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Modes of processing influencing errors in reading comprehension

By

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A Research Thesis submitted in the partial fulfilment of the requirements for the degree of Masters Research psychology in the Humanities Faculty, University of Witwatersrand, Johannesburg.

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Abstract:

Learner's processing styles may play a vital role in their approach to learning, more specifically; the ability to make inferences plays an important role in all areas of language and learning and may contribute to difficulties learners are experiencing at school. It is therefore that the research was directed at investigating a possible relationship between the left hemispheric analytical and right hemispheric holistic processing styles and the types of errors inferential versus literal, made in reading comprehension tasks. The hemispheric processing styles were operationalised as the approach taken to the Rey-Osterreith Complex Figure (ROCF) and the types of errors made on the Stanford Diagnostic Reading Test (SDRT) across two levels of educational development. The sample consisted of grade 4 and grade 10 model C learners from the same schooling district. The data obtained from both assessments were subjected to correlation analyses, chi squared tests, analyses of variances (ANOVAs) and logistic regressions. Finally the results and associative conclusions indicated that there were only modest positive relationships between the predominant hemispheric processing styles and the error types on reading comprehension tasks and the demographics of the learners were the main contributors and accounted for the results discovered in the study as opposed to general hemispheric processing. Thus there is a need to understand the unique dynamics within the country and to explore alternatives to teaching practices to account for the variations evident in the classrooms.

Key words:
Hemispheric processing styles, Reading comprehension, Literal, Inferential, Rey-Osterrieth Complex Figure (ROCF), Stanford Diagnostic Reading Test (SDRT), Language, Ethnicity.

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Chapter 1: Review of the literature

1.1. Introduction:

Learner's processing styles may play a vital role in their approach to learning, more specifically; the ability to make inferences plays an important role in all areas of language and learning and may contribute to difficulties learners are experiencing at school. Inferential skills are highly relevant from the earliest to the most advanced stages of learning and may have detrimental influences on learners who are less inferentially based or who are second language learners (Littlemore & Low, 2006). It is therefore that the current research is directed at investigating a possible relationship between the left hemispheric analytical and right hemispheric holistic processing styles and the types of errors inferential versus literal, made in reading comprehension tasks. The hemispheric processing styles are operationalised as the approach taken to the Rey-Osterreith Complex Figure (ROCF) and the types of errors made on the Stanford Diagnostic Reading Test (SDRT) across two levels of educational development.

Research in a South African context is important, as there is a diversity of languages and cultures, therefore understanding other possible contributing factors such as ethnicity, home language and gender should be considered. Furthermore, a clear understanding of the relationship between predominant analytical style and reading abilities, across age and educational level and relative to population subgroups may further inform educational pedagogy (Knott, 1986; Littlemore & Low, 2006). This is vital as anomalies in reading comprehension may have implications for education and the learning-teaching practices as it is conducive to learning. If educators consider how their teaching principles and medium of instruction may correspond to what the learners bring to the classroom and make more informed pedagogical decisions, this may prevent learner frustrations and the vast number of failures evident in the country (Dogancay-Aktuna, 2005).

1.2. Rationale:

In recent times the perceived weakening of the academic standards and the literacy levels amongst the youth has received much attention in the popular press (Bell, 2009). The radical changes in the composition of the average classroom characteristic of the “new” dispensation and ongoing adaptation of educational policy may pose problems for educators, who are the main agents of educational change and who should be exploring alternatives to teaching practices to account for the variations evident in their classrooms (Joseph & Ramani, 1998). If the country produces a too uniform system of education with limited flexibility for the adaptation of learners needs, the current educational concerns may never be resolved and may have long term detrimental effects. The system needs to deconstruct its practices to determine whether they are working (Bell, 2009) and in doing so, educators must consider the effect of possible variations in basic cognitive processing style as a determinant of best pedagogic practice.

The current research calls on educators to take this into account and to explore alternatives to their teaching practices and respond to the complex and changing needs of their students. Models need to be developed which include the problematized aspects of literacy, promote critical reflection and action instead of constraining frameworks of instruction. For a transformative education system, educators should be more aware of certain configurations of the English language and how it impacts on reading comprehension abilities. (Bell, 2009; Mirhosseini, 2008). These concerns are further complicated by issues of multilingualism in the South African context and have implications for teaching and learning. Second language learning has made significant headway into mainstream pedagogical practice and in the designs of teaching materials (Littlemore & Low, 2006) but there are still significant improvements to be made. These may encompass the various language and teaching methodologies which may not correspond to the experience of the learners, which may lead to frustration and subsequent failure. With the awareness and understanding of the

essentials, educators may be sufficiently equipped to provide particular groups of learners, educationally sensitive pedagogy. Therefore considering variations of materials and pedagogical approaches for particular contexts, through adequate investigations, would be the first step to developing innovative methodologies across contexts and in turn influence the outcomes of the learning processes (Dogancay-Aktuna, 2005).

