pointing at the image and has used informal pointing words like 'that' rather than naming some parts of the clepsydra, he used conjunctions in relative and adverbial clauses to explain how and why, for example, 'which would make the cogs turn some', 'cause it floats' and 'every time that gets higher.'

In regard to Year 6 students, the investigations from the 2006 interviews into the first part of research sub-question D found no differences between genders, geo-locations or Aboriginal status. The only statistical difference for Year 4 students was that Aboriginal students made fewer correct inferences about images than non-Aboriginal students and it seems likely that this difference was partly due to differences in the balance of reading ability between Aboriginal and non-Aboriginal students in the provincial sample. Therefore the answer to research sub-question D is that no substantial differences in the number of inferences or the amount of complexity in spoken language according to gender, geo-location or Aboriginal status were found.

The next two sections of this chapter report the results of the analyses of variance for reading ability groupings and the correlations between reading scores, number of inferences and amount of linguistic complexity in students' talk.

### 7.2.2.2 Differences in spoken inferences between reading ability groups

The ANOVA results summarised at Table 7.7 show significant ( $p < .01$ ) differences between reading ability groupings with regard to the number of correct inferences about verbal text and images and the amount of linguistic complexity in students' talk. Assumptions of homogeneity of variances were met for these variables across reading ability groupings.

Reading Ability	Year 4			Year 6		
	N	F	significance	N	F	significance
Correct inferences about verbal text				51	7.173	<b>.002</b>
Correct inferences about images	57	22.172	<b>.000</b>	51	15.726	<b>.000</b>
Linguistic complexity of talk	57	10.401	<b>.000</b>	51	12.769	<b>.000</b>

**Table 7.7** Significant results of ANOVA between reading ability groups (Low, Medium, High) for Year 4 and Year 6 where assumptions of homogeneity of variance were met

As expected in a valid reading test, Fisher's LSD post hoc test results (see Appendices P and Q) showed that significantly ( $p < 0.01$ ) fewer correct inferences about verbal text were made by Year 6 students who had low BST reading scores ( $M = 2.06$ ,  $SD = 2.29$ ) than students with high BST reading scores ( $M = 6.00$ ,  $SD = 4.074$ ) and students with medium reading scores ( $M = 5.35$ ,  $SD = 3.366$ ). The ANOVA showed significant

differences for correct inferences about verbal text by Year 4 students but the Levene's test revealed that the assumptions of homogeneity of variance were not met [ $F(2, 55) = 3.61, p = .034$ ].

The post hoc test results also showed that fewer statements about images were made by Year 4 students with low BST reading scores ( $M = 33.33, SD = 9.850$ ) than Year 4 students with high BST reading scores ( $M = 44.09, SD = 14.439$ ). Both Year 4 and Year 6 students with low BST reading scores made significantly ( $p < .01$ ) fewer correct inferences about images than students with high and medium BST reading scores and Year 4 students with medium BST reading scores also made significantly ( $p < .01$ ) fewer inferences about images than students with high BST reading scores as shown by the means in Table 7.8.

LSD

<b>Correct Inferences about Images (DV)</b>	<b>Year 4</b>			<b>Year 6</b>		
	<b>Reading Ability (IV)</b>	<b>N</b>	<b>Mean</b>	<b>SD</b>	<b>N</b>	<b>Mean</b>
Low	24	5.08	3.538	18	3.89	2.494
Medium	23	8.74	3.165	23	9.70	4.290
High	11	13.55	4.228	11	9.91	3.506

**Table 7.8** Mean correct inferences about images by Year 4 & 6 reading ability groups

The differences between low and high reading ability groupings for numbers of inferences about images and for the linguistic complexity of talk measures were significant as often for the Year 4 students as for the Year 6 students. What was surprising was that the Year 4 means for inferences about images for both low and high ability students were higher than the Year 6 means for the same ability groups even though the Year 4 data was based on responses about three texts and the Year 6

data was based on responses about five texts, two of which were also in the Year 4 post-test. However, the number of images in the two post-tests was actually equal because the third Year 4 text, ‘Water Animal Records’, had eight images: four diagrams and four photographs. It is unexpected that younger students would make more inferences and the students’ transcripts will be considered later in this section.

Another difference, which has been subject to less research, was the difference in the linguistic complexity of students’ talk between reading ability groups. Students with low BST reading scores in Year 4 and Year 6 had significantly ( $p < 0.01$ ) less linguistic complexity in their talk than students with high and medium BST reading scores and Year 6 students with medium BST reading scores had significantly ( $p < 0.05$ ) less linguistic complexity in their talk than students with high BST reading scores as shown by their means in Table 7.9.

LSD

Linguistic complexity of talk (DV)	Year 4			Year 6			
	Reading ability (IV)	N	Mean	SD	N	Mean	SD
Low		24	7.04	6.836	18	7.33	7.654
Medium		23	14.09	8.224	23	18.04	9.716
High		11	19.64	9.750	11	26.45	14.180

**Table 7.9** Mean linguistic complexity of talk for Year 4 and 6 reading ability groups

The ANOVA results found highly significant differences between students who have different BST reading scores but no significant differences between groups according to gender or geographic location in the number of correct inferences or the amount of linguistic complexity of their talk. Between Aboriginal and non-Aboriginal students there were no significant differences for Year 6 students and the only significant Year

4 difference (inferences about images) was probably related to an imbalance of reading ability in the provincial sample. Therefore in answer to sub-question D, the different number of inferences and amount of complex spoken language between reading ability groups that was not evident between the gender, geo-location and Aboriginal status groups suggests that the cause of differences in reading achievement lies beyond just the factors of Aboriginality and geo-location. However, there were some observations in the interviews of different ways Aboriginal and non-Aboriginal students responded to stimulus texts in the Year 3 and the Year 5 BST reading tests and these will be discussed in the next chapter.

In the next section, the results of investigations regarding possible relations between inferences, linguistic complexity of talk and reading scores are reported and exemplified from the transcripts of interviews.

### **7.2.3 Correlations for scores, inferences and linguistic complexity in 2006**

As the ANOVA results had identified differences between ability groups, it was incumbent to investigate the last part of research sub-question D, 'If there are differences according to reading ability, are there significant relationships between reading score, the number of inferences made and the amount of linguistic complexity in students' talk about images and verbal text?'

To test for relationships between inferences, linguistic complexity and comprehension of image-language relations in texts (BST and post-test scores), Pearson's correlation statistics were calculated across all of these variables for Year 4 and Year 6.

The results of Pearson's correlation studies for the data from the first stage in 2006 are shown in Appendices R and S. For the Year 4 data the Pearson's correlation results were significant ( $p < 0.05$ ) between both the reading scores (see summary in Table 7.10) and the number of correct inferences about verbal text and about images, the number of explanatory inferences about images and the amount of linguistic complexity in the students' talk.

<b>2006 Interviews</b>	<b>Y3 BST reading score</b>	<b>Year 4 post-test score</b>	Correct inference about verbal text	Explan. Inference about verbal text	Correct inference about images	Explan. inference about images	Linguistic complexity of talk
<b>BST score</b>			.				
<b>Pearson's r</b>	1	.631**	.326*	.253	.593**	.578**	.498**
<b>Significance (2-tailed)</b>		.000	.012	.056	.000	.000	.000
<b>N</b>	58	58	58	58	58	58	58
<b>PostTest</b>							
<b>Pearson's r</b>	.631**	1	.344**	.294*	.574**	.503**	.496**
<b>Significance (2-tailed)</b>	.000		.008	.025	.000	.000	.000
<b>N</b>	58	58	58	58	58	58	58
<b>Ling. comp.</b>							
<b>Pearson's r</b>	.498**	.496**	.486**	.368**	.788**	.754**	1
<b>Significance (2-tailed)</b>	.000	.000	.000	.005	.000	.000	
<b>N</b>	58	58	58	58	58	58	58

\*\* Correlation is significant at the 0.01 level (2-tailed)

\*Correlation is significant at the 0.05 level (2-tailed)

**Table 7.10** Summary of correlation results (Yr 4 scores/ inferences/ ling. complexity)

The results of the Pearson's correlations for the Year 6 data were also significant (summary in Table 7.11) between both the BST and post-test scores and linguistic complexity of talk and all inferences except explanatory inferences about verbal text. These results confirm a strong relationship between success in answering BST reading questions and the number of correct inferences these students made about verbal text, the number of correct and explanatory inferences they made about images and the amount of complex language they used when talking about the multimodal texts.

<b>2006 Interviews BST and post-test</b>	<b>Y5 BST reading score</b>	<b>Y6 post-test score</b>	Correct inference about verbal text	Explan. inference about verbal text	Correct inference about images	Explan. inference about images	Linguistic complexity of talk
<b>BST score</b>							
<b>Pearson's r</b>	1	.666**	.369**	.191	.476**	.460**	.478**
<b>Significance (2-tailed)</b>		.000	.007	.174	.000	.001	.000
<b>N</b>	52	52	52	52	52	52	52
<b>Post Test</b>							
<b>Pearson's r</b>	.666**	1	.379**	.269	.456**	.360**	.416**
<b>Significance (2-tailed)</b>	.000		.006	.054	.001	.009	.002
<b>N</b>	52	52	52	52	52	52	52
<b>Ling. comp.</b>							
<b>Pearson's r</b>	.478**	.416**	.732**	.599**	.581**	.577**	1
<b>Significance (2-tailed)</b>	.000	.002	.000	.000	.000	.000	
<b>N</b>	52	52	52	52	52	52	52

\*\* Correlation is significant at the 0.01 level (2-tailed)

\*Correlation is significant at the 0.05 level (2-tailed)

**Table 7.11** Summary of correlation results (Yr 6 scores/ inferences/ling. complexity)

There was also a highly significant negative correlation of moderate strength between the Year 4 post-test reading score and the number of **incorrect** inferences about images ( $r = -.463$ ,  $n = 58$ ,  $p < .001$ ) and a highly significant negative correlation of low strength between the Year 4 post-test reading score and the number of **incorrect** inferences about verbal text ( $r = -.365$ ,  $n = 58$ ,  $p = .005$ ).

In addition to the correlations with reading scores, Tables 7.10 and 7.11 show that there were highly significant correlations for both Year 4 and Year 6 students between the amount of linguistic complexity in their talk and the number of all types of inferences made about verbal text and about images. These correlations were moderate or strong except for a weak correlation for Year 4 explanatory inferences about verbal text. In the next two sub-sections of this chapter excerpts from the students' transcripts are presented to exemplify their textual understanding and use of linguistic complexity

in their talk as well as sometimes relating these variables to the reading strategy students selected to find the answer to questions.

### **7.2.3.1 Examples of Year 4 inferences and linguistic complexity**

The coincidences in making inferences, using linguistically complex language and comprehending image-language relations in texts are apparent in the interview transcripts for the two Year 4 provincial students who used the highest number of dependent clauses in their talk. These students selected correct answers to all of the questions about image-language relations and had the highest number (and proportion) of correct inferential statements, more than half of which were explanatory inferences. Non-Aboriginal provincial female 6 is the student who made fifty percent more correct inferences about images than any other Year 4 student in the research study. In the following extract from her interview she is talking about the diagram of the Greek water clock and how it works:

*Non-ATSI provincial female 6:           The water supply goes in there  
and then the overflow comes out here.  
This trickles into there  
which rises [sic] the float.  
As the float rises  
it turns the cog  
and the cog turns the clock hand  
to tell the time.*

This example shows that the student has made connections to the labels on the diagram, ‘water supply’ and ‘overflow’, to infer the processes, ‘goes in’ and ‘comes out.’ She has also inferred the process ‘turns’ from the labelled cogs and clock hand in combination with the processes in the commentary, ‘raised’ and ‘attached’, which are not shown in the image (see Figure 7.1). In this way she has combined the distributed

meanings in an image-language relation of complementarity (distribution of processes) to understand how the clepsydra works. To make these inferences the student has used complex language structures to explain, for example, she uses the dependent clauses, ‘*which rises [sic] the float*’, ‘*As the float rises*’ and ‘*to tell the time*’, to sequence the events and show connections. At the same time she is making associative inferences from the verbal text, which stated, ‘Water trickles in and raises a float which is attached to a clock hand,’ in order to explain how the clock hand is turned.

By contrast a Year 4 student (Aboriginal provincial female 1) with a low BST reading score, who selected an **incorrect** answer to the sequence question, was only able to state what was represented in the image (water dripping) when asked about the meaning of the clepsydra image:

*ATSI provincial female 1: That drips  
then goes down to there.*  
*Interviewer: Excellent, and then what happens?  
What happens when the water goes in there?*  
*ATSI provincial female 1: Don't know.*

Two other Year 4 Aboriginal provincial students with low BST reading scores (female 5 and male 1) selected the correct answer to the sequence question in the post-test even though they selected **incorrect** answers in the 2005 BST but they used no linguistic complexity when describing the Greek water clock. The strategy of female 5 to answer this question was to only look at the images and that is clear in her use of the pointing words, ‘here’, ‘there’ and ‘this’, instead of the labels on the diagram.

*ATSI provincial female 5: Well, maybe the water goes in here  
and it goes down there and in here  
and this goes around.*

For male 1, as for female 5, it is apparent from the pointing words in the phrases, ‘down there’ and ‘that thing’, that this student was considering the image more than the labels in the following extract:

*ATSI provincial male 1:      They used the water  
   and it went into the pot,  
   and then it went down there...  
   and then that thing floated right up to the top.*

The strategy that male 1 said he used to answer the sequence question was remembering what he had talked about when describing the diagram, which is evidence that the ‘think aloud’ process could have assisted him to have a better understanding of the diagram during the interview than he did during the BST. It is possible that the process may have also assisted female 5 and other students who answered correctly during the post-test.

Both of these students used minimal complex language throughout their interviews: one dependent clause and one non-core word for female 5 and two dependent clauses and no non-core words for male 1. It is not possible to know if their minimal use of complex language structure is a result of such language being unfamiliar because it is not often being used in their homes. Their understanding of the Greek water clock image following thinking aloud, demonstrated by the selection of the correct sequence of events in Question 31 by these students, suggests that less use of complex language structure when talking about the texts was not related to lack of comprehension of the images in the texts. However, the students’ lack of reference to technical terms used in the verbal text suggests that students might have had poor comprehension of complex verbal text, which could be why they selected the incorrect answer during the BST.

The only other Year 4 provincial Aboriginal male with a low reading band score (male 2) also selected the correct sequence of events for Question 31 in the post-test but, when asked about the diagram and how the Greek water clock worked, he used his knowledge of a modern day analogue watch which two hands instead of referring to the diagram which had only one clock hand:

*ATSI provincial male 2: It spins around  
and the hands go,  
one like, only the second goes around,  
when it hits 12  
the minute hand moves.  
And when the minute hand moves to the 12,  
The hour one moves.*

*Interviewer: And what is making it move?*

*ATSI provincial male 2: The water pushing in there, pushing.*

His final statement shows that this student has understood the concept of the water providing the energy to push the cogs up and make the hand spin around. He uses dependent clauses, such as ‘when it hits twelve’, when talking about knowledge he has gained prior to reading the BST texts, which suggests that a familiar context could have facilitated more complex language structures. However, this student is one of the few who increased his reading score by two bands from 2005 to 2007 thus moving his BST reading score from a low band to a medium band. The observation, that a student who uses more complex spoken language to explain and infer is also capable of increasing his reading score, is highly relevant to the last part of research sub-question D and the quantitative findings of significant correlations between the number of inferences, the amount of linguistic complexity and reading scores for Year 4 students. In the next section the results for Year 6 students are reported.

### 7.2.3.2 Examples of Year 6 inferences and complex spoken language

The student who had the highest score for linguistic complexity in his talk (58) was a Year 6 metropolitan Aboriginal male with a reading score in the top band. He used more dependent clauses (39) and non-core words (19) than any other student in the study. Half of his statements about both images and verbal text were correct inferences and one third of these were explanatory inferences. This student said that he ‘figured out’ how the clock worked by looking at the picture without needing the labels. He provided the most direct explanation of any student about how the clock works, including how the cogs move each other, by using five relative clauses and finishing with a non-finite adverbial clause to show cause and effect as follows:

*Interviewer:* What is the picture showing?  
*ATSI metro male 1:* It's showing us a wooden frame with a clock face that I would presume would be fixed to the frame, a cog that would be allowed to move and along the tip ... twisted ...the cog which moves on the ... smaller cog that moves the clock hand, and also a jar of water, a water supply and a float that moves up and down to move the larger, longer one.

Year 6 non-Aboriginal metropolitan male 5 had the next highest score for linguistic complexity (40) and by using conditional clauses he is able to verbalise how the augmentation relation between the verbal text and image helped him to understand how the Greek water clock works:

*Interviewer:* Do the words make it a lot easier?  
*Non-ATSI metro male 5:* Them two, I understood.  
If I didn't know that floated,  
I didn't know that was down...  
If I didn't know that floated,  
Then I wouldn't know.

‘Tobwabba Art Gallery’ (see Figure 6.1) was in the Year 6 post-test but not the Year 4 post-test. In answer Question 28 which involved an image-language relation of augmentation in this text, Year 6 students needed to read the verbal text to be able to identify which shapes represented traps and nets in the image. Non-Aboriginal metropolitan male 5 makes direct reference to the image-language relation of augmentation in the text by using a relative clause:

*Non-ATSI metro male 5: It shows all different shapes at the back, Triangles, squares, trapeziums, and then there’s a few brown bits which they said in the writing is traps.*

It is apparent from these examples that the use of complex language structure enhances the ability to explain events and connections in texts. When explanatory inferences were analysed in 2006 there were very few made about verbal text (averages of less than 1) but considerably more were made about images by students with high, medium and low reading scores as evidenced by these averages:

- highest band – 6.6 explanatory inferences out of 13.6 correct inferences
- medium bands – 3.7 explanatory inferences out of 8.7 correct inferences
- low bands – 1.8 explanatory inferences out of 5.1 correct inferences

Although most students in 2006 made more inferences about images than about verbal text, Year 6 Aboriginal metropolitan male 1 made more inferences about the verbal text (14) than he did about images (13). When talking about the verbal text in ‘Tobwabba Art Gallery’, this Aboriginal student was able to unpack the meaning in a complex sentence and express a summary of it in his own words:

*Interviewer:* What's that second paragraph about?

*ATSI metro male 1:* It's about a sailfish  
that is cunning  
and is able to get around the nets and fish traps  
that the people have set.

*Interviewer:* What's the picture showing?

*ATSI metro male 1:* It's showing what looks like a swordfish with other fish  
swimming in water around dark coloured nets.

In the last clause, while speaking about the image, this student has made an associative inference to the verbal text thus connecting the augmented information to the image so that he can identify the abstract shapes in the picture as 'dark coloured nets'.

Although all five Year 6 metropolitan non-Aboriginal students with low BST reading scores chose the incorrect answer during the BST to Question 28, which asks students to identify a fish trap or net, two of these students (a female and a male) chose the correct answer during the post-test. The only dependent clause spoken by the female contains words taken directly from the text (plain font), 'The sailfish *being* able to feed ...without being caught *in traps*,' but she shows her understanding of these words by adding '*in traps*'. The male student used no dependent clauses but has been able to paraphrase the complex sentence and connect this information to the image as follows:

*Interviewer:* So what's that second paragraph about?

*Non-ATSI metro male 1:* Well they reckon this fish can get past all the  
fishing traps and all that  
and the traps are destroying all our coastal fish.

*Interviewer:* What's the painting showing?

*Non-ATSI metro male 1:* They're all the traps  
and the fish is getting past them.



answer in the post-test. However, only a response from one of the four students evidenced some understanding of the verbal text as follows:

*Non-ATSI remote male 3: It means it's a real smart fish  
and it won't go in the dark places  
because people throw nets and fish traps in there.*

A similar improvement occurred among the seven remote Year 6 Aboriginal students of whom six selected the incorrect answer in the BST and then five of these students selected the correct answer to Question 28 in the post-test. This question about 'Tobwabba Art Gallery' and the sequencing question about 'Telling the Time Using Water', which was discussed earlier in this section, involved understanding image-language relations of complementarity and complex verbal text. The improvement in the number of students correctly answering these questions suggests that the 'think aloud' reading process has assisted them. In order to investigate whether the reading process had affected the post-test scores in 2006, a comparison has been made with 2007 BST scores and post-test scores in 2007 when interview procedures were changed.

#### **7.2.4 Analyses of variance for inferences in 2007**

There was less improvement in the post-test scores following the silent 'read through' process in 2007 than there had been following the 'think aloud' process in 2006. The amount of increase in the average number of correct answers from the BST to the post-test for Year 4 and Year 6 in 2006 and Year 5 in 2007 is shown in Table 7.12.

	<b>2006 Year 6</b>	<b>2006 Year 4</b>	<b>2007 Year 5</b>
<b>Metropolitan non-ATSI</b>	2.23	1.45	0.40
<b>Provincial non-ATSI</b>	1.75	0.90	0.50
<b>Remote non-ATSI</b>	3.00	1.67	0
<b>Metropolitan ATSI</b>	2.14	2.11	1.14
<b>Provincial ATSI</b>	2.50	0.63	0.25
<b>Remote ATSI</b>	0	1.00	-0.09

**Table 7.12** Differences in the average number of correct answers from the BST to the post-test for Year 4 and Year 6 in 2006 and Year 5 in 2007

It is apparent from the average scores in Table 7.12 that there was greater improvement in 2006 than 2007, for most groups. With the exception of the remote Aboriginal students, the average improvement was not as strong for Year 4 as for Year 6 students but this is partly due to a ceiling effect caused by one third of the Year 4 non-Aboriginal students in provincial and remote schools having all correct answers on the targeted questions in the BST and partly because there were more questions in the Year 6 post-test than the Year 4 post-test. There were improvements in the post-test by half of the provincial Aboriginal students, who had BST scores in low and medium bands, but there were also declines in score for three Aboriginal students, which accounts for the lower average improvement in the post-test.

The difference in scores overall suggests that either the lapse in time between the 2005 BST and the 2006 post-test or the ‘think aloud’ process used in 2006 has resulted in some students improving their score in the post-test. In 2006, forty percent of Year 4 and fifty percent of Year 6 students increased their post-test score by two or more and of these, seventeen Year 4 students and sixteen Year 6 students increased their score by three or more. In both Year 4 and Year 6, eleven of these students had Year 3 BST reading scores in the lowest bands and the others in medium bands. However, in 2007 only twenty percent of students increased their score by more than one in the post-test

and only two students (four percent) increased their score by more than two despite there being more questions in the 2007 post-test than in the 2006 post-test. The possible effect of interview procedures will be further discussed in the next chapter.

While the ability to infer from verbal text could be expected to be a precursor to success in reading comprehension, the highly significant moderate correlations between reading score and the production of complex language when talking about the multimodal texts is a different finding that will be further considered in the next chapter. As the Year 5 students in 2007 are the same cohort of Year 4 students in 2006, the analysis of 2007 data does not include a second analysis of the linguistic complexity of the students' talk. In the next section results are reported from the analysis of variance for students' responses about texts in the 2007 Year 5 BST.

#### **7.2.4.1 Differences across Aboriginal/geo-location groupings in 2007**

An investigation of more finely defined social groupings with the 2007 data was enabled by combining Aboriginal status and geo-location to obtain smaller but more specific groupings: metropolitan Aboriginal, metropolitan non-Aboriginal, provincial Aboriginal, provincial non-Aboriginal, remote Aboriginal and remote non-Aboriginal. The more specific groupings would ensure that the broad separate Aboriginal and geo-location categories in 2006 could not result in specific groups, such as remote and metropolitan students, countering each other within a broad category, such as Aboriginal students. In 2007 there were enough associative inferences about images and verbal texts to be analysed in addition to the dependent variables of correct and explanatory inferences, however, there were too few incorrect inferences to be included in the analysis because they were only made by twenty percent of students.

Although the 2007 ANOVA results (see Appendix T) between combined Aboriginal/geo-location groups for associative inferences about verbal text did not meet the Levene's test for homogeneity of variances [ $F(5, 40) = 3.475, p = .011$ ], it is relevant that students in 2007 made more of these inferences than students in 2006. There were several questions about augmentation in 2007 but there had been none in the Year 3 BST in 2005 and it is intuitive that making associative inferences could be important in making associations between verbal text and images when students are interpreting augmented or distributed meanings in multimodal texts. The nature of the texts in the 2007 post-test was also different in other ways to the texts in the 2006 post-test, for example, there were more literary texts including a cartoon in 2007, whereas there had been more explanatory diagrams in the 2006 post-test. In view of these differences, further qualitative analysis is warranted and associative inferences from the transcripts will now be considered to identify where associations were made and whether these inferences assisted students to comprehend image-language relations of complementarity.

A non-Aboriginal metropolitan female with a BST reading score in the top band made 68 correct inferences about verbal text and a metropolitan non-Aboriginal male who had a BST reading score in a medium band made 46 inferences while most other metropolitan non-Aboriginal students made between 21 and 29 correct inferences about verbal text. These two students were probably mainly responsible for both the inequality in variances and the significantly greater number of correct inferences about verbal text by non-Aboriginal metropolitan students. Most students made an associative inference about the verbal text in 'Dragon Quest' by recognising that the

narrator is the man represented in the images, but these two students were the only students to realise that the second picture in 'Dragon Quest' is on the cover of the book that the boy is reading in the first picture. This has led to most of the female's explanatory inferences as exemplified in the following extract from the transcript of her interview:

*Non-ATSI metro female 1: ...It's about a man who's on a mission  
and he thinks this boy ...  
and this boy must have something about him  
'cause he's the one  
who has been chosen to help him.  
Cause he was reading a book  
and there on the cover ... he's reading a book  
and there's [pointing to 2<sup>nd</sup> picture] on the cover  
and so it must mean that he was chosen  
because he was reading the book or something,  
he must have gotten taken into the book...*

The ANOVA for Aboriginal/geo-location groups also indicated a significant difference for total number of statements about verbal text [ $F(5, 40) = 2.647, p = .037$ ] and this dependent variable did pass the Levene's test. Fisher's LSD post hoc test revealed that more statements about verbal text were made by the metropolitan non-Aboriginal students ( $M = 29.60, SD = 15.85, N = 10$ ) than the provincial Aboriginal students ( $M = 18.33, SD = 7.84, N = 6$ ) or the remote Aboriginal students ( $M = 14.73, SD = 4.27, N = 11$ ). This result could indicate a cultural difference in the oral discourse practices between these groups but it is also possible that the total number of statements for all students could have been affected by changes in the interview procedures which will be considered next.

As previously mentioned, the comprehension data from 2007 was obtained after a silent 'read through' of the text instead of during a 'think aloud' reading in which students were asked at several intervals during their reading about the meaning of the words and images. Even though the students were talking about six texts in 2007 and only three texts in 2006, the mean number of statements made about both text and images in 2007 was only 44 whereas it had been 51 for the same cohort in 2006. It is probable that the change in procedure was the reason why some students made less elaborate statements about text meaning. To recall all textual information at the end of reading a text would create a much greater demand on working memory than to do so gradually during reading.

For the same cohort of students in 2006, metropolitan students (both Aboriginal and non-Aboriginal) made fewer statements about verbal text than provincial or remote students, therefore, the 2007 differences in number of statements about verbal text are unlikely to be reflective of the oral discourse practices of the metropolitan group. However, Aboriginal students in 2006 made fewer statements about images than non-Aboriginal students so the similarity in the 2007 findings suggests they could be reflective of the oral discourse practices of remote and provincial Aboriginal students, particularly since one of the eight ways of learning preferred by Aboriginal students is non-verbal communication (Yunkaporta 2009). Researchers in Aboriginal English have also commented on the place of silence, the degree of directness and how questions and answers are used differently in Aboriginal communication (Eades 1995) as well as how brevity is valued so you only say what is needed (Haig, Konigsberg & Collard 2005). Another possibility is that the differences in the number of statements

could be related to the nature of the texts or different procedures in 2007 and all of these issues will be discussed in the next chapter.

#### **7.2.4.2 Differences across ability groupings in 2007**

In 2007 the analysis of variance results (see Appendix T) for reading ability groupings in relation to the number of correct inferences about verbal text and the total number of statements made about verbal text were not reliable as the Levene's test for homogeneity of variances was not met for these variables.

There had been a significant difference for this cohort when they were in Year 4 in 2006 between ability groupings for correct inferences about images but there were no significant differences in 2007 between ability groupings in relation to inferences about images whether correct [ $F(2, 42) = 2.909, p = .066$ ], explanatory [ $F(2, 42) = 3.039, p = .059$ ], or associative [ $F(2, 42) = 2.488, p = .095$ ]. The lack of significant results for images could be partly due to the difference in procedures previously mentioned but the different nature of the images could also be relevant. For example, the image showing how the clepsydra works in *Telling the Time Using Water* and the diagrams in *Water Animal Records* from the 2005 BST were generally more conducive to the production of explanatory inferences than the more narrative and descriptive images in the 2007 Year 5 BST texts with the exception of the extra meanings in 'Dragon Quest' that were identified and explained by only two students. Examples from the interview transcripts will first identify typical responses by students with different BST reading scores, then evidence for the effects of different procedures and finally evidence for the effect of different reading texts.

To answer two questions about the text, 'Puddles' (see Figure 7.2), students needed to infer from the introduction ('All was quiet in Grandma's house...') that Grandma was the hidden speaker of words in the third frame of the cartoon. Most remote students who had BST reading scores in a low band made literal statements, like the remote Aboriginal female, who said the man was the speaker *'because there is a man in the picture'* and when asked what the text was about she made limited statements and no inferences only saying, *'about rain'* and *'about going outside.'*

Aboriginal remote male 3, who had a Year 3 BST reading score in a medium band, realised that the man was speaking to someone else, when he said, *'It's about a man talking to another man, talking to his mate, and a boy runs in and scares him.'*

However, this student who was aware of the introductory statement did not make the connection to the image in the third frame and therefore did not identify Grandma as the speaker.

A non-Aboriginal remote female with a BST reading score in the top band, inferred who the speaker would be from the register, which is *'like how grandma would talk,'* as follows:

*Non-ATSI remote female 6: Because the little boy isn't saying, oh good, he's such a dear and the grandpa isn't because he's saying other things. And it looks like it's coming from the kitchen. ... And that's like how grandma would talk.*

These are just a few examples of the type of responses from students with different BST reading band levels concerning how they comprehended one text. Further findings with regard to the effect of the interview procedures will be presented



students did in 2006 interviews following the ‘think aloud’ process before they answered the questions. The correct inference about Grandma being in the kitchen was coded as an associative inference about the image. The student has inferred that Grandma is speaking the words that are coming from someone behind a wall (*I think in a kitchen maybe*) by making an association to the words in the text’s introduction that let her know it was ‘Grandma’s house’. In this way, making an associative inference assisted students to understand an image-language relation of augmentation or at least to express their understanding of the augmented meaning.

As the text ‘Puddles’ is a cartoon with integrated words and pictures, the students’ comments about verbal text and images often overlapped, however, over the whole post-test students with BST reading scores in low bands made more correct inferences about the images ( $M = 4.61$ ) than correct inferences about verbal text ( $M = 3.06$ ), whereas for students with a BST reading score in the top band, this situation was reversed: their average number of correct inferences about verbal text ( $M = 10.56$ ) was greater than their average number of correct inferences about images ( $M = 7.89$ ). This explains why the differences between ability groupings in 2007 were less for the number of correct inferences about images than for the number of correct inferences about verbal text, and might also be why the correct inferences about images variable did not pass the Levene’s test for equality of variances.

Whereas the difference between ability groupings with regard to inferences about images was evident in responses about the ‘Puddles’ text, the differences between ability groupings with regard to inferences about verbal text were evident in responses about ‘Double Treble or Not’ because of the complexity in its language. As the latter

text was explaining how to play a game it also led to explanatory inferences from students who could understand the language. When asked what the words are telling the reader most students with BST reading scores in low bands could say, for example, 'It's about a game' or 'It's telling you how to play the game,' and some also referred to the first four simple sentences in the text. However, when they got to the long complex paragraph, many students like the following three students became confused:

*ATSI metro male 2: The text after that tells and shows how you play exactly and the text after that shows ... tells ... yeah I'm not sure if that that text is something about ... I'm not sure about the text.*

*Non-ATSI metro male 5: The words was hard because the first question I had to look at the picture but the second one, I had to read this and I got all confused with it.*

*ATSI provincial female 1: I don't know really. It's too hard to understand.*

Some students with BST reading scores in a medium band also had difficulty with the verbal text, and in the following response an Aboriginal male seems to be implying that he had trouble with the language structure rather than the vocabulary:

*ATSI metro male 3: I just didn't understand ... I know the words but I just didn't understand the way they were putting it.*

Another difficulty in the verbal text was the use of non-core words, such as 'treble', for example, an Aboriginal provincial female said, 'Well I just really didn't understand the text...They're using big words.' Although all of the non-Aboriginal students with top band reading scores knew the meaning of treble, only two non-Aboriginal students with medium band reading scores and two out of all the

Aboriginal students knew what it meant. One Aboriginal provincial female managed to choose the correct answer because she knew that double implied multiply and she connected that to the addition shown in the image but many other students thought of double as adding two numbers that are the same and did not think of multiplying. A remote Aboriginal male guessed treble meant divide and the following metropolitan Aboriginal male thought it meant subtract:

*ATSI metro male 1: Yeah, double ... double means multiply  
and I've never heard the word treble before  
but I was pretty sure that that's subtract.*

However, like most other metropolitan students, he did know what triple means and when told 'treble' means the same he was able to realise that 'add and multiply' was the correct answer to the test item which was, 'When playing this game you are supposed to...'. The use of the uncommon word, 'treble,' instead of a more familiar word, 'triple,' disadvantaged these students who would have otherwise selected the correct answer.

A non-Aboriginal metropolitan female with a BST score in the top reading band gave a full explanation about how to play the game as follows:

*Non-ATSI metro female 1: ... it's a maths game and you have to add  
and you can double the number you get,  
so three plus six would be nine.  
So you can double that to make 18  
or you can triple it to make 27.  
And if you get nine  
you drag ... say you're in the shell,  
you drag the shell into the nine and then drop it  
or you can drag the shell onto the 18 and drop it  
or you can drag the shell ...if they have it to 27.*

This student has understood the words, ‘the player can decide to double or treble the answer’ and she has made several explanatory inferences using this understanding and her numeracy knowledge. While she was explaining, this student was pointing to the picture and she later said, ‘*It’s definitely a help that it’s there or else you wouldn’t know.*’ Most students, whether they selected the correct answer or not, recognised there was an image-language relation of distribution whereby processes were distributed across the text, with ‘double or treble’ in the main verbal text and addition (3 + 6) represented in the image. The difficulty was in understanding the verbal text. It is recognized that the reading tests are required to test students across a variety of comprehension skills and questions and ‘Double, Treble or Not’ did so by targeting complex language structures and non-core words. However, if the targeted skill was to understand non-core words in complex language structures and connect that information to the image, the item’s purpose was not achieved. Although eighteen students selected the incorrect answer, sixteen out of the twenty-eight students who selected the correct answer to Question 30 about ‘Double, Treble or Not’ did so by making inferences from the image alone or by partly using the information represented in the image and partly by guessing, instead of accessing the verbal text. This finding and others which impact on text development are further discussed in the next chapter.

The qualitative analysis of the students’ inferences has identified connections between the types of texts and the types of inferences and which students make them thus contributing to answering the main research question, ‘How do Aboriginal and non-Aboriginal students in different geo-locations comprehend and talk about a variety of image-language relations and complexities in reading tests?’

Although the Levene's test showed that homogeneity of variances was not met in respect of the number of correct inferences about verbal text in 2007 for the BST reading ability groupings, Pearson's correlation coefficients were calculated across the inferences and scores. The results are reported in the next section of this chapter.