Reading for example is regarded as a fundamental skill necessary for personal learning and intellectual growth (White, 2007). It is important to determine the difference in comprehension abilities or difficulties of school-going participants as, for instance a study conducted by Skibbe and colleagues (2008) indicated that 67% and 64% of second and fourth graders exhibited non specific language impairments and were unlikely to draw level with their peers abilities (Skibbe, Grimm, Standton-Chapman, Justice, Pence & Bowles, 2008) based on their comprehensive scores (no follow up study was mentioned nor was the permanence of these variances). This is further emphasizes by the cumulative reading trajectory, which predicts that the divergence between non achieving and achieving individuals in reading comprehension, increases over time (Skibbe et al., 2008). It is for this reason that a cross sectional approach was adopted in this research, for different educational levels, as reading is a fundamental component of the educational process (Carpenter & Just, 1986) and may be affected by the predominant hemispheric processes of the individuals. Given the heterogeneous nature of the cohorts entering into the educational system one must challenge the assumption that a left hemispheric route might be inherently preferred as the route to written language comprehension (Bryan, 1995) and to determine the effects processing styles have on ones comprehension abilities from a developmental platform.

Educators should reconsider not only the minimum competencies but also the ability and nature of the learners reading and comprehension skills (Knott, 1986),

such as how the hemispheric processing styles , left hemispheric analytical and right hemispheric holistic processing styles, may influence the types of errors inferential versus literal, made in reading comprehension tasks. This research may offer educators insight on the anomalies individuals may exhibit in their language abilities based on their different processing styles and support them in promoting specific reading development plans (Skibbe et al., 2008) which would therefore increase their students learning abilities within their range of capabilities. As reading involves certain cognitive processes and structures that can be investigated, learned and modified (Carpenter & Just, 1986), educators and researchers are able to determine the source of errors and difficulties (Chun, 2009) and suggest methods of preventing or remediating the difficulties present (Carpenter & Just, 1986). One may also consider restructuring the class syllabus or to specifically choose the appropriate tool, in this case reading matter, to focus on the specific areas of difficulty (Chun, 2009) to enhance, develop and master skills. The hemispheric participation in reading comprehension, whether the child indicates more literal or inferential errors, is vital as it may have implications for child neuropsychology and provide information pertaining to the effects it would have on one’s adaptive performances as well as how reading anomalies deviate from the normal developmental processes (Waldie & Mosley, 2000). The research may contribute by highlighting cultural deviations from the standardized norms and raise awareness of different adaptive pedagogy. These anomalies may have further implications for education and the methods used for early reading instructions and how these would later affect remediation (Waldie & Mosley, 2000).

1.3. Literature review:

1.3.1. What is reading and why is it important:

Reading is defined as perceptual, cognitive, social and linguistic factors and involves the process of comprehending in order to communicate (Knott, 1986). Comprehension and reading not only includes the processing of semantic and syntactic information but text structure, previous knowledge, concept formation and its application as well as letter identification skills, phonological skills and memory skills (Knott, 1986; Waldie & Mosley, 2000). Although learners may experience difficulties with a number of these processes; the current research will focus on the implications of the left and right hemispheric processing styles and how these may influence the types of errors, inferential versus literal, made in reading comprehension tasks. Unravelling and determining the brain regions that are responsible for cognitive processes that sustain reading, remain complex and intricate (Jobard, Crivello & Tzourio-Mazoyer, 2003). A method that may aid in the indication of brain regions responsible for certain reading skills includes the dual route theory of reading.

1.3.2. Dual route theory of reading:

This model provides the researcher with a framework to investigate reading. This model developed from cognitive neuropsychological observations of brain-damaged individuals and was later supported by experimental psychology of normal readers (Jobard et al., 2003). This theory suggests that of the many routes available, there are 2 routes better suited for the recognition of words and their meanings (Carpenter & Just, 1986), these include the direct (visual processing) and indirect (phonological processing) routes (Jobard et al., 2003). Each route depends on specific brain areas and highlights the different hemispheric processes required for reading.

1.3.2.1. Visual system:

Visual information is processed through 2 pathways that extract fundamentally different types of information. The ventral or occipito-temporal pathway also known as the 'what' pathway is utilized for object perception as well as recognition. The dorsal or occipito- parietal pathway also known as the where (or how) pathway, is specialized for spatial perception, configuration and guiding the interactions between objects (Gazzaniga, Ivry & Mangun, 2002). Research has found that bilateral lesions to the ventral pathway lead to deficits in object discrimination which are restricted to the visual modality. More specifically, damage to the anterior regions effect visual memory and posterior regions affect visual discrimination (Gazzaniga et al., 2002). Lesions to the parietal lobe have been found to affect land mark reversal tasks, but only mildly. This region responds to stimuli in the more lateral regions of the visual field and is used to detect the presence of a stimulus. The temporal regions encompass what is considered more central vision, which includes the fovea, and is ideal for the specialized object recognition tasks (feature recognition and recognition by components) (Gazzaniga et al., 2002). With the use of PET scans, researchers have been able to determine that during position tasks, blood flow increases in the right parietal lobe. Furthermore, object recognition tasks have lead to increased bilateral blood flow at the junction between the occipital and temporal lobes. Both of these basic pathways are not isolated from each other as the integration of the different components is necessary for higher cognitive processing (Gazzaniga et al., 2002).The current research will make use of the basic description of the ventral pathway to aid in the understanding of the higher cognitive processes that are involved in reading comprehension.