### 7.2.5 Correlations between scores and inferences in 2007

The Pearson's correlation results (appendix U) which are summarised in Table 7.13 show significant correlations between both the number of correct inferences and explanatory inferences about verbal text and both the BST reading score and the post-test score on BST questions about image-language relations. The Pearson's correlation coefficient was also significant between the number of associative inferences about verbal text and the post-test score.

2007 interviews	Yr 5 BST reading score	Yr 5 post-test score	Correct infer. about verbal text	Explan. infer. about verbal text	Assoc. infer. about verbal text	Correct infer. about images	Explan. infer. about images	Assoc. infer. about images
Y5 BST								
Pearson's r	1	.633**	.478**	.353*	.275	.257	.254	.164
Significance (2-tailed)		.000	.001	.019	.071	.092	.096	.288
N	44	44	44	44	44	44	44	44
Y5 Post-test								
Pearson's r	.633**	1	.426**	.303*	.340*	.176	.213	.000
Significance (2-tailed)	.000		.003	.041	.021	.241	.155	.999
N	44	46	46	46	46	46	46	46

\*\* Correlation is significant at the 0.01 level (2-tailed)

\*Correlation is significant at the 0.05 level (2-tailed)

**Table 7.13** Summary of correlation results between 2007 Y5 scores and inferences

The 2007 analysis did not show significant correlations between scores and inferences about images, even though the 2006 correlations had been significant and the 2007

students are the same cohort of students. The change could be related to the different reading materials or interview procedures which will be discussed in the next chapter.

### **7.3 Summary of results of analyses of strategies, inferential comprehension and linguistic complexity of talk about multimodal texts**

This chapter has presented results of the analyses of students' choice of reading strategies, their inferential comprehension and the linguistic complexity of their talk. The purpose of the analyses of students' choice of reading strategies was to answer research question C by investigating whether there were any differences in how the students' choice of expected reading strategies correlated with reading score in relation to gender, geo-location and Aboriginal status. The purpose of the analyses of the students' inferential comprehension and the linguistic complexity of their talk was to answer the first part of sub-question D, to see if they differed according to gender, geo-location, Aboriginal status or reading ability. If there were significant differences according to reading ability groupings, the purpose of correlating the variables with reading score was to see if there was a relationship not only with reading score but also between inferential reading comprehension and spoken language complexity.

There was a relationship between the number of expected reading strategies (used to select correct answers) and BST reading achievement in all groupings with the exception of Year 4 provincial students in 2006, Year 6 metropolitan students in 2006 and Year 5 provincial, female and Aboriginal student groups in 2007. An imbalance in the proportion of Aboriginal and non-Aboriginal students with high and low reading ability in the Year 4 provincial sample probably contributed to the lack of correlation for this group in 2006, for the same group when they were in Year 5 in 2007 and might have had an effect on the Aboriginal group in 2007. Otherwise most groups of

students who had high reading scores used expected strategies to select correct answers. The only other socio-cultural differences were for the Year 6 metropolitan group in 2006 and the female group in 2007 which are groups that usually perform well in state-wide and national tests so these findings do not provide any explanation for the state-wide lower performance by male and rural students.

The findings in relation to the first part of research questions D were that the 2006 results of analyses of variance regarding inferential comprehension of images and verbal text and use of linguistically complex talk showed no significant differences between genders, between Aboriginal and non-Aboriginal students or among geolocations for the Year 6 students. The only socio-cultural differences for Year 4 concerned fewer inferences about images by Aboriginal students, which might have been the result of an imbalance in the provincial sample, and fewer statements about verbal text by metropolitan students. Since metropolitan students did not make significantly fewer inferences about verbal text, it could be implied that they might have actually made the same or a higher proportion of inferences about verbal text.

In contrast, there were significant differences between reading ability groupings for the number of inferences about images and verbal text and the amount of complexity in spoken language when talking about text meanings. To find out if there was any relationship between these two factors and reading score, correlations were conducted to answer the second part of research sub-question D. The correlations confirmed a strong relationship. However, qualitative analysis of the students' responses revealed many interesting differences in how students interpreted and spoke about texts. In the next chapter these results will be further discussed and related to other research.

## **Chapter 8 – Discussion and implications for further research**

- 8.1 Difficulties experienced in reading multimodal texts**
  - 8.1.1 Image-language relations in multimodal texts**
  - 8.1.2 Verbal and image complexity in multimodal texts**
- 8.2 Assessment of comprehension of image-language relations in texts**
  - 8.2.1 Assessment items not interpreted as intended**
  - 8.2.2 Implications for reading test developers**
- 8.3 Strategies used to comprehend image-language relations in texts**
  - 8.3.1 Unexpected strategies used by students with high reading scores**
  - 8.3.2 Implications for further research**
- 8.4 Inferences made and language used when talking about multimodal texts**
  - 8.4.1 Explanatory inferences about images**
  - 8.4.2 Associative inferences about verbal text**
  - 8.4.3 Relations amongst scores, inferences and linguistic complexity**
  - 8.4.4 Interview processes - ‘think aloud’ and ‘read through’**
  - 8.4.5 Implications for teaching reading**
- 8.5 Comprehension of multimodal texts by Aboriginal and rural students**
  - 8.5.1 Educational advantage factors**
  - 8.5.2 Inferences and linguistic complexity in written language and talk**
  - 8.5.3 Field knowledge of Aboriginal and rural students**
  - 8.5.4 Implications for Aboriginal and rural students**
- 8.6 Conclusion**

## **Chapter 8 – Discussion and implications from research**

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The main question addressed in this research was, ‘How do Aboriginal and non-Aboriginal students in different geo-locations comprehend and talk about a variety of image-language relations in reading tests?’ Before discussing the comparison of student groups, this chapter first discusses the types of image-language relations and the complexity in images and language in the reading texts and how these factors might have impacted on the difficulty of assessment items. Some implications for test developers are then identified. Next, the findings about reading strategies, inferences and linguistic complexity used by students when talking about the texts are discussed. The possible impact of the interview procedures and some implications for teachers are also considered. Finally, the responses by Aboriginal and rural students to the multimodal texts are discussed and implications for further research are considered.

In this chapter particular examples will be discussed to highlight various aspects of the findings about complexity in the type of image-language interaction and in the images and verbal text and what students said about them. As in previous chapters any quotes from student transcripts will be in italics and quotes taken from the reading stimulus texts will be in plain font in order to distinguish between what was spoken or written.

### **8.1 Difficulties experienced in reading multimodal texts**

This section first discusses findings from an Australian Research Council Linkage Project (Unsworth, Barnes and O’Donnell 2006-2009) reported in Unsworth and Chan (2008) which also addressed the first part of research sub-question B concerning analysis of image-language relations. The findings in relation to these research questions were that the mean difficulty of 2005 and 2007 BST and 2007 ELLA

reading test items targeting understanding of concurrent image-language relations of *equivalence* were easier than items targeting understanding of another image-language relation of concurrence, *exposition*, and two image-language relations of complementarity, *distribution* and *augmentation*. The mean difficulty of items targeting relations of augmentation, where a participant in one mode is not evident in the other, were shown to be significantly greater than the mean difficulty of items involving other image-language relations including the concurrent relation of exposition, where meanings are elaborated in another mode, and the complementary relation of distribution, where processes are distributed across the two modes.

The first part of this section deals with the first part of research sub-question B and discusses the findings about the types and difficulty of image-language relations, and then the findings in relation to the complexity of verbal text and images are discussed in answer to the other parts of research sub-question B concerning text complexity.

### **8.1.1 Image-language relations in multimodal texts**

The image-language relations of equivalence were relatively easy for students to understand. Many of the items targeting relations of equivalence were about factual texts and assessed the ability to comprehend labels, simple captions and keys on maps. In some other items involving equivalence, where the language or the image was complex and the meanings in the images and language reinforced each other, students could sometimes access the meaning from the less complex textual mode alone. For example, the language relevant to a question about ‘Double Treble or Not’ was complex involving four adverbial clauses and three non-core words, but some

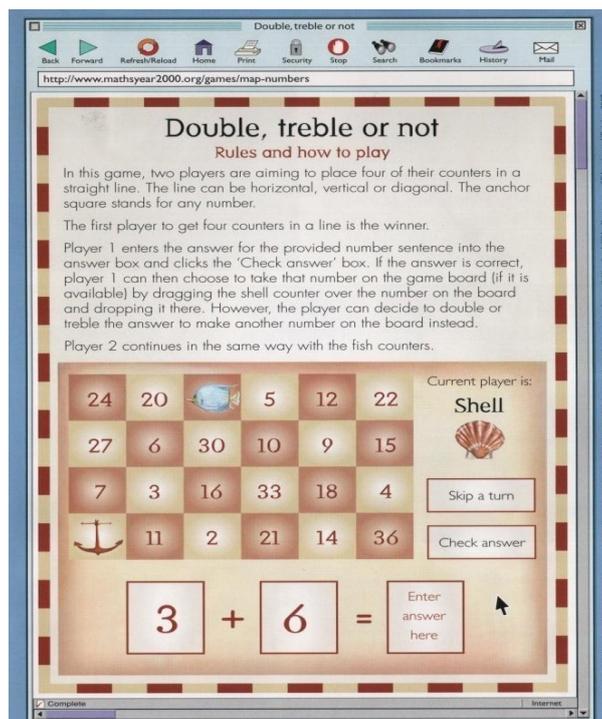
students, who said they did not understand the relevant part of the text, were able to identify which picture was a counter from the computer screen image alone.

While most of the items involving equivalence were relatively easy items about factual texts, most of the items involving augmentation were more difficult items about literary texts. The items involving augmentation were predominantly in the Year 5 tests and there were only two items involving augmentation in the Year 3 tests. The relations of augmentation were more difficult to comprehend because students could only understand them by connecting the images and language in order to infer that a participant represented in one mode has relevance to events in the other mode.

In the 2007 Year 5 BST, Question 30 about ‘Double Treble or Not’ (see Figure 8.1) assessed comprehension of image-language relations of both exposition and distribution. Most students were aware of the distribution of processes in that they knew addition was shown in the image but not mentioned in the verbal text, for example, one student said when referring to the sum  $(3 + 6)$  in the image, ‘*Yeah, you'd have to do that and it's not in the words.*’ The plus sign is on the background of the main screen (so presumably is fixed) between the boxes in which numbers will be provided during the Internet game. The number sentence in the image is a reformulation of the words, ‘the provided number sentence,’ and so it might be seen as an example of exposition. However, the image-language relation of distribution which ‘refers to juxtaposed images and text jointly constructing activity sequences’ (Unsworth & Chan 2008: 72) was identified. The item involves distribution because the answer to the question, ‘When playing this game you are supposed to...,’ is an activity sequence (‘add and multiply’). The process, addition, is shown in the image

but not the words, whereas ‘double or treble the answer,’ which implies multiplication of the answer to the addition process, is in the verbal text but not the image. In this way the distribution of processes forms the activity sequence of add then multiply.

The mathematical symbols are viewed as a separate symbolic semiotic resource (O’Halloran 2003) and the plus sign is considered as a new process introduced symbolically within the image. The plus and equals signs in the image of ‘Double Treble or Not’ are very simple mathematical symbols compared to the symbols in O’Halloran’s Descartes problem. While there is not an exact shift in meaning from + to ‘add’, the signs for plus and equals in  $3 + 6 = \square$  in the image provide exemplification of the noun group in the text, ‘the provided number sentence’, and at the same time they constitute a distribution of meaning by identifying the processes, add and equals, which are not identified in the verbal text.



**Figure 8.1** ‘Double Treble or Not’ from the 2007 Year 5 BST

Similarities between the mean difficulties of items assessing distribution and exposition could have been contributed to by unexpected interpretations of some items, for example, the most difficult items involving exposition and the easiest items involving distribution. The most difficult item about exposition was about the text, 'Mapping Islands' and its difficulty was greater than expected because twenty percent of students interpreted 'shortest way' in the question as shortest time, not shortest distance, leading to an incorrect answer being chosen. Some students also identified safety issues as reasons for choosing 'along the track' instead of 'through the trees'.

The second and third most difficult items involving image-language relations of exposition might also have been interpreted differently by some students because of differences in background knowledge or contextual understanding which led to a different strategy being required to answer correctly. The second most difficult question involving exposition was about 'A hole in your hand' in the 2007 Year 3 BST and would have been difficult for some students to answer correctly by only viewing the image. The question, 'In this text, the tube is compared to...' required students to select 'a telescope' as the answer, however, the image only shows a girl holding a roll of paper up to her eye and it does not show a telescope, so many students selected 'a sheet of paper' as the answer.

The written text stated, 'Hold the tube over your right eye with your right hand, as if it were a telescope'. For Year 3 students who were not familiar with a telescope, the meanings in the image and the verbal text might have seemed complementary and for these students the word, telescope, in the text would have been a necessary augmentation of meaning to enable them to identify that the tube of paper held over

the eye compares to a telescope. There are also many complexities in this sentence: a dependent clause with the subjunctive mood (if it were); there are three nouns preceding 'it' which students could have substituted for the pronoun; and if students had used the core word 'like' as the meaning of 'compared to' then it is probable that they would have selected 'a sheet of paper' as the answer.

The third most difficult question involving an image-language relation of exposition, was about 'Tobwabba Art Gallery' in the 2005 Year 5 BST, and it could have seemed like a relation of complementarity to some students. For example, when asked how she knew that the grass was the light green area near the kangaroos, a student with a BST reading score in the top band said, '*You had to combine both the writing and the picture to find where the grass was.*' The painting was abstracted with bands of colour so most students could not assume that the green area at the top of the painting represented grass until they read the information in the sentence, 'The kangaroos are feeding on the fresh grass after the rain.' In fact for many students the information about fresh grass seemed to be augmented information as they selected the iconic green image of creek weed at the bottom of the painting which looked like a tuft of grass. The image at the bottom of the picture, where students would expect to see grass in a landscape, could only be correctly interpreted as creek weed by recognising that it is next to the platypus which, 'searches along the creek bottom for yabbies' according to the text describing the painting.

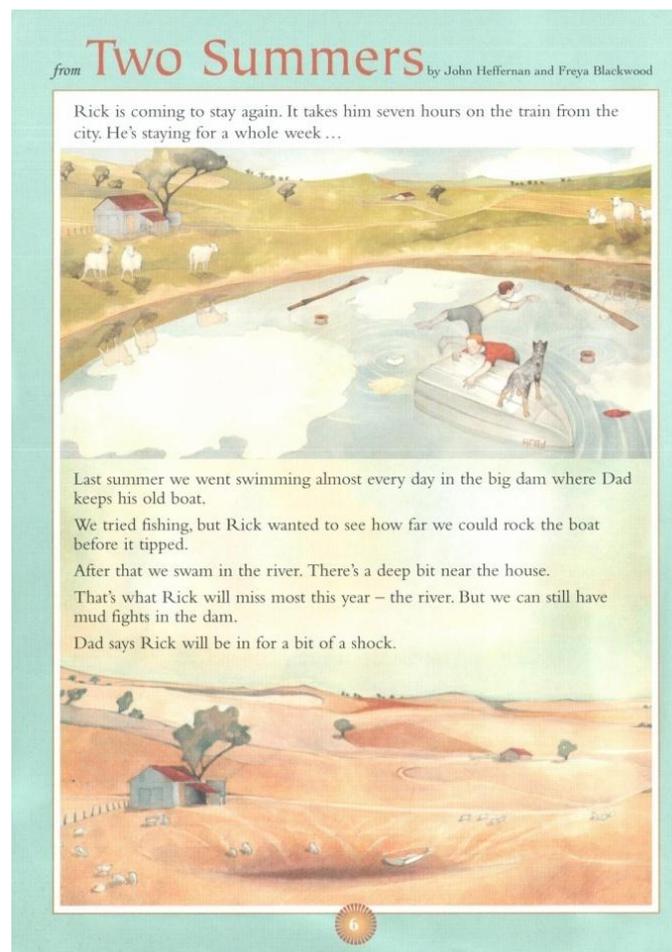
The important implication from these three questions is that, the background knowledge that students bring to a reading task can differ and affect their understanding of a text, possibly changing the reading skill required and thus affecting

the difficulty of the question. For students who needed the additional verbal information ('on the fresh grass' and 'like a telescope') to identify the participants represented in the images, the questions about the grass in 'Tobwabba Art Gallery' and the telescope in 'A hole in the hand' could have been classified as augmentation instead of exposition. If these difficult items had not been classified as exposition or if the question about 'Mapping Islands' had been more specific, then the mean difficulty of the items involving exposition would have been lower and the analysis of variance might have shown a significant difference between the mean difficulty of the image-language relations of exposition and distribution. Through a closer investigation of the items, which reveals different aspects of the relations that differentiate them, it might be possible to more distinctly differentiate the exposition and distribution categories.

The two easiest items involving distribution of meanings had negative logits. Most students answered one of these questions by only accessing the meaning in the image of the text, 'Puddles'. The question asked, 'What is the man trying to do?' and the answer was mainly identified by students interpreting the image of a man reading the paper. Although the thought bubble, 'Peace at last', is implying that the man wanted to do what he is actually doing in the image (read the newspaper), the desire to read and the act of reading do not construct an obvious *sequence* of activities, especially since the thought, 'Peace at last', is expressed *while* the man is reading.

An examination of the other easy item involving distribution, Question 15 which asked 'What happened when the boys went fishing?' in the text, 'Two Summers' (see Figure 8.2), suggests that it might be necessary to consider whether images are actually depicting activity sequences (processes) or simply showing a reformulation of

participants, which only suggests or implies an activity sequence has occurred. It is often the processes in still images that are more difficult for students to interpret, particularly since movement cannot be literally shown and sometimes material processes are only implied by vectors between participants. Relational processes such as ‘compared to’ are also usually indirectly represented and require the reader to make inferences.



**Figure 8.2** ‘Two Summers’ from 2005 Year 5 BST

For example, if the definition of distribution required that images and verbal text must be ‘jointly depicting activity sequences and processes’, rather than just ‘jointly constructing’ them as in the definition used in this research, then Question 15 about

‘Two Summers’ would not be categorised as distribution. The first picture in ‘Two Summers’ does not depict the process of ‘tipping,’ but most students knew the boys ‘tipped the boat’ because the picture shows the boys in the water and a ‘capsized boat.’ Therefore, the boat in which the boys were fishing in the verbal text is reformulated in the image which shows it upside down, the result of what had happened after they rocked it. Thus the *effects* of a process are represented in the image through changes in circumstance rather than actually showing the process of ‘tipping’. Reformulation of participants in the image-language relation is therefore similar to an image-language relation of exposition which by definition is ‘a reformulation of the meanings of the image or the text in the alternative semiotic resource’. The similarity could be why this item was easier than other items involving distribution which required the interpretation of processes in images or the application of processes in verbal text to images that did not include those processes. The similarity might also be a reason why there was no significant difference between the mean difficulty of items involving exposition and items involving distribution.

Originally it was planned to distinguish between Gill’s (2002) two types of distribution: intra-process distribution, where images and text portray different aspects of a shared process, and inter-process distribution, where images fill a gap in meaning when only part of the meaning is conveyed by the text. However, because of the small number of items in this study, it was necessary to collapse the two types of distribution. The text segment from ‘Two Summers’ relating to Question 15 could be seen to be presenting intra-process distribution where the verbal text represents processes before the capsize event and the first image represents what happened after the capsize of the boat.

The second image in the 'Two Summers' text which shows the dried out dam provides the inter-process distribution which students need to comprehend in order to know that the answer to Question 16, 'Rick will be in for a bit of a shock because'...is, 'the farm is dry and there is not much water.' The same inter-process distribution must be comprehended to know that the book *Two Summers* will be about 'changes from one year to another' in answer to Question 17. Inter-process distribution also occurs between the explanatory caption and the image in the diagram of the Greek water clock in 'Telling the Time Using Water' (see Figure 7.1).

Future researchers in the field of image-language interaction may wish to consider these issues of definition. The items involving inter-process distribution in 'Two Summers' and 'Telling the Time Using Water' had higher logits of difficulty than the items involving intra-process distribution but the significance of the difference has not been tested in this research because of the small number of cases. The need to infer from the images to fill gaps in meaning in the written text in instances of inter-process distribution contributed to complexity in the texts.

Some students did not look at one mode and it is important for teachers to identify the reason for this. This research has identified a range of students who ignored images from those who were too busy decoding to those who were fluent readers with the opinion that images are not important. At either extreme the students would have understood the text better if they had considered the images. On the other hand, teachers are often aware of students who focus on images and ignore verbal text because it is too hard to read. However, they might not be as aware of the observations

in this research that students sometimes seemed to ignore labels and captions on images as exemplified when they used pointing words rather than name labelled parts of a diagram or they did not know how the water clock worked because they did not read or could not understand the commentary in a caption. These findings suggest a need for more teaching focus on multimodal texts and how to read the different modes in conjunction with each other. Findings about the separate complexities in the images and language are discussed in the next section.

### **8.1.2 Verbal and image complexity in multimodal texts**

There was a range of difficulty within the groups of items involving each image-language relation as well as between them. One of the two most difficult items involving augmentation required students to understand a complex sentence in ‘Tobwabba Art Gallery’, which uses the passive voice and ellipsis (see Figure 8.3) and the easiest item involving augmentation required comprehension of dialogue that only contains independent clauses in an extract from *Zoo* by Anthony Browne. It was also observed that the most difficult item involving augmentation, which was about ‘Puddles’, required students to make inferences about an image while easier items involved less complex images. As a consequence of such observations concerning the reading materials, the second and third parts of research sub-question B were investigated: Does reading difficulty differ according to the (ii) linguistic complexity of the multimodal texts (grammar and vocabulary) and (iii) visual complexity of the multimodal texts (images)?

When the complexity of grammar and vocabulary (non-core words) in verbal text was investigated, correlations indicated that verbal complexity was related to item

difficulty. As a major part of the verbal complexity measure was in the syntax (number of dependent clauses), these findings corroborate the findings with 5 to 8 year olds by Beatty and Care (2009:239) who suggest that ‘as text difficulty increased, it is possible that the syntactic demands of the text were also increasing’ and that ‘reading interventions and instruction should target grammatical relationship skills’ (Beatty & Care 2009:241). Although advanced academic writing in journals is typified by complex noun phrase constituents and complex phrases, and dependent clauses were more common in adult conversations than the journals (Biber, Gray & Poonpon 2011), one would not expect the reading texts for primary students, such as the BST texts in this research or the texts in the Beatty and Care research, to be typical of the dense academic texts used in secondary schools.

The findings of Biber, Gray and Poonpon (2011) are to be expected because it has long been accepted that the complexity of academic language is lexically dense rather than grammatically intricate (Halliday 1985). It is argued in this research that complex sentences are midway along the continuum from colloquial to academic language and therefore it is not surprising that capable readers were more likely than less successful readers to use dependent clauses in conversations about texts. Derewianka (2011:95) explains that many students do not fully understand the logical relationships indicated by conjunctions and connectives and therefore they have difficulty in following the meaning of texts. She goes on to identify research about difficulties distinguishing between *before* and *after*, with constructions containing *because*, the meaning of *if* and *if...then*, and the appropriate use of conjunctions such as *unless* and *although*, before stressing the importance of monitoring students’ understanding of the relationship between ideas during activities such as guided reading.

Correlations also indicated that image complexity, involving abstract style, technological content and implicit features, was related to item difficulty. The correlations were strongest when complexity in either the image or verbal text was counted only if its comprehension was essential to correctly answer the test item.



*Escaping the Nets*

Artist: Moe Cunningham

The sailfish is believed to be a cunning fish, able to feed amongst the various fish traps and nets shown by the dark areas, without being caught. This art highlights the use of long lines and nets that are destroying our coastal fish.

**Figure 8.3** Part of ‘Tobwabba Art Gallery’ relating to Q28, 2005 Year 5 BST

This suggested that some students might have ignored complex verbal or visual parts of a text if they could answer questions using information from another mode of the text, that is, where there were relations of equivalence. For example, several students were successful in selecting the correct answer by interpreting an image without fully comprehending the verbal text.

The qualitative findings in this research considered the transactional nature of reading (Rosenblatt 1985), considering texts in the context of the readers’ response, not only considering ‘what a text “said” and how it “said” it’ (Cranny-Francis 2005:57). It was important to consider the specific cultural practice of a reading test, where there are time constraints and students sometimes do not read all parts of the texts. Some

students admitted that they did not read all of some texts that looked time consuming to read, for example, in answer to Question 14 about 'Eggs' a provincial Aboriginal student said she did not read all of the words because she thought the text looked too long and difficult. This strategy is likely to be successful when image and language are in a concurrent relation of equivalence but not when they are complementary. Teachers need to encourage students to scan texts for detail not just skim read or guess from part of the text. Test developers also need to take student reading paths into account when targeting skills for assessment and not assume that students have been able to comprehend complexity in one mode if the answer can be easily identified by only accessing another mode. This research supports similar recommendations following analyses of reading tests (Unsworth, Bush & Thomas 2004; Daly & O'Donnell 2008).

Cultural practices might also have been important influences on how students answered test questions, for example, some Aboriginal students' interpretation of a question about the shortest way from the jetty to the buildings on a map was different from non-Aboriginal students' interpretation. These Aboriginal students' interpretations were affected by their safety and environmental education which had taught them to always walk on tracks and not wander off through trees in the bush. For example, after choosing 'the track' answer half of the remote Aboriginal students gave reasons such as 'because you can see around that way' and 'that's the way you're meant to go.' Half of the provincial Aboriginal students and one metropolitan Aboriginal student gave reasons such as, *because if you went through the trees you might get lost, I'd never be that dopey* and *Cause that's rough... there'll be trees in your way*. These students were disadvantaged by their emphasis on safety and caution

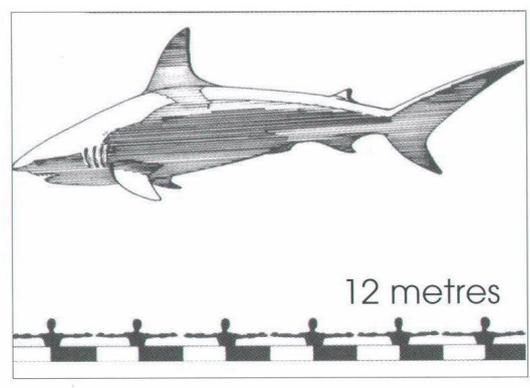
and by their adoption of a macro perspective in considering all factors determining the shortest time. By contrast students who took a micro perspective and identified a short distance were advantaged. This seems counterproductive in view of the need to encourage students to read between and beyond the lines and make inferences.

The reasons given by students for choosing ‘along the track’ instead of ‘through the trees’ are examples of ‘the cultural or political specificity of their reading practice’ referred to by Cranny-Francis (2005:157). The fact that it was only Aboriginal students who identified the problems associated with going through the trees suggests difference in knowledge of the environment or a cultural difference in interpreting the question which could be related to Aboriginal ways of learning such as the non-linear ways referred to by Harris (1990). The 8ways pedagogy for Aboriginal students in Western NSW also identifies a preference for non-linear, connected ways of learning and ways that are related to authentic meaningful purposes (Yunkaporta 2009).

Interpretation of images with technological complexity was also affected by students’ field knowledge which is another aspect of the individual ‘cultural... specificity of their reading practice’. For example, it was previously mentioned that some Year 3 students might not have been familiar with telescopes and some students also seemed unfamiliar with technical images. When asked about the meaning of a drawing of a shark with a scale diagram including arm spans below it (see Figure 8.4 on page 280), a student answered as follows:

- Non-ATSI remote male 1:*      *It’s showing us how long the shark is on a cinema screen.*
- Interviewer:*                      *How did you know it’s on a cinema screen?*
- Non-ATSI remote male 1:*      *‘Cause there’s people sitting down in the chairs.*

Although this student, who had a BST reading score in the lowest band, was aware from the label (12 metres) that the purpose of the shark image was to show length, he seems to lack knowledge from the mathematical field about scale images. Being unable to interpret the diagram as showing arm spans, he has instead linked it to his own experience of people sitting in a row in a cinema looking at a large image. Another student thought the image was a shark net, some others thought the rectangles in the scale below the arm spans image were a decoration or '*like a wall back at the pool*' and several students said they did not know what they were.



**Figure 8.4** Scale image from 'Water Animal Records' text in 2005 Year 3 BST

Although some students could interpret the scale image, it is not an example of the naturalistic coding orientation which Kress and van Leeuwen (1996:170-171) refer to as 'the one coding orientation all members of the culture share when they are being addressed as "members of our culture", regardless of how much education or scientific-technological training they have received'. It is apparent from some students' misinterpretations of the scale drawing that this image was characterised by

technological complexity for students who lacked the ‘education or scientific-technological training’ needed to interpret it.

This research has acknowledged that reading multimodal texts is a complex task which involves many skills and the difficulties of these skills are affected by many factors. Not only were items involving connections between complementary words and images more difficult than concurrent words and images as demonstrated in the last section, but the difficulty was also related to the complexity of grammatical structure and how images were represented, as discussed in this section. The familiarity of vocabulary and contexts and abstraction or technological aspects of images also caused difficulties for students, for example, the use of the word, treble, in ‘Double, treble or not’, and the technical images of the Greek water clock in ‘Telling the time using water’.

The complexities in one mode of a text often led students to ignore one mode and rely on the other mode alone. The importance of accessing and relating both modes to each other is one of the many aspects of multimodal texts about which students might need explicit modelled and guided teaching before they can independently comprehend them. In the next section the reading strategies used by students are discussed.

## **8.2 Assessment of comprehension of image-language relations in texts**

The high difficulty of questions that assessed understanding of image-language relations of complementarity dispels a commonly held belief that images necessarily make reading easier for students and suggests that teachers should carefully identify the role of images in multimodal texts. Teachers need to identify images whose meanings are concurrent with the written text before using them to support reading

comprehension. Identification of images with meanings that are complementary to the written text will alert teachers to know that explicit teaching is required to assist students to access multimodal meanings. Teachers require precise diagnostic information in relation to a range of items assessing comprehension of multimodal texts so that they can identify the kind of skills and therefore the explicit teaching and practice that is needed to improve students' comprehension of image-language relations, especially where meanings in each mode are not concurrent with each other.

As has been argued by many researchers (for example, Lemke 1998a, 1998b; Unsworth 2001, 2004, 2006a, 2006b, 2007, 2008a, 2008b, 2008c; Jewitt 2002; Luke, 2003; O'Halloran 2003; Royce 2002, 2007a; Deriwianka & Coffin 2008; Love 2008; Torr 2008b), that twenty first century literacy education about contemporary texts must incorporate an understanding of the meaning shifts and connections between codes in multi-semiotic texts and it is a corollary that literacy tests need to assess this understanding (Unsworth, Thomas & Bush 2004; Unsworth & Chan 2008). It was concerning that the National Assessment Program for Literacy and Numeracy (NAPLAN) reading tests in 2008 and 2009 which replaced the BST had fewer items involving comprehension of image-language relations than the 2005 and 2007 BST assessments but reassuring that the number increased in 2010.

While the majority of the BST questions investigated in this study provided precise measures of reading skills as intended, the answers chosen by students and the reasons students gave for their choices revealed some questions were interpreted in ways obviously not intended by the test developers. Some questions included concepts that were more difficult than the ideas in the texts, some words in questions were

interpreted in different ways to what was intended and one question was misread by many students. Such questions cannot provide the precise information required in a diagnostic assessment task and these findings and their implications will now be outlined.

### **8.2.1 Assessment items not interpreted as intended**

In each of the three tests that were probed by the interviews in this study there was one question that attracted unexpected answers from students who used expected strategies. The unexpected answers, to Question 6 in the 2005 Year 3 BST, Question 5 in the 2005 Year 5 BST and Question 32 in the 2007 Year 5 BST, were quite valid for how the students interpreted the questions, and these findings have implications for test developers.

With regard to Question 6 in the 2005 Year 3 BST which asked why humans were included in the photographs in ‘Water Animal Records’, there were several students who selected an incorrect option, ‘to show how the animal is measured’. However, when these students were asked to explain why they chose that answer, it was clear that their intention was the same as the correct option, ‘how large the animal is next to them.’ The students’ understanding of the term ‘measured’ could be different from an adult’s precise technical understanding of the term because of how the term is introduced in primary mathematics lessons about length by using comparisons to body parts by using strides, arm spans, foot and body lengths. This was apparent in the reason given by a remote male non-Aboriginal student for his choice of the measuring option: *‘This man here might be like... you see with his arms... he might be trying to find out the length,’* (see photo in Figure 6.1) and was reinforced in an image which

includes arm spans as part of a scale representing twelve metres to show the length of the Great White Shark in the final diagram (Figure 8.4).

Another issue in this question is the use of the passive voice in the incorrect option, ‘to show how the animal is measured.’ The lack of agency makes it unclear whether the option is referring to the divers in the pictures doing the measuring or the viewer looking at the picture making a comparison which is the intention of the correct answer, ‘to show how large the animal is next to them.’ The clear understanding of the comparative nature of the images by students who chose the option, ‘to show how the animal is measured,’ raises the question of whether the question is assessing comprehension of the text or of more formal mathematical terminology than that used in the text. Selection of the appropriate strategy was not sufficient to answer this question. Students also needed to interpret the term, ‘measured,’ as meaning ‘ascertained standard units of measurement’ rather than the informal type of measurement by comparison with bodies which is implied in the correct answer.

With regard to Question 5 about the text ‘Mapping Islands’ in the 2005 Year 5 BST, many Year 6 students interpreted the ‘shortest way’ as the shortest time instead of the shortest distance. Some of these students decided it would take less time to go the shorter distance through the trees but others thought it would take longer to go through the trees because it would be rougher terrain off the track. This reasoning was obvious when a student in a wheelchair chose ‘along the track’ as the shortest way from the jetty to the buildings. Other students considered safety issues thinking they might get lost if they went through the trees as demonstrated by a provincial Aboriginal female who said, ‘*Yeah. I’d never be that dopey.*’

Warnings about not wandering off tracks are stated on signs in National Parks, and teachers would have reinforced these ideas in lessons about the environment and child protection. The reasons given by students for choosing ‘along the track’ instead of ‘through the trees’ are further examples of ‘the cultural or political specificity of their reading practice’ referred to by Cranny-Francis (2005:157). Even the amount of field knowledge about mathematics needed to discount ‘how the animal is measured’ in answer to the question about the images in ‘Water Animal Records’ would be reliant on the cultural specificity of their reading practice for Year 3 or Year 4 students. In another text, ‘Puddles’, a culturally different term was identified by three of the Aboriginal Education Officers who participated in the interviews. They commented that ‘grandma’ and ‘grandpa’ are not familiar terms for most Aboriginal students who usually call their grandparents Nan and Pop.

Interview responses suggest that the unexpected difficulty of Question 32 about the text ‘Dragon Quest’ in the 2007 Year 5 BST, was because of the question not the text. In the post-test forty percent of students, some of whom were competent readers, misread the question, ‘Who is the narrator speaking to when he writes *Hey, you!?*’ by overlooking the preposition ‘to’ and this led them to choose the wrong answer. When forty percent of students misread a question it is concerning, especially since most students knew the correct answer when they discovered their error.

The issues in the three questions outlined here indicate that although certain skills are targeted in reading assessments, the questions can sometimes be interpreted differently by students. Test developers need to ensure that the questions are not ambiguous,

culturally biased or more difficult to read than the stimulus text. Interviews with a range of students while they answer trial questions could identify such issues. Other implications for developing reading assessments are discussed in the next section.

### **8.2.2 Implications for reading test developers**

There are several implications from this research for the development of reading tests. In order to develop reading assessments that are intended to provide diagnostic information, test developers must be able to identify the skills necessary to correctly answer test questions. As previously mentioned the skills students will use can be definitely identified for comprehension of relations of augmentation, however, in texts where image or verbiage correspond with each other and thus provide elaboration, as in *Water Movement in Plants*, it is difficult to design discrete diagnostic multiple choice questions, because it is not possible to know whether students used the image or the words to identify a correct answer (Daly & O'Donnell 2008:281).