Although reading is a form of language which is associated with spoken language, it consists of cognitive processes that are specific to the visual processing and recognition of information (Carpenter & Just, 1986). Areas that are specialized for processing written language include the left planum temporale (specifically language comprehension) and Brodmann's area 39 in the left

hemisphere (specialized for reading) (Gazzaniga et al., 2002). These areas are able to distinguish among the various complex visual stimuli and recognize the information regardless of the differentiations in the conditions under which they are presented (Banich, 2004). It is important to understand that written language is relatively new with respect to the evolution of the brain however; current research has provided further insight into the organization of the ventral visual processing pathway with the use of neuro-imaging techniques (Banich, 2004). This allows researchers to determine areas within the brain and the specific hemispheres that are activated during certain tasks, including reading comprehension. One view may be that the visual word created within this system would be available to be processed in different manners by different routes depending on what was necessary to obtain meaning (Jobard et al., 2003). The visual word system is able to process not only the visual stimulus (word) as a whole, but also separate it into graphemes, syllables and morphemes. According to this view, when a word is presented, it may be affected in different ways depending on the experience of the individual (Jobard et al., 2003).

1.3.2.2. Indirect route:

The indirect route (phonological route) to reading is when print is associated with meaning through a sound mediator (Banich, 2004). This route requires the visual words presented to be altered into the auditory equivalents (Jobard et al., 2003). This involves segmenting the word into sections, sounding out each element and then integrating the sounds to produce a word. Once the word has been pronounced, the meaning associated with it will be recognized (Banich, 2004; Jobard et al., 2003). Thus this route is necessary for grapheme to phenome mapping for storing, maintaining and assembling these sections to obtain a final pronunciation and meaning of a word (Jobard et al., 2003). This method is utilized when the individual is learning to read (for example a grade 4 learner) or is a second language learner. It is thought that skilled readers (grade 10 learners) generally do not use this approach unless dealing with difficult material, pseudo-words or when the words are unfamiliar to the individual. For second

language learners so many words may appear to be “pseudo-words” but as reading volume increases it is thought that they should develop contextual strategies similar to the more skilled first language or skilled learners, but may never completely master them (Banich, 2004; Carpenter & Just, 1986; Jobard et al., 2003). The phonological route is thought to be found within the left hemisphere (Roux , Lubrano, Lauwers-Cances, Tremoulet, Mascott & Demonet, 2004; Waldie & Mosely, 2000), specifically the dorsal temporal, ventral parietal regions (Banich, 2004) and the supramarginal gyri (site for phonological store) (Roux et al., 2004; Jobard et al., 2003). Jobard et al., (2003) have also indicated that this route may be located in the left hemisphere, namely regions including the superior temporal gyrus, the middle temporal gyrus, left superior temporal sulcus and the opercular part of the left inferior frontal gyrus.

1.3.2.3. Direct route:

The direct route to reading is used when the learner is able to directly associate the particular visual word form with its meaning without the use of the phonological mediator (Banich, 2004). These words may not follow the most usual spelling to sound rules as previously discussed, in relation to the indirect route, but relies on the association between the visual form and its meaning (Jobard et al., 2003). This relationship is developed when individuals repetitively come into contact with words, thus this association is learned and stored in a visual form (Jobard et al., 2003). This method is mainly used by skilled or first language learners as the sounding of the words are no longer necessary (Banich, 2004). This method has been associated with the more ventral processing pathways (mentioned above) in the temporal regions (Banich, 2004) and the processing of these visual wholes are linked to the right hemisphere (Waldie & Mosley, 2000). Thus the right hemisphere is involved in the spatial semantic-thematic and automatic aspects of reading (Waldie & Mosley, 2000).

In summary, dual processes involved in reading both phonological and visual lend themselves naturally to different hemispheric processes, with the visual

being predominantly processed by the right hemisphere and phonological by the left hemisphere.

1.3.2.4. Further hemispheric processing styles.

The language processing during reading is complex involving multiple areas of the left and right hemispheres (Roux et al., 2004). Reading impairments in normal individuals have previously been associated with hemispheric specialization for language processing (Kershner, 1977). This may be related to the hemispheric differences in the processing of visual linguistic stimuli and may account for the anomalies found in readers (Kershner, 1977; Roux et al., 2004) or may affect their learning capabilities and their ability to fulfill educational potential.

There are specialized areas in each hemisphere that facilitates optimal development (Roux et al., 2004), for example comprehension processing within the left planum temporale (Gazzaniga et al., 2002). Hemispheric specializations focus on particular elements of cognitive processing and are not considered generic to all other processes (Elliot, 1995). It implies that individuals have a certain predisposition to favour one hemisphere over the other with respect to a given task however, although an individual may display a high degree of left hemispheric specialization for a particular task, this does not imply that they do not for example have right hemisphere specialized tendencies (Elliot, 1995). Extensive research in the field of hemispheric specialization has revealed important information regarding the dual processing nature of the brain. These investigations have revealed that the right and the left hemisphere utilized different strategies to process, code and organize information (Elliot, 1995, Gazzaniga et al., 2002). Each hemisphere is therefore differentially better suited for performing certain types of tasks, analytical versus holistic, fact based versus intuitive based as well as verbal versus visual (Elliot, 1995 Gazzaniga et al., 2002).