As it can only be assumed that students are capable of performing whichever of these strategies is the easier option, test developers need to acknowledge this limitation when reporting results and describing targeted skills. Some of the skill descriptions in reports may need re-definition to identify what is tested by the assessment items so that it is not assumed that students can interpret complex text or images when they have actually accessed the information from a simpler alternative semiotic resource.

Test developers, reporters and recipients of the results also need to be aware that students with low reading abilities might not be following expected test processes or using expected strategies, for example, some students took such a long time to decode

the post-test texts during the read aloud, 'think aloud' process used in 2006, that they would not have had enough time to read the whole test in the time allocated for the BST. Most of these students did not omit many questions in the BST so it can only be assumed that, if they did not read all of the texts, they must have guessed some answers. In fact some students admitted using this strategy during the BST. The test provides diagnostic information about each reading question so it is important that teachers encourage students to carefully read each text and not feel obliged to finish the whole test, otherwise the data teachers receive will not be valid. It is therefore recommended that test administrators emphasise to students that the test is an assessment of their reading skills, not reading speed, and that they should read carefully and not rush or guess answers, even if this means they do not finish the test. Teachers can then see that students have omitted the last questions and realise there is an issue with reading speed whereas unread texts and guessed answers do not provide valid information for schools.

In order to ensure test items are valid, test developers also need to consider multimodal texts from the view point of students. Multiple choice items offer a limited selection of options to students and the options must be very carefully selected so that selection of the correct answer means the reader has comprehended the text. Item validity was questionable when students selected the correct answer to a question about the clepsydra diagram while not fully understanding how the water clock worked. Item validity was also questionable when students selected an incorrect answer even though they understood the size comparison concept in the images of divers with the whale, turtle and whale shark in the 'Water Animal Records' text.

The misreading of questions or the selection of incorrect answers because of valid interpretations of texts, suggests that test developers were not aware of how students would interpret the questions or optional answers. Questions in NSW and national tests have been, and national tests still are, trialled to estimate their difficulty and statistical validity but that process does not determine how students reach their decisions and whether the difficulty for students lies in understanding the text or understanding the question. It would be good practice if test developers conducted interviews with participating students following the trials of test questions to identify items that are misinterpreted. Such an investigation into how students interpret the questions would enable item selectors to avoid misinterpreted questions and to verify that the targeted skills are appropriate for the selected items.

### **8.3 Strategies used by student groups to comprehend multimodal texts**

There were sometimes several strategies students could use to answer questions and sometimes only one strategy. For example, students could access verbal text or images or both to correctly answer questions about image-language relations of equivalence in texts, but it was necessary for students to connect and comprehend both verbal text and image in order to correctly answer questions about all of the image-language relations of augmentation and most of the image-language relations of distribution.

Across all students in each cohort who were interviewed, the findings were affirmative in answer to the first part of contributing research question C: Are the strategies that students use to read multimodal texts, related to reading comprehension test scores? However, the answer was not as clear cut to the second part of the question: Is there any variation according to gender, geographic location or Aboriginal status? While

there was no statistically significant variation for most of these groups, in each cohort there was a different group for which selecting the correct answer using an expected strategy was not related to the reading comprehension test scores.

Within most groups of Year 4 students, those who scored well on the BST were more likely to use expected strategies and those who did not score as highly on the BST were less likely to use expected strategies. The only Year 4 group that had no significant correlation between number of expected strategies and reading score was the provincial group. It is relevant that several Year 4 provincial students experienced difficulty understanding the verbal text and diagrams about the water clocks despite using expected strategies. The difficulty of these comprehension questions was not surprising in view of the complexity in the language and images, and the relationship between these factors which was mentioned in the previous section of this chapter.

When the number of correct answers using an expected strategy was correlated with BST reading score, the Year 6 female group and the Year 5 Aboriginal, provincial and female groups also failed to have significant correlations. In the Year 6 female group, students with BST scores in low and high bands selected a similar number of correct answers using expected reading strategies. This unusual result seemed to be because many females with low BST reading scores improved their score in the post-test.

It could be relevant that fewer Year 6 females than males fully comprehended how the Greek water clock worked. Some females looked at the wrong picture or verbal text. This could be because they did not distinguish between the Egyptian and Greek water clocks or were attracted by some aspect of the layout to a different clock but in any

case they consequently chose answers associated with the wrong water clock. The coding of these strategies as just ‘image only’ was sometimes misleading and more specific categories such as ‘related image’ and ‘unrelated image’ might have correlated better with the post test score. However, to aggregate data it was necessary to have general categories for strategies, which could be applied across a number of questions, rather than specific categories meeting the requirements of individual questions.

Some other students who said they looked only at the images did not make a connection between the two pictures of the dam in ‘Two Summers’, so they did not recognise the change from a lush landscape to a dry landscape. These pictures together with the title implied that the book would be about that change. More specific questioning in the interviews about which images or parts of an image made students decide on answers might have elicited more specific answers, however, a conscious decision had been made to remain as general as possible to avoid leading students to certain answers. Although follow-up questions probed further, some students did not seem able to be more specific unless specific parts were mentioned by the interviewer. Future research will have to consider the fine balance between the need for specific answers and open-ended questions in interviews.

Another reason for why strategies might be misrepresented is that some of the students who said they only looked at the map or the diagram could have automatically (unconsciously) remembered the written details from their original reading at the time of selecting answers to test questions, which is likely for students who have good comprehension ‘skills’. Afflerbach, Pearson and Paris (2008) distinguish between

skills and strategies by defining the term, 'skill', as a behaviour that has been learnt and is produced automatically and without effort. Performing a skill might therefore leave students unaware of having carried out the action because no conscious decision was made to invoke the skill. However, students who are less proficient readers are more likely to be consciously applying reading 'strategies' and therefore more likely to remember deciding to take that course of action. Some students were poor decoders and such readers 'have difficulty comprehending because they often spend time and conscious effort decoding individual letters and words, where the meaning is less evident, rather than clustering words into larger meaningful wholes' (Woolley 2010:108).

It is highly likely that more students could remember the information they had read when they answered the post-test questions in 2006 because the 'think aloud' process during the post-test interviews ensured students had read the whole text aloud, including words in map keys and labels. Students with higher BST reading scores would be more likely to have remembered the verbal text in view of findings from a study in which 'skilled comprehenders outperformed a range of poor comprehenders on measures related to working memory' and were more likely to have the ability 'to bind or link visual and verbal information in working memory' (Woolley 2010:110).

Although Year 5 students with higher reading scores were more likely to select correct answers using expected strategies than students with low reading scores, there was no correlation for the Year 5 female, provincial and Aboriginal students between reading scores and use of an expected strategy to select the correct answer. Several students, including a female provincial Aboriginal student who had a reading score in the top

band, used the expected reading strategy of considering both words and image but chose an incorrect answer to the question about the number of characters in the text, 'Puddles'. These students seemed to be experiencing a kind of cognitive dissonance, whereby they could not accept that a character would not be visible in a cartoon, and so they decided that there were only two characters in the text, as evidenced by the following student with a BST reading score in the top band.

*Interviewer: For question eleven, how did you know there were two?  
ATSI female 3: Well up here it says it's quiet at grandma's house,  
and it says it's her house  
but it doesn't actually show her in the pictures at any time.*

In contrast, metropolitan, male, remote and non-Aboriginal student groups with low reading scores were not only less likely to use expected strategies to select correct answers but were also more likely to use expected strategies to select incorrect answers. These students probably did not understand the image or the language or they did not make necessary connections between images and language. This was particularly apparent when students did not understand complex sentences in the text, 'Double, Treble or Not', and when they acknowledged the reference to Grandma in the first frame of 'Puddles' but could not accept that she was the hidden character who spoke words in the third frame.

It can be concluded that texts with more complexity in either language or images also require advanced language or image interpretation skills. Choosing an appropriate reading strategy is a necessary, but not on its own sufficient, aspect of successful text comprehension for texts involving image-language relations of complementarity. Teachers need to provide explicit instruction about the complexities in sentences, such as connections expressed in complex sentences through the use of conjunctions,

participants represented in a different order through use of the passive voice or assumed to be present through ellipsis. Similarly, teachers need to provide explicit instruction about the complexities in images expressed through the use of different coding orientations, abstraction or technicality (Kress & van Leeuwen 1996).

### **8.3.1 Unexpected strategies used by students with high reading scores**

Although the research showed a relationship whereby most students with high reading scores used expected strategies to select correct answers, there were several instances where some of these students stated that they used different strategies. When students were asked how they decided on answers to questions, their answers sometimes reflected only a final conclusion rather than the full range of considerations they made before reaching that conclusion. For example, a provincial non-Aboriginal female who said she found the correct answer to Question 15 in the verbal text of ‘Two Summers’ (see Figure 8.3) is actually showing understanding of the distribution of processes which were evident in the verbal text (*fishing*) and implied in the image (*tipped boat*):

*Non-ATSI prov. female 3: Well you couldn't really get it from the picture  
Because it only shows the tipped boat, and  
it doesn't show that they wanted to go fishing.*

Even though this student does not realise that the fishing reels in the water indicate that the boys had been fishing, her response indicates that students who have stated one strategy and relied on information in one part of the text to answer the question might have also considered other parts of the text. However, some capable readers such as the following student did not perceive the need to look at the pictures accompanying stories possibly because ‘more able readers tend to naturally visualise

story content and rely less on illustrations than younger or less skilled readers’

(Woolley 2010:112):

*Non-ATSI provincial male 5: They had a mud fight or they tipped the boat, ‘cause nothing really confirms that they tipped the boat.*

*Interviewer: What’s the top picture showing?*

*Non-ATSI provincial male 5: Okay, (giggle) I don't really look at the pictures much. They tipped the boat.*

This student did look at the diagrams of the water clocks when answering all of the questions about ‘Telling the Time Using Water’ so it would seem that he had a different attitude to images accompanying factual texts than his attitude to narrative text images. However, responses such as these suggest that students with high reading scores, as well as other students, would benefit from more teaching instruction and discussion about how images and verbal text relate to each other.

### **8.3.2 Implications for further research**

During this research the interview data relating to items assessing comprehension of image-language relations of complementarity provided the most illuminating information about the strategies students used to comprehend the multimodal texts. This was because students needed to access both modes of the text to realise the complementary meanings whereas they could often access only one mode of the text to answer questions assessing comprehension of text where the meanings in the language and images were concurrent. In future research into students’ comprehension of multimodal texts, it would therefore be worth focusing on relations of complementarity in order to ensure that students need to access both the image and language modes of texts. Clarification of the image-language relation of distribution is

also advisable, for example, distinguishing between intra-process and inter-process distribution (Gill 2002).

Future research into teaching and learning could investigate why some students ignore images and others seem to experience a kind of cognitive dissonance whereby they are not ready or willing to make inferences about complementary meanings in words and images. Such research could also investigate possible teaching strategies to overcome these problems.

Further investigations into reading strategies could benefit from a differentiation between automatic skills and conscious strategies. This might be done by using video recording to document what students do automatically, possibly by tracking eye movements, in addition to asking about what they remember doing, which would be what they have done consciously. Another implication for future research into student's strategies for reading multimodal texts is to identify more specific categories of strategies, for example, accessing images that are relevant or irrelevant to the comprehension task and identification of images alone or images plus supplementary text.

#### **8.4 Inferences made and language used when talking about multimodal texts**

The main differences in the number of inferences and the amount of linguistic complexity were between students with low and high BST reading scores. There were no significant differences between genders or between students in different geolocations in the number of inferences or the amount of linguistic complexity in the talk of the Year 4 and Year 6 student groups. The ANOVA results showed that Year 4 non-Aboriginal students made significantly ( $p < .05$ ) more statements and more

correct inferences about images than Year 4 Aboriginal students but there were no differences in the number of correct inferences about verbal text or the amount of complexity in spoken language. Between Year 6 Aboriginal and non-Aboriginal students, there were no significant differences at all in either the amount of linguistic complexity or the number of correct inferences.

What was particularly interesting was that the Year 6 Aboriginal students made more correct inferences about images than the Year 4 Aboriginal students but the Year 6 non-Aboriginal students did not make more correct inferences about images than the Year 4 non-Aboriginal students. As it might be expected that older students would make more inferences, it seems possible that the Aboriginal and non-Aboriginal students could have responded differentially to the reading stimulus in the different BST tests. This seems likely in the light of previous research in which most questions about narrative texts, many of which were difficult for students across the state, seemed to be easier for Aboriginal students in the study, however, an information report had questions that were easy for the whole state but harder for the Aboriginal students in the study (Daly 2000b, 2006).

These findings resonate with those discovered by Heath (1983) in her longitudinal research in the US, where the black community of Trackton had a strong oral tradition of narrative discourse and the children's familiarity with comprehending hidden meanings in stories seemed to assist their inferential reading comprehension. Research in Australia has also found that narrative is a more familiar genre for Aboriginal students (Rose, Gray & Cowey 1999:52; Yunkaporta 2009; Eggington 1990).

While the Year 4 post-test only included questions about factual texts, the Year 6 post-test included a narrative text, 'Two Summers', and a culturally relevant text, 'Tobwabba Art Gallery' which described two Aboriginal paintings. The text about Aboriginal art elicited many correct inferences from Aboriginal students so the familiar context could have assisted them. It is also possible that the Aboriginal students might not be as familiar with factual texts, which was the case for the 'Trackton' children in the US, who 'seem to have skipped learning to label, list features, and give what-explanations' (Brice Heath 1994:92).

It is particularly relevant that the lower number of correct inferences by Aboriginal students was not evident in the remote or metropolitan Aboriginal groupings but only in the Year 4 provincial Aboriginal grouping. The provincial non-Aboriginal students made nearly four times the number of explanatory inferences about images as the provincial Aboriginal students. This was probably due to an imbalance in reading ability between the Year 4 Aboriginal and non-Aboriginal groups sampled in the provincial schools compared to other locations. The Aboriginal group had nearly twice as many students in low bands, half as many in medium bands and one third the number of students with scores in the top band as the non-Aboriginal students in provincial schools. In addition to this imbalance one of the non-Aboriginal students with a BST reading score in the top band made fifty percent more correct inferences about images than any other Year 4 student in the study. The lack of high performing Aboriginal students in the sample occurred because the BST results had identified one high performing Aboriginal student who was no longer attending school and another student from South America who had mistakenly identified as Aboriginal.

The differences in the number of correct inferences by Aboriginal and non-Aboriginal students are therefore reflective of reading level differences and it could be concluded that the main differences in inferential comprehension and linguistic complexity were between students with different reading scores regardless of their gender, Aboriginal status or geographic location. The strong correlations between reading score, number of inferences and amount of linguistic complexity in students' talk also suggest that students with higher reading scores tended to make more correct inferences than students with lower reading scores. This is not unexpected since making inferences constitutes deeper level comprehension, however, the use of more linguistically complex language is another matter and the relevance of linguistic complexity to making inferences will be further discussed later in this chapter (see section 8.4.3).

In chapter seven several examples of the coincidence of inferences and linguistic complexity were cited (see sections 7.2.3.1 and 7.2.3.2) particularly in relation to the questions about 'Telling the Time Using Water' and 'Tobwabba Art Gallery'. The questions involved distributed meanings between the image and a complex sentence in the diagram of a Greek water clock and augmentation of meaning between a very complex sentence and the painting it described. Some students used complex sentences to explain how the clock worked and to identify the meaning of elements in the Aboriginal artwork. These statements often involved inferences that identified main ideas but also sometimes involved making explanatory or associative inferences. Although a statistical analysis of explanatory and associative inferences was not reliable, because the requirements of the Levene's test of homogeneity of variances were not met, it was still possible to carry out qualitative investigations which are

discussed in the next two sections. How these inferences may relate to the students' use of linguistic complexity in their talk is discussed in the third section that follows.

#### **8.4.1 Explanatory inferences about images**

When explanatory inferences were analysed in 2006 there were very few made about verbal text (averages of less than 1) but considerably more were made about images by students with high, medium and low reading scores as identified in section 7.2.3.2.

Thinking aloud about the meaning of images in 'Telling the Time Using Water' was conducive to the production of explanatory inferences about the images because the diagrams in the texts were about how water clocks worked. The explanation genre was represented in that text through two explanations: one consisted of an image and written words about how the Egyptian water clock worked and the other was a labelled diagram of a Greek water clock. Using the 'think aloud' process prior to answering questions about the text ensured that students had focused on the images and labels and had talked about their understanding of how the two water clocks worked. The focusing of students' attention on the images might have been what assisted them to understand the texts, make inferences and select more correct answers in the post-test than they did during the BST.

If it is true that 'spoken language is the medium in which we understand and comprehend' (Lemke 1988:136), then students might also have been assisted to select more correct answers because they made statements and inferences about the texts before reading the test questions. In fact the associative inferences students made connecting information in the written text to the images or vice versa were often what led to explanatory inferences. Students who were able to understand the complex sentence describing the painting in 'Tobwabba Art Gallery' generally made

associations to the verbal text ('shown by the dark areas') when explaining why they selected the correct shape in answer to Question 28.

There were more associative inferences than explanatory inferences in the 2007 Year 5 post-test than there were in the 2006 Year 4 post-test. This was probably because in the 2007 post-test there were no complex explanatory diagrams and there were more image-language relations of complementarity, particularly relations of augmentation. The Year 5 students made three times as many correct inferences about verbal text as they did in 2006 as Year 4 students so the difference in mean number of correct inferences about verbal text might have been partly related to the difference in age. However, Year 5 students made marginally more correct inferences than Year 6 students despite being younger, so it is likely that the differences in the texts that each cohort of students read might also be relevant. The findings in relation to associative inferences about verbal text and the texts to which they related will now be discussed.