1.3.3. Monolingualism & Bilingualism:

The specific modularity of language processing is complicated by bilingualism, age of readers, the number of years of literary experience and reading competency levels. These aspects of language are vital given the multiple languages present globally and especially in South Africa, given the number of official languages. There is a need to investigate and understand the effects of exposure to and acquisition of second languages, as these may have profound influences on the development and processing of brain regions (Hull & Vaid, 2006). As we have established, the neurobiological basis for the capacity of language has a variety of manifestations, with the majority of existing research supporting the theories of the left hemisphere of the brain being responsible for a fair amount of language processing. There is however other research to support the theories that the right hemisphere plays a dominant role in supporting other areas of language, such as discourse coherence (Hull & Vaid, 2006). This evidence is further confounded by research on the repercussions associated with the attainment of a second language.

Bilingual language may present unique patterns of neuro-functional activity within the different hemispheres of the brain. Electrophysiology, laterality and neuro-imaging studies have presented evidence to suggest structural difference in the brain, associated with bilingualism and monolingualism (Hull & Vaid, 2006). Monolingual individuals are those who have in-depth and functional knowledge of one language only. Bilinguals are those individuals who have the above mentioned functional knowledge of more than one language. These individuals may be further categorized as proficient or non-proficient bilinguals whereby, proficient bilinguals characterize those individuals who exceed 85% accuracy on standardized language proficiency exams and who have 5 or more year's experience of formal education in the said language. Individuals who do not meet the above mentioned criteria are said to be non-proficient bilinguals (Hull & Vaid, 2006).

Ectrophysiological and laterality studies have indicated that the brain processing of bilingual individuals deviate from monolinguals. Monolingual individuals exhibited more left hemispheric processing where bilinguals exhibited bilateral hemispheric processing (Hull & Vaid, 2006). Furthermore, non proficient bilinguals show a larger right hemisphere effect and the more proficient bilinguals show and increased left hemisphere effect, for overall language. Some theories that reiterate these findings include the second language hypothesis which theorizes that in general, bilinguals are more right hemisphere lateralized compared to monolinguals; the stage hypothesis predicts that second language individuals are subserved by the right hemisphere and as they become more proficient, the language shifts to left hemispheric dominance. This is contradicted by the balanced bilingual hypothesis which suggests increased proficiency lends itself to more right hemispheric participation (Beaton, Suller & Workman, 2007; Hull & Vaid, 2006). These neuro-functional patterns are then once again altered based on the age of exposure to the additional language.

Bilingualism itself is essential but not sufficient to argue for or predict hemispheric lateralization. MRI studies highlight the interaction between proficiency of a second language and the acquisition of the additional language (Beaton et al., 2007). Furthermore, the majority of bilingual cognitive theories believe that earlier exposure to additional languages will follow the pathways of left hemispheric language patterns as found in monolinguals and only later acquired bilingualism would indicate alternative pathways, either bilateral or right hemispheric (Hull & Vaid, 2006). Beaton et al. (2007) suggests that both first and second language activate common neural networks within the left hemisphere and the individuals who acquired their second language later in their development, or in early adulthood, show different activation sites for the two languages. Thus the literature stresses the inconsistencies in the findings of the numerous studies investigating neural network activation for language. The inconsistencies found may be due to factors such as proficiency of the second language, the age of

acquisition, the environment the languages occur in and finally the difference between written material and spoken language (Beaton et al., 2007).

Although bilingual research has made clear arguments concerning the involvement of the right hemisphere in language processing, further monolingual studies have revealed that the left hemisphere is not always dominant and that the right hemisphere is significantly more involved than previously thought (Beaton et al., 2007; Hull & Vaid, 2006). There is no questioning the continuous findings that the left hemisphere is the dominant language hemisphere for the majority of the human population however, from studies on brain damaged individuals, we are able to further investigate the role of the right hemisphere. If during early childhood the left hemisphere is considerably damaged or removed, the individual's right hemisphere has the capacity to take over the left hemisphere's language functioning (Beaton et al., 2007). One considers whether these language capabilities are present in cases where the left hemisphere is intact and what are the supporting roles the right hemisphere plays. There is the assumption of a supporting role of the right hemisphere as functional imaging and tachistoscopic half field experiments reveal bilateral activation during language processing and as previously discussed the right hemispheric dominance for bilingual individuals (Beaton et al., 2007). Paradis (2004) argues against the suggested role of the right hemisphere and theorizes that although the right hemisphere has the capacity to recognize concrete and familiar words, it is still thought to lack the capacity to process much needed grammatical morphemes. This leads back to the argument of skilled and unskilled readers and what causes their difficulties in reading comprehension.

1.3.3.1. Skilled readers' application of inferences:

The aim of reading is to obtain meaning and understanding, this process exceeds the basic decoding of words, sentences and text in comprehensions. There are a large proportion of school learners who are able to and have mastered decoding skills, yet they suffer specific reading comprehension deficits.