#### **8.4.2 Associative inferences about verbal text**

Most of the few associative inferences made by Year 6 students in 2006 were about the augmentation in 'Tobwabba Art Gallery.' For example, while speaking about the image, an Aboriginal metropolitan male with a BST reading score in the top band said, '*It's showing what looks like a swordfish with other fish swimming in water around dark coloured nets.*' In this way he made an associative inference to the verbal text connecting the augmented information in the text ('nets shown by the dark areas') to the image in order to identify the abstract shapes in the picture as '*dark coloured nets.*'

As students were asked to talk about the meaning of the semiotic resources (image and language) separately, the inferences were sometimes made about the alternate textual

resource, that is, when talking about the image an associative inference was often made referring to the verbal text or vice versa. Associative inferences have therefore been defined differently in this research than in previous research with children thinking aloud about written texts (Laing & Kamhi 2002). Associative inferences seem to be particularly relevant to this study because making associations between modes is relevant to the comprehension of image-language relations in texts. The statistically significant correlation between students' reading score and the number of associative inferences they made in 2007 suggests a need for teachers to encourage students to make associations between verbal text and images while talking about multimodal texts, possibly by the use of open ended questioning. The greater number of items involving image-language relations of complementarity in the 2007 post-test than in the 2006 post-tests is probably why students made more associative inferences in 2007 than in 2006. It is important for NAPLAN to include items assessing comprehension of relations of complementarity involving associations within texts.

The two students who made most associative inferences were the only students who made associations to the cover of the book that the boy is reading in the first picture of the text, 'Dragon Quest'. By recognising that the cover shows the image in the second picture of the BST reading stimulus, this associative inference led one of these students to make explanatory inferences, '*so it must mean that he was chosen*', '*because he was reading the book or something*' and '*he must have gotten taken into the book.*' This seems to be an example of a student making inferences to access the 'multiplicative' meanings in multimodal texts (Lemke 1998a).

When students accessed the multiplicative meanings they often made associative and explanatory inferences many of which have been expressed through relative and

adverbial clauses. The coincidence of inferences and linguistic complexity in written texts and students' talk will now be further considered.

### 8.4.3 Relations amongst scores, inferences and linguistic complexity

In 2006 students who were successful in answering comprehension questions about image-language relations in texts were more likely to make correct and explanatory inferences and to have more complexity in their talk about the texts they had read than students with low comprehension scores. When talking about the verbal text in 'Tobwabba Art Gallery', the following Aboriginal student, who had a BST reading score in the top band, was able to unpack the meaning in a complex sentence and express it in his own words:

*ATSI metro male 1: It's about a sailfish  
that is cunning  
and is able to get around the nets and fish traps  
that the people have set.*

This Aboriginal Year 6 student had more linguistic complexity in his talk about the texts than any other student. He uses relative clauses to elaborate and link information and give agency, through the clause, 'that people have set', to nominalised words in the text: 'the use of long lines and nets.' It is clear that the use of dependent clauses is integral to another of his explanations:

*ATSI metro male 1: It's showing us a wooden frame with a clock face  
that I would presume would be fixed to the frame, a cog  
that would be allowed to move  
and along the tip ... twisted ...the cog  
which moves on the ... smaller cog  
that moves the clock hand,  
and also a jar of water, a water supply and a float  
that moves up and down  
to move the larger, longer one.*

The relative clauses elaborate the participants (lines 2, 3, 5 and 8) and create connections between the **participants** via the *processes* as follows:

*twisted* > **cog** > *moves* > **smaller cog** > *moves* > **clock hand**

In this way the student expresses his understanding of the clause complex in the text, ‘and raises a float which is attached to a clock hand,’ and infers all the steps between the rising float and turning clock hand. Finally, the purpose is indicated by the non-finite adverbial clause, *to move the larger, longer one*. The student is exemplifying the use of the clause complex in spoken language ‘to represent... whole configurations of processes related to each other in a number of different ways’ (Halliday 1985:86). He has connected verbal text and image through associative inferences from processes in the verbal text (*moves up* is inferred from ‘raises’ in the text) and connections to participants named in the labels (*cog, clock hand, water supply* and *float*) and participants represented in the image (*frame, clock face* and *the larger, longer one*). The student has paid selective attention to the details in both the image and the written text, has made connections between these details and has then used linguistic complexity to express his understanding of the whole text.

In a similar manner the following Year 4 student, who used more complexity than other Year 4 students when talking about texts, explained the connections by using sentences containing **a relative clause, an adverbial clause** and **a non-finite clause**:

*Non-ATSI provincial female 6:*

*This trickles into there  
which rises [sic] the float.  
As the float rises  
it turns the cog  
and the cog turns the clock hand  
to tell the time.*

While making explanatory inferences (*it turns the cog and the cog turns the clock hand*) this student is also making associative inferences (*As the float rises*) about the image from the verbal text, 'raises a float'. These two students have combined the distributed meanings in an image-language relation of complementarity and used dependent clauses to sequence the steps showing how the clepsydra works. By making associative inferences directly from the verbal text the students have used technical terms in their explanations and moved beyond the immediate context of the image which limited other students to the use of demonstrative pronouns such as 'this', 'that,' and 'there'. Heath (1982) found that such explanatory language was more common among students from middle class homes and she commented that, 'They have developed ways of decontextualizing and surrounding with explanatory prose the knowledge gained from selective attention to objects' (Heath 1982:56). This seems to be similar to the way students who used more linguistic complexity in their explanations were able to move from the immediate context of the image to incorporate knowledge gained from the verbal text into their explanations.

Many students with low BST reading scores, who selected incorrect answers to the sequence question about the clepsydra, were only able to state what was represented in the image (for example, water dripping) and when asked what happens after that, they said they did not know. Some other students with low reading scores were able to select the correct answer in the post-test even though they did not in the BST, although it was apparent from the use of pointing words in phrases, such as, 'down there' and 'that thing', that most of these students were considering the image more than the labels. From the increased number of correct answers in the post-test, it seems possible that the 'think aloud' process could have provided a kind of oral rehearsal of their

understanding that assisted these students to have better comprehension of the diagram during the post-test interview than they did during the BST.

As the ‘think aloud’ process relies on spoken language to convey students’ understanding of the complexities in texts, analysis of the complexity in the students’ talk was considered to be relevant to both the inferential and textual analyses in this research. There were concerns that the number of complex features in the students’ talk could be a function of the number of clauses they uttered, so an analysis of the percentage of dependent clauses was conducted in an exploratory investigation about the different aspects of linguistic complexity in the students’ talk (Appendix V).

The exploratory analysis showed that there was a significant correlation ( $p < .05$ ) between students’ percentage of correct answers in the Year 5 BST and their percentage of dependent clauses spoken (out of the total number of clauses uttered) across all Year 6 students and for all of the Year 6 subgroups (male, female, Aboriginal, non-Aboriginal, metropolitan, provincial and remote). The exploratory language analysis suggests that the amount of linguistic complexity was not simply a function of the number of statements made and students with low BST reading scores used a lower proportion of complex sentences even when they uttered more statements than students with high BST reading scores. It is of course possible that students might use more complex sentences in other contexts where they know the topic well and it would be interesting to carry out further research on the linguistic complexity of students’ talk in familiar contexts. However, the purpose of the current research is to investigate students’ talk about written multimodal texts.

In keeping with Laing and Kamhi's (2002) 'think aloud' procedures, no proportional analysis of the inferences was conducted. In future, for similar research, it might be important to consider the proportion of statements that are inferential, rather than just the number of inferential statements to ensure that propensity to talk (or not talk) does not influence results. As correlations between the number of statements and the post-test scores were not significant, propensity to talk was not related to the students' success in answering questions about multimodal texts. It would therefore seem that, in this sample of students, success in answering questions about multimodal texts was associated with a specific kind of inferential talk about texts during interviews. This type of talk could be what Lemke (1988) was referring to when he said,

The problem of learning through texts is, I believe, fundamentally a problem of translating the patterns of written language into those of spoken language. Spoken language is the medium through which we reason to ourselves and talk our way through problems to answers. It is for the most part, the medium in which we understand and comprehend. (Lemke 1988:136)

This talk can be explicitly taught and/or modelled, for example, Cole (2010) cited in Woolley (2010), found that 'when reading and thinking processes are taught to students through dialogic interactions, they increase students' engagement and control of the reading comprehension process' (Woolley 2010:117). Dialogue that allows children to see and hear enactments of inner mental processes that are the essence of literate behaviour enables children to appropriate the processes for their own use (Wells 1999).

The type of talk Lemke (1988) is referring to in the quote above was exhibited by students with high reading scores who were likely to show their understanding by interpreting the verbal text and restating the meaning using their own words. For

example, a male with a BST reading score in the top band made direct reference to the image-language relation of augmentation in the text, 'Tobwabba Art Gallery' by using a relative clause, '*there's a few brown bits [which they said in the writing is traps]*'. One student with a low BST reading score, who substantially improved his score in the post-test, used no dependent clauses but was able to paraphrase the complex sentence (*Well they reckon this fish can get past all the fishing traps*), and associated this information to the image and explained what was happening (*They're all the traps and the fish is getting past them*).

In contrast, most students with low BST reading scores chose an incorrect answer and made incorrect inferences about the text, for example, a non-Aboriginal metropolitan student thought the sailfish was '*a fish that destroys like other fish's lives and ruins things*.' She seems to have connected information at the beginning and end of the paragraph, possibly because she did not understand the complex sentence with embedded clauses and passive voice in the lines between. Difficulty in understanding a complex sentence could be because, 'a long sentence with multiple embedded clauses ... may be too long to be successfully processed by a listener or reader' (Royce 2007b:363). To deconstruct long sentences, some readers need teachers to provide support to eventually be able to paraphrase by themselves thus 'translating the patterns of written language into those of spoken language' (Lemke 1988:136). For example, in the *Reading to Learn* methodology such complex sentences are disaggregated by teachers in terms that all students can understand and then read aloud by the teacher (Martin & Rose 2007:13).

Students with low BST reading scores tended to use less linguistic complexity when they were interviewed, but in this study as in others most of the ‘the poor readers did not appear to lack any type of relative clause structure entirely’ (Shankweiler & Crain 1986:158). There is an innate capacity to acquire syntactic knowledge through Universal Grammar, however, although grammar can be acquired from speech sources alone, the speech must be well modelled to ensure all the grammar needed is experienced by the child (Shankweiler, Crain, Brady & Macaruso 1992:287). If children are not experiencing the modelling and scaffolding of more complex language then their linguistic capacity will not be realised.

The influence of modelling and scaffolding is ratified by a recent study of preschool twin children in Australia, Scandinavia and the United States, in which analyses indicated that grammar/morphology as well as print awareness and vocabulary were subject primarily to shared environment effects rather than genetic influence (Byrne, Olson, Samuelsson, Wadsworth, Corley, DeFries & Willcutt 2006). It is parents, teachers and community members who model spoken language and develop the student’s familiarity with and competence in using and understanding more complex syntactic structures, but some members of society are not as likely to use complex language structures or to have a broad vocabulary in their spoken language:

Literature on language (Snow, Baines, Chandler, Goodman & Hemphill 1991) indicates that children who are poor hear a smaller number of words with more limited syntactic complexity and fewer conversation-eliciting questions... (Neuman 2008:5)

Drawing on the work of Bernstein (1971 revised 1974) and Heath (1982, 1983), Williams (1994:319) identifies the source of differences as social class, based on

degrees of autonomy/power at work that typically result in the use of a restricted coding orientation for production workers or an elaborated coding orientation for managers (Bernstein 1974). It seems probable that familiarity with (not capacity for) complex language, and the contexts in which it is used, could result in increased working memory across longer stretches of connected meanings and thus enhance comprehension of complex sentence structures. If this is the case then the implication is that teachers should model complex language and scaffold the production of more literate language in dialogic but decontextualized situations with students who live in communities with low education levels. Gradually building more opportunities for practice in using such language would increase familiarity with both receptive and productive complexity in spoken language and hopefully facilitate the comprehension of complexity in written language.

More research is indicated in the area of linguistic complexity in relation to students' talk and possible connections to reading comprehension. The different interview processes and how they might have influenced students' post-test scores, inferences and linguistic complexity are discussed next.

#### **8.4.4 Interview processes – ‘think aloud’ and ‘read through’**

More than half the students (across all locations) increased their score in the 2006 post-test from their score on the same questions during the 2005 BST. The ‘think aloud’ protocol is thought to be the main reason for this increase since a similar increase in score did not occur in 2007 when students were asked about the meaning of the text at the end of a ‘silent’ reading. The increase is unlikely to have been developmental because the amount of increase in reading score from the 2005 Year 3

BST to the 2007 Year 5 BST was not as great as the increase in scores on the same items during the 2006 post-test following the ‘think aloud’ protocol in interviews.

The improvement in reading score after thinking aloud is in keeping with findings that comprehension performance was significantly better for both average and below-average readers in a think aloud condition than in a listen through condition (Laing & Kamhi 2002:436). Think aloud has also been used at focal sentences in texts with Latent Semantic Analysis (LSA) to assess under-graduates ability to refer to prior causal sentences. However, it is doubtful if LSA would be useful with primary level texts, which tend to repeat key words, because ‘if the sentence shares several content words with the immediately prior sentence, then LSA would have trouble discriminating between a paraphrase of the focal sentence from a bridge to the prior sentence’ (Magliano & Millis 2003:275).

Thinking aloud has revealed strategies that are indicative of comprehension and reading skill, for example, readers who explain more during thinking aloud demonstrate better memory, show better deep comprehension and are better able to access prior text and reason from it (Magliano & Millis 2003:254). The significant correlation between explanatory inferences and reading score in the current study could be related to the use of these strategies. However, the significant correlation between these two factors and the amount of complexity in students’ spoken language raises the question as to whether familiarity with complex language enables students to be better able to access prior text and demonstrate better memory. The converse of this could be that the ‘think aloud’ protocol is not useful for students who do not have the vocabulary to express their ideas or the syntax to sequence them. In fact this could be

why some students did not improve their score following the ‘think aloud’ as much as others. Despite these issues, the greater increase in scores following use of the ‘think aloud’ protocol relative to a silent read through process suggests the use of the ‘think aloud’ protocol could be relevant.

It therefore seems that reading aloud and/or being able to think aloud about the meaning of a diagram and words as they read or having someone to keep them focused on their reading could have assisted the sixteen Year 4 students (as many Aboriginal as non-Aboriginal) who improved their number of correct answers in the post-test by at least three while most other students’ scores increased by one or two. For example, the process seemed to have helped some Year 4 and Year 6 students, who had BST reading scores in low and medium bands and had selected incorrect answers in the BST, to make sense of the diagram of the clepsydra in the text, ‘Telling the Time Using Water’ and select correct answers in the post-test. It is possible that thinking aloud at intervals as they read could have helped students with less developed working memory to make connections between information which they otherwise could not retain in their memory. Another factor could be that asking students to talk about the meaning of the images prior to answering questions drew their attention to visual parts of the text that they might otherwise have ignored or not considered as carefully.

Across Years 4, 5 and 6 the structured interview protocols were the same, except that the ‘think aloud’ process was not used with Year 5, but the average number of statements slightly decreased with age (52, 46 and 44 respectively) and the average number of correct inferences increased by one with age (10, 11 and 12) while the average number of explanatory inferences remained the same at 3.4. No conclusions

can be drawn about these figures other than a slight increase in the proportion of inferences with increase in age which could be expected. However, these figures show a similar backdrop against which other factors can be considered.

Between the 'think aloud' process in 2006 and the 'silent read through' process in 2007 for the same students when in Year 4 and Year 5 there was very little difference in the average number of statements made by the high reading ability groups (both 60) and low reading ability groups (43 and 45) and the average number of correct inferences made by high reading ability groups (17 and 18) and low reading ability groups (6 and 8). However, it was also observed in the other cohort that many Year 6 students improved on their 2005 BST reading score in the 2006 post-test, particularly in relation to the questions about the text, 'Telling the Time Using Water,' but also in relation to other texts.

Several Year 6 students who had selected the incorrect shape during the BST in answer to Question 28 about augmentation in the text, 'Tobwabba Art Gallery,' were able to select the correct answer in the post-test. A remote non-Aboriginal male with a BST reading score in a low band was able to select the correct answer and cite the reason as, *'because your text said that the fish doesn't go in the dark places because the nets are planted there.'* During the earlier 'think aloud' process this student had made the following inferences about the verbal text: *'It means it's a real smart fish and it won't go in the dark places because people throw nets and fish traps in there.'* Other students also made this more literal interpretation of 'the dark areas' as dark places rather than the description of abstract shapes in the painting as traps and nets through the words, 'fish traps and nets shown by the dark areas.' However, this

interpretation was sufficient for these students to understand the text well enough to select the correct answer.

If the improved reading score for some students in the post-test following the ‘think aloud’ process suggests that talking about the texts might have assisted these students’ comprehension, then it would support the following contention by a teacher in a rural area of the Northern Territory:

Children need to learn to articulate and become aware of what goes on inside their heads when they read. They need to understand the importance of internal dialogue and how to bring it to the fore, to think aloud the mental processes.  
(Dwyer 2010:22)

Dwyer (2010) recommends that students have conversations with others in groups, where they are able to ask questions and be supported with feedback. Even though the post-test improvement did not occur for all students, it is important to remember that the ‘think aloud’ process was used to elicit unassisted responses and if a think aloud process was used in a reciprocal teaching situation, there would be scaffolding and feedback which would offer even more support. In the next section further implications for the teaching of reading will be considered.

#### **8.4.5 Implications for teaching reading**

The findings of a strong relationship between the Year 6 post-test reading score and the amount of linguistic complexity used by students when talking about the texts might be relevant to previous research where students were tested at age 8 and age 9 and a lower reading level suggested that, ‘syntactic impairment may exert a greater constraint on reading ability with increasing age’ (Morice & Slaghuis 1985:141).

However, the increase in reading scores following the ‘think aloud’ process in the current research coupled with the relation between reading scores and use of linguistic complexity and inferences suggests some interventions that could be investigated. For example, encouraging students to talk about the meanings in texts might be a way of developing students’ comprehension of complex language and images in multimodal texts.