A suggested theory is that these individuals have specific difficulties in generating inferences from the text they read (Bowyer-Crane & Snowling, 2005). We therefore question whether poor comprehenders have poor comprehension skills or whether their problems are confined to difficulties with regards to inferences. These individual's understanding of the text may tend towards the literal rather than developing mental representations of what is presented to them. This would require a less passive method of text analyses (Bowyer-Crane & Snowling, 2005). Literal information refers to information that is factually written in the text and requires no inference. Inferences refer not to the exact word for word account of the text, but rather the overall meaning of the passages. The difference in the performance of skilled and non-skilled readers lie in the strategies utilized during reading and the ability to use general knowledge to interpret the information presented (Bowyer-Crane & Snowling, 2005). It is argued that the more skilled readers are able to make vital inferences and develop representations of the written material, where as the less skilled readers do not benefit from reading text in context. This is because they unable to coherently integrate the information presented to them so as to infer meaning. When questions are asked regarding comprehensions presented to the learners, the more skilled readers obtain higher scores due to their ability to infer meaning and provide the necessary answers. Inferences may require the use of real world knowledge not evident in the text and this may explain the difference in test scores (Bowyer-Crane & Snowling, 2005).

1.3.3.2. Demographics influencing reading capabilities:

The discussed real world knowledge may not be "standardized" for all learners. This is an important point to consider, especially since all the ethnic integration that has occurred in the schools in South Africa. Concerns raised have been centred on the difference in achievement scores between African and white learners. It is important to qualify that when the writer mentions race regarding previous research, it is acknowledged that this is a general assumption made by society that is an artificial classification that arises from second language learning

and the demographic that underlies education in an English medium. Thurmond (2001) says that surveys indicate that black students as a whole are lagging behind the white students as a group, especially when the assessments are considered to be standardized. This train of thought links back to the discussion of bilingualism. The responses of the learners may be influenced by the interaction between the ethnicities of the learner and the standardized language of the reading comprehension assessments. Many of the black learners are second language learners in South African schools as compared to their white counterparts, who are first language learners and it is this difference that may influence the reading capabilities of learners. English may not be as universal as researchers would hope; there are numerous forms of English found across the country (Thurmond, 2001). Although it is not considered in the current research, one needs to determine to what extent is there a mismatch between what is considered “black English” and the English of the standardized assessments. When interpreting the results of such standardized assessments in South African schools, with the vast majority of the learners being exposed to multiple languages, researchers need to keep in mind that the variance in the results may be due to the discrimination in the written language and the assumption concerning the real world knowledge held by the learners. If reading material were to conform to the language patterns of the learners, black learners may indeed be obtaining higher comprehension and inferential scores (Thurmond, 2001).

With reference to the Stanford Diagnostic Reading Test (SDRT) utilized within the current research, Thurmond (2001) reported that white students who completed the assessment scored significantly higher that did the black learners who completed the same test. This Standard English may not reflect the real potential of the black learners, as the vocabulary on the test may be alienating them further. The researcher discovered that most of the black learners were unable to complete the assessment as the passages became too challenging (Thurmond, 2001). The assumption held is that black learners’ comprehension

abilities would be increased should the standardized assessment material align itself more with the individuals' oral language. The results obtained by learners who completed a "black English" form of a standardized assessment indicated that these students obtained significantly higher scores than those black learners who took the standardized form. It is therefore that the Standard English form of the test measures the ability of white learners more accurately than it may black learners (Thurmond, 2001). Although Thurmond (2001) made the distinction between black and white learners and the influence of language, the current research focuses on skilled/ first language learners and less skilled or second language learners and in relation to ethnicity, and how these may influence reading comprehension abilities. Thus, if decisions concerning second language learners are to be based on such assessments, all the possible effort should be made by the developers of the tests to ensure that there is as little discrimination in the documents as possible. As the researcher of the current study only had access to the standardized version of the assessments and decisions were made on the results obtained, every effort was made to be cautious when generalising the results.

1.3.4. What is the Rey-Osterrieth Complex Figure (ROCF) and what does it measure:

The ROCF is a neuropsychological measuring instrument that is useful for assessing a variety of cognitive processes and functions. The ROCF was originally used to differentiate between acquired and genetic mental disorders in adults but later became useful in the investigations of perceptual organization skills and visual memory (Hubley & Tremblay, 2002; Jin, Kim, Park & Lee, 2007). The ROCF consists of overlapping geometric shapes inclusive of squares, rectangles, triangles and various other shapes. This instrument therefore requires specific perceptual, visual spatial and organizational skills to allow for optimal performance on the task (Fujii, Lloyd & Miyamoto, 2000; Jin et al., 2007; Smith & Zahka, 2006). Individuals are required to organize these shapes into meaningful perceptual units which are then scored using a 36-point scoring

systems originally developed by Rey Osterrieth in 1944 and later refined by Taylor (1959) based on the accuracy of the reconstruction (Deckersbach, Savage, Henin, Mataix-Cols, Otto, Wilhelm, Rauch, Baer & Jenike, 2000; Henry, 2001; Hubley & Tremblay, 2002, Lezak et al., 2004). The above mentioned planning, organization skills and perceptual analytic strategies are important when copying of the figure due to the complexity of the diagram. The distinction between these skills can be determined through different assessment strategies (Hubley & Tremblay, 2002; Fujii et al., 2000). The current research utilizes scoring systems that allow the research to determine not only the visual spatial accuracy of the reconstruction of the diagram, but the organizational strategy too. The organizational strategy refers to the quantification of the manner in which the individuals approach the figure as a whole (Lezak et al., 2004; Smith & Zahka, 2006).