Another possibility is that thinking aloud about the meanings of the images prior to answering questions about the texts might have focused students’ attention on the images, whereas students might otherwise have only concentrated on the verbal meanings in the texts. If this was the case, it is recommended that teachers focus more on the interpretation of images and their relationship with the verbal text so that students recognise how images and text interact. Future research could investigate whether such a teaching strategy would result in students being more likely to direct their attention to images in a test without the intervention of an interviewer.

It is unclear whether improvements in reading score in the 2006 post-test would be due to students’ attention being directed to the images as previously mentioned or due to ‘talking out’ the meaning of texts (Lemke 1988:136). If students’ comprehension has been assisted by just having them talk about text meanings, without any reciprocal teaching support, then it would seem achievable for students in pairs or groups to discuss text meanings and possibly achieve similar benefits to their comprehension. Indeed, a ‘think aloud’ process should be enhanced by group discussion. Even greater effects could be expected in dialogic classroom applications involving ‘handover’ and

‘assisted performance’ (Dufficy 2005: 31-33) in the form of feedback from more linguistically competent peers or teachers who could assist students to elaborate ideas.

It is especially important for teachers to provide the necessary scaffolding for children who do not see literate behaviour modelled at home (Ewart 2007:26). It is through hearing more sophisticated language modelled, with opportunities to reciprocate, that children could increase the linguistic complexity in their own talk. Further research could investigate whether such an intervention would result in improved understanding of complex written language.

The examples of how associative inferences led to explanatory inferences (see sections 8.4.2 and 8.4.3 of this chapter), together with the correlations between the 2007 reading score and the number of correct, explanatory and associative inferences about verbal text, suggest that research is warranted into teaching students about looking for associations between verbal text and images. Researchers could investigate whether encouraging students to make associations between textual modes might make them more likely to develop an ability to make explanatory inferences concerning reasons, sequences, consequences and explanations for how actions and events transpire in multimodal texts. Gee (2008) contends it is important to allow children to develop expertise with regard to favoured subjects like trains or dinosaurs because they tend to give and hear school-related explanatory language, which ‘appears to facilitate early school success’ (Gee 2008:101).

As previously reported (Daly 2007:43), asking students to explain or justify (provide evidence for) their answers to questions about texts seemed to help them to identify

errors they made. It is therefore recommended that teachers give students practice in explaining or justifying their answers to multiple choice questions, for example, by telling students to check back to stimulus texts and actually put their finger on the part of the text that states, or suggests, an answer *before* they select that answer. Often students have read a text quickly and they think they remember something that relates to a key word in a question but they could confuse different parts of the text when remembering and, if they do not check back, they might choose the wrong answer.

Carefully checking texts before making decisions about them is of course a strategy that readers would benefit from throughout their lives not just in test situations.

Another implication for teachers (mentioned previously with regard to test developers) is a corollary to careful reading, that is, for teachers to remind students that it is better to read at their own pace, even if they do not complete the whole assessment, rather than guess answers in their rush to complete assessments on time. It is extremely important for the validity of the test as a diagnostic tool that students do not treat it as a guessing competition and yet some teachers believe they are assisting students by advising them to guess if they do not know the answer.

In the next section the findings about reading strategies, comprehension and linguistic complexity of the students' talk will be discussed in relation to Aboriginal students and students in rural areas (both provincial and remote) compared to non-Aboriginal students and students in metropolitan areas.

## **8.5 Comprehension of multimodal texts by Aboriginal and rural students**

The correlations between reading scores and correct answers using an expected strategy for both Aboriginal and non-Aboriginal students was not surprising in view of findings from the OECD Program for International Student Assessment (PISA) for 15 year olds in which there were no great differences between Indigenous and non-Indigenous students' use of different learning strategies (De Bortoli & Thomson 2010:91). Although there were also no significant quantitative differences between Aboriginal and non-Aboriginal students in different locations regarding the number of correct, explanatory or associative inferences they made, an examination of the transcripts of the interviews revealed some qualitative differences with regard to test-taking strategies and how they comprehended some of the texts.

Some Aboriginal students made comments about finding the texts in 2007 difficult to comprehend. For example, in answer to the question about 'Eggs' a provincial Aboriginal student with a BST reading score in a medium band said she guessed where the air pocket was in both the BST and the post-test because she had thought the text looked too long and difficult to read it all. However, when the student was asked to justify her answer and was offered the time to look carefully she found the correct answer in the verbal text. It therefore seems possible that a silent reading of texts in 2007 resulted in a different response to the text than might have been made in the read and think aloud process used in 2006. Some other Aboriginal and rural students who did try to access complex verbal text in 2007 had difficulty in understanding either the vocabulary or the complexity in the language structures. Some students also experienced difficulties with the layout of visual texts and complexities in images. The latter difficulties and their implications will be discussed first.

An examination of the transcripts of the three Aboriginal students with Year 3 BST reading scores in the top band revealed that although the remote and provincial students acknowledged the grandma's presence in the 'Puddles' text, they said there were only two characters. Both students seemed unwilling to identify a character who was not portrayed in the images. They thought the question was difficult and they were unfamiliar with the layout of cartoons. The provincial student said, *'I don't really know how to read them. I've never really had an interest in reading cartoons... like you're not sure if you're supposed to go down or across or...'* The students' lack of familiarity with a type of text that is sometimes used in children's picture books suggests that teachers need to ensure reading is taught using a variety of text formats.

These instances of uncertainty and lack of confidence from Aboriginal students with high Year 3 reading scores were in contrast to the demeanour of the students during their interviews in 2006. None of the three Aboriginal students who had reading scores in the top band in the 2005 Year 3 BST achieved reading scores in the top band in the 2007 Year 5 BST. The example above suggests that unfamiliarity with the text types in the 2007 BST could have contributed to less than expected improvement in their reading scores from 2005 to 2007. These students also seemed less confident in the 2007 interviews but it is not clear whether that was due to the unfamiliar texts or other causes. A PISA study of 15 year olds' literacy, which investigated levels of confidence, found that, 'On average, Indigenous students reported significantly lower levels of confidence in their abilities to handle tasks effectively than their non-Indigenous peers' (De Bortoli & Thomson 2010:91). The implication for teachers is a need to build the confidence of Aboriginal students in their reading ability and to

encourage them to take academic risks as recommended by Walton (1987) and Munns et al. (2000) and infer beyond literal meanings in texts.

### **8.5.1 Relevance of educational advantage factors**

Within the parameters of this study it has not been possible to investigate the socio-educational advantage in the background of individual students. However, these factors could be quite relevant to the different reading achievements of Aboriginal and non-Aboriginal students and of remote, rural and metropolitan students in the general population. Some aspects of this study and how they could relate to levels of community socio-educational advantage will now be discussed.

The My School website was launched in 2009, three years after the commencement of this research and more than a year after the last interviews. The Index of Community Socio-Educational Advantage (ICSEA) values reported on the My School website reveal less difference between the sample schools in different geographic locations than had been expected. From 2010 the ICSEA measure included Census Collection District variables directly relating to caregivers' education and occupation (non-professional or professional) as well as school variables relating to accessibility/remoteness index, percentage of Indigenous students and disadvantaged students with language background other than English. It is apparent from the ICSEA values for the sample schools (see Table 5.5 on page 135) that there was some overlap and similarity between the sample provincial and metropolitan schools.

The average ICSEA value for all Australian schools is 1000 and most of the sample provincial and metropolitan schools had an ICSEA value close to average. The lack of

difference in ICSEA values between the schools sampled meant that the schools were not representative of the mean ICSEA for their geo-location, particularly in view of the reported lower levels of employment and education of families in rural areas (James, Wyn, Baldwin, Hepworth, McInnis & Stephanou 1999:8). This could be why few differences were found between students in different geo-locations even though differences are evident across NSW.

Similarly, the average ICSEA values of the metropolitan and provincial schools suggests that the families of the Aboriginal students interviewed in these schools might not have the level of educational advantage that is representative of average Aboriginal households. However, the selection of schools that were not socio-economically representative could have been important in establishing that no significant differences are found between Aboriginal and non-Aboriginal students in the number of inferences and the amount of linguistic complexity in their talk when educational advantage factors are similar. The socio-educational disadvantage factors faced by many Indigenous students are not only lower education and employment levels but also more single parent families and fewer educational resources such as computers, internet access and text books (De Bortoli & Thomson 2010:i).

The education level of parents is probably more relevant to achievement on tests than socio-economic status in view of RAND Corporation research in the U.S. (Lara-Cinisomo et al. 2004) and other research in Australia (Najman et al. 2004). The relevance of parental education and employment to educational advantage has been further endorsed by the increase in predictive power of ICSEA (in relation to student achievement) from 59% in 2009 to 68% in 2010 when direct data about family

education and employment data was used instead of indirect data even though this data was taken from school enrolments. Research by Brice Heath (1994) in the U.S. and Williams (1994) in Australia would suggest that the positive effect on educational attainment is because educated mothers use home literacy practices that are similar to school literacy practices, and these practices include how people talk about texts which is one of the focus investigations in this research.

Torr (2008a) directly compared beliefs held by Indigenous and Anglo-Australian mothers from different educational backgrounds and found that beliefs about literacy development were related to education level rather than cultural difference. The influence of education level rather than Aboriginal status on beliefs about literacy is pertinent to this study's findings of no significant differences between Aboriginal and non-Aboriginal students in relation to inferential comprehension and complexity of language when speaking about texts. The effect of education level of parents might be partly because there is often a difference between the vernacular language of elaborated codes used by highly educated parents and restricted codes used by less educated parents (Bernstein 1974). The everyday language of highly educated parents is more likely to be like the specialist language of texts in the following ways:

...one key area where specialist varieties of language differ from vernacular ones is vocabulary. Yet they also often differ in syntax and discourse features as well ("syntax" means the internal structure of sentences; "discourse" in this context means how sentences are related to each other across a text and what sorts of things can or cannot be said in a particular type of text). (Gee 2008:96)

Gee (2008:99) also points out that 'interactive, inter-subjective dialogue with more advanced peers and masters' is crucial to children learning how words and grammar

are used to express particular perspectives on experience. Since educated parents use more specialist or complex language, they are more likely than other parents to use that language in dialogue with their children and the use of such language increases familiarity with its complexity and makes complex written language seem more familiar. This could be relevant to two findings in this research: that students who used more linguistic complexity in their talk answered more questions about image-language relations correctly and that many of the difficult questions (fewer correct responses) required comprehension of complex written language. For students whose parents are not highly educated, it is worth considering Gee's (2008) warning that the specialized forms of language and interactions at school can lack resonance with the child's vernacular cultural ways, 'thereby raising the child's affective filter and ensuring that school-based input is not actually intake' (Gee 2008:101).

As the level of parents' education was not investigated in this research, it is recommended that this factor be studied in future research into reading comprehension and spoken language in order to investigate whether there are differences in the specialist vocabulary and syntax spoken by parents and their children and whether that is relevant to the children's comprehension of complex written language. In the next section the students' inferences and the linguistic complexity in their talk about multimodal texts and the complexity in the images and written language of the texts will be discussed.

### **8.5.2 Inferences and linguistic complexity in written language and talk**

The ability to effectively explain events and connections in texts was characterised by the students' use of linguistic complexity. Only six Year 4 students and two Year 6

students did not utter any dependent clauses. All but one of these students had low reading scores and all but two Year 4 students were Aboriginal. As most students are capable of using linguistic complexity, the issue is why these students did not use it.

As the language learning experiences of children are not uniform and can vary according to relationships between caregiver and child, gender, social class and ethnicity (Painter 1996; Hasan 1992), it is possible that these students' minimal use of complex language structure was a result of such language not often being used in the home and therefore being unfamiliar. While the minimal use of linguistic complexity by students with low reading scores could be because some students did not understand the texts, six of the ten Year 4 Aboriginal students with low reading scores did select the correct sequence of events in the Greek water clock image in the 2006 post-test. This suggests that less use of complex language structure when talking about the texts was not related to a lack of comprehension of the clepsydra image in 'Telling the Time Using Water'.

However, the lack of reference to the verbal text by five of the six students suggests the lower amount of linguistic complexity in their talk could be related to poor comprehension of complex verbal text. Some Aboriginal and rural students said they found some words (subject-specific vocabulary) and/or how the words were written (grammatical structure or syntax) of texts difficult to understand. With regard to the question about 'Eggs', an Aboriginal provincial female who had a Year 3 BST reading score in the lowest band said she guessed the answer '*because there're some hard words in there we can't understand*'. The words in the part of the text where the

answer was located were not difficult non-core vocabulary but they were in a syntactically complex structure.

However, in the text, 'Double, Treble or Not', both the syntax and the vocabulary were difficult for many Aboriginal and rural students. Although half (six) of the metropolitan non-Aboriginal students knew what 'treble' meant, the only students in other groups who knew the meaning were two metropolitan Aboriginal students, one remote non-Aboriginal student and one provincial non-Aboriginal student. While several students were able to select the correct answer by inferring from the image or by lucky guesses, others made unlucky guesses. Some students thought 'treble' meant 'subtract' while some others thought it meant 'divide'. The level of some students' mathematical understanding also affected their answers with many students interpreting 'double' as adding two numbers rather than multiplying by two. As a result, some students thought the words 'double or treble' meant players had to 'add and divide'.

Such difficulties with non-core words could be similar to the findings of Chall, Jacobs and Baldwin (1996) who found that low income children in grades 2 and 3 were on a par with the general population when tested on high frequency familiar words, but when the words became less common in grades 4 through to 7 the children from low income families had greater difficulty defining the more abstract, academic and literary words. The failure of the three top Aboriginal students in this study to remain in the top band for reading in Year 5 could be indicative of the 'fourth-grade slump' in reading for low-income children (Chall et al.1996). The socio-economic status of individual students in the current research is not known but Aboriginal students often

have less advantaged backgrounds and it is known that the remote schools were in communities with lower socio-educational advantage (see Table 5.5 on page 135). However, regardless of the students' socio-economic status the implication for teachers is that these students would benefit from explicit teaching with regard to vocabulary development.

Other Aboriginal students had difficulty interpreting complex or unfamiliar language structures and this difficulty could be related to structural differences between standard Australian English and Aboriginal English as the Aboriginal students came from strong Aboriginal communities who speak an Aboriginal English dialect. For example, when a metropolitan Aboriginal male with a BST reading score in a medium band was asked why he thought the text, 'Double, Treble or Not,' was hard, he said, '*I just didn't understand... I know the words but I just didn't understand the way they were putting it,*' and an Aboriginal student with a BST reading score in the top band said, '*It's a bit hard because... just a lot to remember at once.*' It is not possible to know whether the difficulty is related to working memory limitations or unfamiliarity with complex language structures, or a combination of these factors. Shankweiler and Crain (1986:164) consider that 'working memory enables us to explain why the poor reader is far less able to understand complex sentences in print than in speech,' however, it is likely that familiarity with complex language and working memory are inter-related, with one factor building on the other.

The difficulty could also be due to unfamiliar contexts or word order, for example, an Aboriginal student with a BST reading score in the top band said she began to get lost at the sentence, 'Player 1 enters the answer for the provided number sentence into the

answer box and clicks the 'Check answer' box'. In this sentence the words, 'enters', 'clicks' and 'box', have specific meanings in a digital context, and 'the provided number sentence' is an example of rank shifting where the verb 'provided' has become an adjective in a noun group. It could be assumed that these students with Year 3 BST reading scores in the top band had excellent comprehension of the simple texts and relatively short sentences that characterised the Year 3 texts and therefore their difficulty comprehending the Year 5 BST texts was not expected.

Some of the students in the current study might have had problems since entering school but the students who had high reading scores in the Year 3 BST could have reached a point where they are encountering more complex sentences in the Year 5 texts and finding the vocabulary and complex language structures unfamiliar and therefore difficult to comprehend. The use of more complex sentences would be midway along the language continuum that goes from everyday colloquial language, involving clauses strung together in mostly simple and compound sentences, to more formal academic language involving denser nominalised structures (Jones 1996).

The improvement in comprehension for some students following the 'think aloud' process suggests that the process could have facilitated students' verbal reasoning, possibly because it approximated the 'reciprocal verbal interaction' referred to by Hay et al. (2007:405). The one-to-one interview and 'think aloud' process might also have moved towards a 'discourse of negotiation' that is recommended for Aboriginal students because they 'are motivated by the recognition of the teacher as an authority to speak' (Harrison 2005:878).

An implication for teachers could be to assist poor readers by using literacy programs which include a focus on dialogue about texts and the grammar and vocabulary choices made by authors, for example, through the ‘development of reflective dialogue’ in Accelerated Literacy (Gray 2007:19) or ‘by means of carefully planned talk around text’ in Reading to Learn (Rose 2010:13). Both of these programs focus on enhancing students’ skills in reading, writing, listening, speaking and viewing with particular attention to students’ ability to interpret illustrations accompanying texts.

With regard to Aboriginal students, the focus in these programs on visual and oral modes might have a positive effect on Aboriginal students’ learning and could be an example of how, ‘The very strong emphasis on visual and oral values in traditional life may be used in positive ways to empower rather than enfeeble Indigenous Australian children’s engagement with English’ (Zeegers, Muir & Lin 2003:56). In pedagogical terms, valued ways of learning, such as using visual and aural modes, can be used to scaffold literacy learning, rather than to dumb down the curriculum by avoiding lessons where students need to read and write. The primary focus on the written word in the Accelerated Literacy and Reading to Learn programs ensures that they are **not** saying that ‘children prefer visual and aural modes of learning’ and then ‘neglecting the written word when we know this is exactly what they need’ (Nakata 2003:10).

The inconclusive findings about associative inferences suggest that further research is advisable. It is recommended that such research not only investigates differences between student groups in propensity to make associative inferences but also whether differences in experiences outside school affect students’ willingness to make the association between verbal text and images. In view of the PISA findings about fewer

educational resources in Aboriginal households, a factor which is relevant to all students of low socio-economic status, it would be worth investigating influences such as discussing texts with parents or access to computer texts and games where images are usually essential components of the digital text or provide gateways to access parts of the texts. Differences in parental education and resources might also relate to differences in the background knowledge of student groups. In the next section evidence of differences in students' field of knowledge around texts will be discussed.