Previous research has indicated that one of the most useful methods used to assess the organization strategy used by individuals, is by changing and controlling the order of coloured pencils during the copying the ROCF. By controlling the sequence of colours, the researcher is able to determine the order in which each element is drawn. More importantly the sequence indicates whether a piecemeal approach or a configuration approach was used (Dumont-Willis, 2003). Previous research on the ROCF has suggested that the majority of the individuals completing the diagram do so in a hierarchal manner, whereby the finer details of the diagram are nested in a the more global features of the figure. This is referred to by Dumont -Willis (2003) as the configurational approach, where individuals complete the framework of the figure consisting of the larger rectangle and its diagonals and then fill in the finer details (Poreh & Shye, 1998). Although these organizational strategies inform the researcher of important global cognitive factors including non-verbal problem solving and the ability of the individuals to understand and integrate complex visuo-spatial information (Smith & Zahka, 2006), the organizational approach may also determine the hemispheric processing used to construct specific organizational

strategies and therefore infer the dominant hemisphere of the individual. Akshoomoff and Stiles (1995) reported on the performance of adult patients with focal brain injuries and suggested that both left and right hemispheres are differentially specialized for performing spatial analytical processing and therefore contribute differently to the performance on the ROCF. Observational studies have shown that patients with right hemispheric damage exhibit deficits when reproducing the ROCF namely, they fail to integrate the general elements of the figure. Yet, patients with left hemispheric damage are able to copy the general features and exhibit errors when constructing the finer individual components of the diagram (Akshoomoff & Stiles, 1995; Poreh & Shye, 1998). Patients with frontal lobe damage not only have difficult reconstructing the diagram when copying, they also have an impaired ability when recalling the ROCF. The frontal lobe is thought to be crucial in the strategic processing of spatial information that allows for these visuo-spatial elements to be recalled adequately (Poreh & Shye, 1998). Although the current study does not take the recall of the ROCF into consideration, these studies reiterate the specialized processing of the right and left hemispheres of the brain. In review of the literature, the right hemisphere is responsible for more traditional/ configurational strategies of the global features of visuo-spatial tasks and the left hemisphere is more dominant in the processing of part orientated organizational strategies and focuses on the finer details of a figure (Akshoomoff & Stiles, 1995; Dumont-Willis, 2003; Poreh & Shye, 1998).

1.3.4.1. The functions of the left and right Hemispheres, inferred by the strategies utilized in the ROCF.

It is generally thought that the left hemisphere is responsible for the production and comprehension of language (Elliot, 1995) and it has been discovered that the left hemisphere is more sensitive to the rules of language and its phonological components (Banich, 2004). The left hemisphere functions mainly by focal organization and processes information analytically (Bryan, 1995), therefore maintaining the dominant meaning of the word presented, where as the

right hemisphere processes the more abstract meanings of the information (Banich, 2004). The left hemisphere has a specific ability to decode print and can learn to perform more efficiently than that of the right hemisphere (Kershner, 1977). Furthermore semantic aspects of language are processed more coarsely in the right hemisphere than in the left (Banich, 2004).

This being said, the right hemisphere is not a silent partner in language processing and gains access to meanings of words in a different manner than the left hemisphere (Banich, 2004). It plays a vital role in allowing intuitive inferences (the ability of the individual to fill in the blanks and make assumptions about the material presented) and the processing of narrations (the ability to construct and understand a story line) (Banich, 2004). It is therefore that the right hemisphere aids in the understanding and processing of non literal components of written language such as abstracts and metaphors (Banich, 2004; Bryan, 1995). Once again the left hemisphere processes the alternative meanings of these words (Bryan, 1995). When the right hemisphere of an individual is damaged, the patient suffers impairment in comprehending the meaning of individual words that are contextually bound. Thus the patient has difficulty with word retrievals and is unable to fully comprehend metaphors (Banich, 2004); jokes and stories however; these impairments do not include syntax or phonology (Bryan, 1995). Moreover individuals with right hemispheric brain damage are unable to build and organize information from what has previously been presented to them (Banich, 2004) or integrate across parts of a narrative component (Bryan, 1995). It is therefore that the right hemisphere functions by more diffuse and holistic processes (Bryan, 1995), based on the evidence presented above, the researcher expects to discover different error patterns during assessment.

1.3.4.2. Hemispheric specialization and differences in reading comprehension:

During the development of language, the right hemisphere plays a substantial role up to the age of 10 years, thereafter the right hemisphere's potential wanes

(Bryan, 1995; Waldie & Mosley, 2000) and the left hemisphere plays the dominant role through adulthood (Banich, 2004). Waldie & Mosley (2000) conducted research to determine whether hemispheric specialization for reading changed as the individual aged and increased their reading experience. They hypothesized that older individuals were more likely to show less right hemispheric participation than younger individuals (Waldie & Mosley, 2000). Younger Individuals were found to be significantly more accurate than older individuals when words were presented to the right hemisphere. It was discovered that the left hemisphere of older individuals were specialized for processing concrete words and for the discrimination between words and non words (Waldie & Mosley, 2000). Thus in the beginning children seem to rely on visual wholes when they read and utilize phonological sections when spelling (Waldie & Mosley, 2000). Furthermore, the right hemisphere has demonstrated visuospatial processing, which allows for the recognition of a stimulus in a gestalt rather than through a phonological route (Waldie & Mosley, 2000). Waldie & Mosley (2000) concluded by stating that the participation of the right hemisphere decreases as reading experience increases, whereby older individuals rely on more sequential strategies of the left hemisphere for word recognition. This is contradictory to Kershner (1977), who found that reading impaired children employed the right hemisphere as a coding strategy for reading.

It is therefore hypothesized that reading anomalies may be due to use of the right hemisphere for perceptual coding that is inappropriate for the demands made by the comprehending text and insufficient for academic success, based on conventional reading instructions (Kershner, 1977). Renewed attention should be given to the structure and the content of the text given to young individuals (Carpenter & Just, 1986), suggesting that secondary schools include comprehension that moves beyond the literal level based on the left hemisphere (Knott, 1986) and consider the effect of the right/inferential aspects to reading.

Based on the above, in the present study, the strategic results obtained from the ROCF were used to determine which type of processing (left versus right) was being employed. The researcher aims to determine the sequence in which the elements of the figure are completed. By analysing the strategy used to complete the figure, traditional, gestalt or piecemeal, may determine how the right and left hemispheres process literal and inferential information and influence the scores obtained on comprehension tasks.

1.3.5. Literature survey of extraneous variable impacting on performance:

1.3.5.1. Influence of age:

Smith & Zahka (2006) have suggested that although there are many broad cognitive processes involved in the organization of visuo-spatial stimuli, these do not influence the strategies used and accuracy scores obtained on the ROCF in children and adults. This is a contentious issue as there is a tremendous amount of information suggesting that one's age influences the scores obtained on the ROCF. Previous studies have found that there are age-related variations in the strategies used to complete the ROCF occurring from the age of 5 years. There is still debate concerning whether adult measures of localized dysfunction are able to be generalized to children, as the brain-behaviour relationships differ depending on the stage of development (Anderson, Anderson & Garth, 2001). With regards to the completion of the ROCF, it is important to note that accurate drawings do not necessarily infer efficient strategies and good conceptual strategies may not result in perfect reproductions of the figure. Children as young as 6 years of age should be able to draw many of the features present in the diagram and by the age of 9 years, the majority of the features should be recognizable and in their appropriate places (Anderson et al., 2001). On the other hand, there is a variation in the level of organization, planning and the conceptual strategies utilized across development and childhood. These variations highlight the development of one's perceptual and visuo-spatial skills as well as hemispheric processing. For this reason, it would be vital to determine the

different age expectations in order to accurately identify the developmental progress of individuals (Anderson et al., 2001; Henry, 2001; Kirkwood, Weiler, Bernstein, Forbes & Waber, 2001). It is questioned as to how children process the perceptual information. Do they do it in a more holistic manner or do they only attend to parts and apply a more piecemeal strategy? It is therefore important for researchers to take into account both the different elements that are identified and the integration of those parts throughout development (Akshoomoff & Stiles, 1995). It is assumed that there is a gradual increase in the integration of elements and the organizational strategy utilized throughout childhood, beginning from the age of 5. Furthermore, the complexity of the patterns within the figure may influence the manner in which the child processes the particular form. The ROCF is considered a hierarchically structured figure which contains both global and finer details, and there are variations in the manner individuals conceptualize the figure (Akshoomoff & Stiles, 1995). Anderson et al, (2001) discovered that children between the ages of 6-11 years adopted a more unstructured approach to the completion of the ROCF and the older the individuals got, the more structured their strategies became. Akshoomoff and Stiles (1995) determined that by the time the child was 6 years of age, they were able to reproduce the elements and the overall design of the figure, but this was done in a less organized and complete manner. This may also suggest that such a complex figure may elicit different patterns of analyses of the different elements and the strategies used to integrate these elements (Henry, 2001).

It has been found that between the ages of 6 and 9 years, children have a tendency of using unstructured, inconsistent and haphazard methods to complete their figures. Although these individuals give a fair representation of the figure, they have a tendency to focus on the finer details and utilize more of a piecemeal approach to the figure (Akshoomoff & Stiles, 1995; Anderson et al., 2001; Dumont-Willis, 2003). After the age of 9 years, similar to the age of the younger sample in this study, the productions of the ROCF become more conceptual and configurational, whereby children begin to focus more on global