### **8.5.3 Field knowledge of Aboriginal and rural students**

The answers selected by students were sometimes influenced by their field knowledge or the context of texts, such as familiarity with the cartoon format in 'Puddles', with knights in 'Dragon Quests', with balance scale images in 'Water Animal Records', with cogs in 'Telling the Time Using Water', with maps in 'Mapping Island' and 'Dairy Farm', with numerical operations and games in 'Double, Treble or Not' and with science experiments in 'Eggs' and 'Water Movement in Plants'. Sometimes the prior knowledge of students does not match what is in a text, for example, an Aboriginal student who had done an experiment with eggs in vinegar seemed to be confused by the different experiment in 'Eggs' and she said, *'They're not telling about the things, like they're in a glass of water and one's in vinegar.'*

Some of the Aboriginal and rural students selected the correct answer to Question 30 about 'Double, Treble or Not' by either making clever inferences from the image or inferences from the image that were based on low level mathematical understandings. Some of the clever inferences were when students saw how big the numbers on the

game board were and inferred the answer should be 'add and multiply' not 'add and divide' because, as a male provincial student said, *'if you divided it, it'd be smaller, but if you multiplied it, it'd be big'* and another student said, *'I saw it ... the plus and then because the one after, 36, I thought you might have to multiply something to get it.* The first student commented on why the number sentence in the image was difficult by referring to a lack of similar information in the verbal text: *'Well because it's just got a three then a plus six, and it doesn't say anything about add or anything.'* However, these students were advantaged by their background understanding of mathematics which enabled them to infer from the image.

It was expected that students would access the main verbal text which said to 'double or treble the answer' in order to identify multiplication and that they would access the image to identify the addition sign. However, the question drew on different skills from those students who could not understand the verbal text and/or inferred the need to multiply from the big numbers on the board. Some Aboriginal and remote students referred to the plus sign and made simplified mathematical analogies to explain why they selected 'add and multiply' and not 'add and divide', for example, *'Cause multiply means plus'*, *'Because divide isn't addition'* and *'Because divide is take away'*. The responses by students to the text, 'Double, Treble or Not,' provide evidence of 'the significance of the epistemological setting of the use of texts in schools ... in the pursuit of discipline specific purposes' (Freebody & Zhang Bin 2008:24-25).

A different type of field knowledge is familiarity with text types and literary practices. It has been mentioned, in relation to the 'Puddles' text how some Aboriginal

provincial and remote students seemed to be hindered from making inferences by their very literal interpretation of words and images and an unwillingness to accept, for example, that there could be an unseen character in a cartoon. An Aboriginal provincial student was confused by her very literal reading of the sub-heading, 'Mirror Mirror', and seemed to think the photograph could be showing a real mirror rather than a drama game as indicated by the text title. Such literal interpretations of images and verbal text suggest that these students are not used to discussing texts in a critical manner. These students could lack confidence in their own opinions and they might not feel empowered to question texts. While other students could have developed a critical approach to texts through their interactions with texts in the home, it is probable that these students have not.

Torr (2008b) stresses the importance of such interactions with texts in the home and advises that children need to read many picture books to experience their possibilities and 'there must be plenty of time for one-to-one discussion' (Torr 2008b:64) but of course this is not easy to provide in the classroom. Knowing that you can question texts and read between the lines or behind the image is a type of field knowledge that goes to the heart of inferential comprehension and it is important that teachers encourage students to discuss and question textual meanings. If teachers model such questioning during reciprocal reading and guide students to participate in shared discussions then students will feel more confident to infer beyond literal meanings.

For Aboriginal students, teachers need to be aware that, 'like questioning, answering is a skill that must be developed slowly to allow students to gain confidence' (Heitmeyer 2003:223) and rather than using direct questions it may be advisable to invite students to comment on texts with thinking aloud statements beginning with, 'I wonder why'.

It has been argued that, rather than being regarded as products of knowledge, images are used in many pedagogic events as if they carry fundamental meanings ‘that appear to show transparently the self-evident surface features of experience’ and, ‘because of that, they need, perhaps even more so than language texts, explicit analytic treatment in educational settings’ (Freebody & Zhang Bin 2008:25). The image of the game board in ‘Double, Treble or Not’ was intended to be self-evident but its meaning was not clear for several students who were unfamiliar with such maths games. These students thought the image was difficult to understand and gave reasons such as, ‘*the numbers and stuff... like which way it goes*’ and said, ‘*It confuses me*’, ‘*It’s a bit unusual*’ and ‘*I think I understood the words better than the picture*’. The implications from these observations are discussed in the next section.

#### **8.5.4 Implications for Aboriginal and rural students**

The main significant findings with regard to students’ reading strategies and the number of correct inferences they made about multimodal texts were in relation to groups of students with different reading scores regardless of their Aboriginality, gender or location. It is apparent that the causes of the differences in the state-wide Basic Skills Test results in reading achievement according to gender, Aboriginal status and geographic location, lie outside the parameters of this research which sought a balance in gender, Aboriginality, geo-location and reading ability but did not measure socio-economic status or education and occupation of parents. The main cause of low reading achievement might be the same for Aboriginal and non-Aboriginal students but the higher proportion of Aboriginal students is probably due to a history of educational disadvantage for Aboriginal people, as expressed here:

*Lynne (Early school-leaving Indigenous mother):* I think with Aboriginal families that a lot of us weren't brought up with a lot of reading in the home. Um, our parents had problems in school. Our parents never got the opportunity to go to high school. They were unable to do homework with us, and it just wasn't part of the routine. As mothers now, I think we're carrying that on, so it's like learning a new life-style, to be able to do that with the children. (Torr 2008a:78)

Another early school-leaving Indigenous mother expressed the desire for programs for parents to support them to help their children (Torr 2008a:78). Differences in family educational background might also have led to differences within the content of the inferences students made in this research not just the number of inferences as Lemke (1998a) argues that the kind of connections we make 'is partly individual, but also characteristic of our society and our place in it: our age, gender, economic class, affiliation groups, family traditions, cultures, and subcultures' (Lemke 1998a:285).

The Report of the NSW Review of Aboriginal Education (NSW DET & NSW AECG, 2004) made 71 recommendations, many of which could benefit the non-Aboriginal students in this research as well as the Aboriginal students. For example, recommendation 10 under the heading, 'Extending Quality Teaching and Learning', includes a focus on training and development in promising literacy programs, for example, 'the *Bidialectal Approach to Teaching Standard Australian English*' and '*Scaffolding Literacy*' (p. 191). Scaffolding Literacy has since been developed into the National Accelerated Literacy Program (Gray 2007), which is 'designed to improve outcomes for Aboriginal students through an intensive exploration of complex grammar' (NSW Department of Education and Training 2009b:12). Accelerated Literacy also focuses on speaking about texts and interpreting images, for example, in

the Low Order Literate Orientation stage teachers direct students ‘to observe and talk about aspects of the focal text such as its structural features, the characters’ motivations, the author’s ideology and meanings embedded in pictures’ (Mullin & Oliver 2010:156). Accelerated Literacy therefore addresses factors associated with reading success across all students in this research: use and understanding of complex grammar and vocabulary when speaking about texts and relating meanings embedded in pictures to verbal text. Mullin and Oliver (2010:160) contend that collaborative dialogue allows students ‘to “notice the gap” between input and their own output, potentially providing them with an opportunity to attend to what needs to be learnt to bridge that gap’.

Programs such as Accelerated Literacy might also help to reduce the inhibitions of poor readers including Aboriginal and rural students who were reluctant to infer meanings beyond what was literal in verbal text or directly represented in images. The students’ reluctance could be due to a lack of confidence and unwillingness to take risks and scaffolding can assist in overcoming this problem as explained here:

Scaffolding their language production eliminates the need for explicit corrective feedback, a crucial element for learner engagement (Gray & Cowey 2001). Gray and Cowey maintain that learning only happens when student stress levels are low and when affect is positive. (Mullin & Oliver 2010:159)

The scaffolding, which provides explicit support for students when they are in the zone of proximal development (Vygotsky 1978), is used to engage students in reflective literate discourse. The reflective discourse in turn builds the students’ confidence to interrogate meanings in texts so that they feel able to take risks, infer beyond literal and represented meanings and read between the lines and images.

Students who did not carefully check the text in the current research might also be assisted by the Accelerated Literacy methodology in which ‘teachers direct [students] to work from the wording in the text rather than relying on their memory or common sense understandings’ (Mullin & Oliver 2010:158).

The BST results, and more recently NAPLAN 2008 to 2011 results, show that gaps between groups according to Aboriginal status and geo-location are increasing with age. The implication is that it is essential to start early and prevent or minimise the gaps in the early years of education. The qualitative aspects of this research have indicated that action research in classrooms is warranted to investigate a number of different teaching strategies that might assist poor readers including Aboriginal and rural students.

## **8.6 Conclusion**

The four main aspects of image-language relations in reading assessments that were statistically analysed in this research concerned the texts, the students’ reading strategies when answering questions and the number of inferences they made and their linguistic complexity when talking about the texts. The latter three aspects involved a comparison of student groups according to gender, geographic location, Aboriginal or non-Aboriginal background and reading ability groupings. Within these groupings the only conclusive differences found in this study were between the low and high (and sometimes medium) reading ability groupings. The findings in relation to the four aspects will now be summarised.

## **Textual Analysis**

The textual analysis focused on 63 reading test items assessing comprehension of image-language relations in five state-wide assessments for Year 3, 5 and 7 students in 2005 and 2007. A hierarchy of difficulty was found whereby the mean difficulty of assessment items involving image-language relations of equivalence was significantly lower than the mean for items involving image-language relations of both exposition and distribution which in turn were significantly lower than the mean difficulty for items involving image-language relations of augmentation. Relations of equivalence could generally be interpreted by accessing either the words or images alone but relations of augmentation were more difficult because they required students to access and connect information from both the verbal text and the images. The difficulty of items involving complementary image-language relations in texts dispels the popular myth that images in books always assist the reader to comprehend texts. There is an implication that students need explicit teaching to learn and practice strategies that will develop their skills in comprehending multimodal texts where information in the images and verbal text is complementary.

The investigations into text complexity found significant ( $p < .05$ ) differences between the mean difficulty of items involving high and low levels of verbal complexity (grammatical complexity and vocabulary) but not for those involving different levels of image complexity. A lack of significant differences in the mean difficulty of items involving image complexity might have been a function of low complexity in the images or the use of a previously untested measure of image complexity.

When the verbal and image complexity of parts of texts were measured only if they were ‘essential’ for students to understand them in order to answer reading assessment questions, this meant complexity in only one mode was counted for the combined ‘essential’ complexity score in regards to image-language relations of equivalence. When compared to combined text complexity that included both modes, the stronger differences between the mean difficulty of items involving different levels of combined ‘essential’ text complexity suggested that students tended to ignore highly complex verbal (or image) parts of texts if they could more easily access the information they needed in the other mode. One of the main implications of this study is that verbal text, images and image-language relations in multimodal texts involve many complexities, the understanding of which should be targeted skills in English syllabuses and assessments. Students need to be taught strategies to access the meanings within and between modes in contemporary texts.

### **Reading Strategies Analysis**

The analysis of reading strategies showed that there were significant correlations between students’ reading scores and their number of correct answers using expected reading strategies for most groups in 2006 but for fewer groups in 2007. However, there were three main changes in 2007.

Firstly, there were changes to the student cohort including attritions and changes in reading achievement bands. None of the three Aboriginal students who achieved reading scores in the top band in 2005 did so in 2007, but eight non-Aboriginal students across the study achieved reading scores in the top band of the 2007 Year 5 BST and three of these students had scores in medium bands in 2005.

The second change was in the test procedures from a 'think aloud' process in 2006 to a silent 'read through' process in 2007, mainly because reading and thinking aloud about the texts had already been assessed during the first stage interviews. There was less change in score from the 2007 BST to the 2007 post-test than there had been from the 2005 BST to the 2006 post-test. The change in process could have resulted in students choosing different reading strategies in 2007 to those they would have chosen if their attention had been drawn to specific parts of texts by being asked to 'think aloud' about them prior to answering questions, as occurred in 2006.

A third change in 2007 was in the test materials. In 2006 there was a predominance of factual texts, including an explanatory diagram, while in 2007 there were more literary texts, including a cartoon, and there were no explanatory diagrams in 2007. There were also more items involving image-language relations of augmentation in 2007. All of these factors could have had an impact that caused slight differences in the statistical analyses of strategies and also the analyses of inferential comprehension.

In addition, analysis of the interview transcripts identified a question in each of the three tests that was interpreted differently by a substantial number of students leading to these questions becoming more difficult than intended and in some instances a substantial number of students did not use targeted skills to answer questions. For example, twenty out of thirty students selected a correct answer to one question by making inferences from the image alone and guessing, instead of accessing information in the verbal text and image. The implication from these findings is that

closer attention needs to be paid to how students interpret questions and access answers during the development of diagnostic reading assessments.

### **Inferences and linguistic complexity of talk about texts**

The amount of linguistic complexity in students' talk about the texts they read and the number of inferences they made about verbal text were not significantly different according to their geo-location, gender or Aboriginal status. This was in strong contrast to the significant differences between reading ability groupings of students. Students with low reading scores made fewer correct inferences about images and had less linguistic complexity in their talk than students with high reading ability and Year 6 students with low reading ability also made fewer correct inferences about verbal text than students with high reading scores. While the findings in relation to inferences about verbal text might have been expected in view of the generally acknowledged difficulty of inferential comprehension, the findings in relation to students' linguistic complexity and inferences about images were investigations without precedents and so not necessarily expected.

The correlations between the 2006 post-test scores and linguistic complexity, correct inferences about verbal text and images and explanatory inferences about images for both Year 4 and Year 6 students reinforce the findings of significant differences between students with different levels of reading ability. These findings cannot be generalized beyond this study as each of the three tests samples was only between 50 and 60 students. However, in view of the significant correlation between these factors in an assessment context, further research into linguistic complexity and reading comprehension in a teaching context is recommended.

Correct, explanatory and associative inferences about verbal text were found to be related to the 2007 post-test reading score. The findings about associative inferences seem to be the most relevant to the comprehension of multimodal texts because of the need to make associations between words and images. However, the number of associative inferences was small so the effect of the correlation cannot be overestimated from this small study and further research is recommended.

The socio-educational advantage measures for the metropolitan and provincial schools in this research were similar and this could be why there were few significant differences according to Aboriginal status and geo-location. In fact analysis of NSW NAPLAN results indicates that the considerable statewide achievement differences according to Aboriginal status and geo-location overlap with and are strongly related to differences according to the index of community socio-educational advantage. The coincidence of social disadvantage with geographic location and Aboriginal status is evident in the fact that fourteen of the twenty highest ranked disadvantaged postcode areas in NSW were located in rural areas in 2003 (Vinson 2004) and Aboriginal people have much lower income and higher unemployment than non-Aboriginal people (Calma 2005:30). Indeed, research has found that, ‘Controlling for socio-economic factors such as income and parental education reduces the Indigenous/non-Indigenous gap by between one-third and two-thirds’ (Leigh & Gong 2008:2). However, schools can make a difference and ‘schooling practices that ameliorate the negative effects of social disadvantage become more crucial by Year 5’ (McConaghy 2008:306).

As there were strong correlations between the reading scores for all students and the number of inferences they made as well as the amount of linguistic complexity in their talk, it would be interesting to investigate the possibility of this latter variable having an impact in relation to all students. Recent research concerned with children in pre-school and the first years of school is 'supportive of the notion that children's oral language competencies underpin children's transition into literacy' (Hay & Fielding-Barnsley 2009:158). There has been similar research that concerned later school achievements by children with language impairments (Catts & Kamhi 2005), however, the students in this study aged between 8 and 12 were not known to have any language impairments, so further research with this age group into students' linguistic complexity and their comprehension of written language is warranted.

The correlations between reading scores and number of correct inferences together with the improvements in post-test scores following the 'think aloud' process, suggest that talking out the meaning of texts might improve reading comprehension and further investigations into such teaching strategies are recommended. Teaching students reading and thinking processes through dialogic interactions has been found to 'increase students' engagement and control of the reading comprehension process' (Woolley 2010:117).

The implications from the range of findings from this study are that students with poor reading achievement might benefit from explicit literacy programs, such as Accelerated Literacy, that focus on grammar, talk about texts, interpreting images and relating them to verbal text. The evaluation of the National Accelerated Literacy Program (NALP) in the Northern Territory from 2004 to 2007, confirmed that it is

‘delivering accelerated reading progress’ (Tyler, Robinson & Bartlett 2008:16).

Research on the effect of an intervention such as Accelerated Literacy on the comprehension of multimodal texts is recommended.

Reading and writing are complex tasks and it is teachers’ expectations, classroom talk, relationships and ‘their actual ways of inducting [students] into specific textual practices that most affect literacy outcomes’ (Kamler & Comber 2003:127). The ‘actual ways of inducting’ need to include a metalanguage about ‘textual practices’ for accessing inter-modal meanings (Unsworth 2006b, 2008a, 2008d) by using ‘the emerging theoretically articulated functional grammars of language and image and the associated metalanguage of image/text relations that facilitate explicit discussion about the interpretative possibilities constructed by multimodal texts and strategies for negotiating their critical comprehension and composition’ (Unsworth 2008d:15).

It follows that assessments of reading must accommodate a range of multimodal texts that reflect educational goals within contemporary culture to assess students’ ability to access the meanings jointly constructed by images and language in a visually rich culture (Unsworth, Thomas & Bush 2004). For construct validity within the reading assessments it is important to be able to identify the type of image-language relation being assessed at different levels of text comprehension (Unsworth & Chan 2008, 2009). Diagnostic assessments need to be able to identify whether students are interpreting visual or verbal meanings (Daly & O’Donnell 2008) or whether students are synthesising meaning by making inferences using information from both images and language resources, as evidenced with regard to the image-language relations of augmentation and distribution in this research.

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