and larger organizational elements of the figure and the accuracy of the reproductions increases. These results suggest that children utilize more effective planning and organizational strategies as they mature which serve to simplify the complex figure for reproduction (Akshoomoff & Stiles, 1995; Dumont-Willis, 2003; Henry 2001). Between the ages of 12-16, the visuo-spatial skills and strategies required to complete the ROCF increases less dramatically. This is due to the assumption that a child's performance on these tasks begins to approximate adult performance by the age of 12 years. The overall accuracy of the reproduction of the diagram improves considerably and there is a general use of a more structured and logical approach to the reconstruction of the ROCF, when compared to younger individuals aged between 6-9 years (Henry, 2001; Dumont-Willis, 2003; Kirkwood et al., 2001; Smith & Zahka, 2006). Dumont-Willis (2003) not only found increased accuracy, but discovered that there was an increased preference for the older individuals to commence their diagrams from the left side working their way through to the right side. The more logical manner discussed involves the completion of the base rectangle and other mains from the left first, followed by the inclusion of the finer elements of the figure (Akshoomoff & Stiles, 1995). How all the above relates back to the topic of the study is that, the manner in which the individuals organize and complete the ROCF may indicate whether or not they exhibit learning difficulties. Poorer performance and piecemeal organizational strategies may infer learning problems (Kirkwood et al., 2001). Furthermore, Klicpera (1983) reported that poorer performance and organizational strategies on the ROCF in the copying phase related to poorer reading skills of individuals who exhibited no learning difficulties. These individuals utilized a haphazard and piecemeal approach rather than a more logical and configurational strategy (Dumont-Willis, 2003).

1.3.5.2.Influence of culture:

Neuropsychologists have mostly considered visuo-spatial and non-verbal assessments to be culturally and educationally fair (Rosselli & Ardila, 2003), however this may not be the case. Culture refers to" a group's adaptations to

recurrent ecological pressures and as a contributor to the direction of the development of individual human beings". It is also considered to "act as a mediator of the ecology of the individual" (Berry, 1971, pp. 325). For some time, researchers have assumed that the effect of culture could be controlled during assessments of standardized tests if verbal items were eliminated and performance was only assessed with the use of non-verbal items. It has been discovered that this is in fact not the case; researchers have found considerable cross cultural differences when assessing a variety of cultural groups around the world. Some non-verbal results have indicated more cultural variability that those of verbal tests (Rosselli & Ardila, 2003). Many of the standardized non-verbal assessments require specific cognitive skills and strategic approaches that conform to westernized cultures, of which a large proportion of these non-verbal tests emphasize skills such as visuo-spatial abilities (Rosselli & Ardila, 2003).Berry (1971) has argued that one's ecological demands and cultural adaptations have influential developmental effects on one's perceptual skills and Rosselli & Ardila (2003) found there to be cross cultural differences on visuo-constructional ability tasks such as the ROCF. It is for this reason that researchers have to consider the socio-cultural and neurobiological factors simultaneously, as an individual's culture is thought to influence brain organization and cognitive development, as the cultural arts and crafts assist in early childhood learning and the discrimination of details. The discrimination of details and figures required during the copying of the ROCF represents abilities that are absent in many cultures. These facts are further confirmed by Henry (2001) who has reported on studies involving adults, where there are cultural differences in their cognitive abilities including their visuo-spatial abilities and Rosselli & Ardila, (2003) who found that cultural practices are significantly related to the development of perceptual skills.

As it is impossible to consider all the developmental adaptations experienced by individuals, the current research focused on visual spatial skills development and the influence this has on ones reading skills. As discussed above, these are

significantly influenced by cultural contributors. Education can be considered a cultural element, which includes literacy and schooling. One's culture and formal education has a significant impact on one's cognitive development (Rosselli & Ardila, 2003). Different cultures determine what children should be taught and at what age, this raises the question as to whether or not non-verbal psychological assessments developed for the American population are appropriate for the use on a variety of cultural groups. General exposure to pictorial material in schools might not be sufficient for the learning of pictorial representations required in these tests. In an attempt to clarify the situation Rosselli & Ardila (2003) compared the test performance of a non-westernized culture such as the Aruaco with westernized populations in Canada and Columbia and found the Aruaco sample presented a larger standard deviation than that of the copying scores of the westernized sample. Surprisingly, even when the education levels of these samples were controlled for, there still remained a difference in the test results between the different cultures. Research has also confirmed that the speeds of processing and performance on the non-verbal assessments are generally slower for members of non-westernized cultures. This may further suggest what was previously implied; that one's culture may play a larger role that one's education levels (Rosselli & Ardila, 2003). The previous results discussed in the review of the literature are generally based on cultures that do not reside in Africa and there may be a potential for the application of the ROCF assessment in African children. Studies have claimed that there are similarities found in the performance of such constructional tasks between westernized and non-westernized Nigerian children. The constructional patterns observed in Nigerian children compared to Canadian youth, were very similar (Rosselli & Ardila, 2003). Within the current study of the ROCF neuropsychological test, only descriptions of planning and copying performance can be made and not more definitive statements concerning the possible influence of culture on one's neurobiological organization. The data is meant to heighten awareness of cultural and developmental differences found in the assessment of children (Henry, 2001).

1.4. Aims:

The current study looks to explore the relationship between hemispheric processing styles, operationalised as the approach to the copy of the Rey-Osterrieth Complex Figure (ROCF) and how it influences the type of errors made in reading comprehension, literal versus inferential, as measured on the Stanford Diagnostic Reading Test (SDRT). As this study uses a cross sectional design to look at the projective developmental implications of the phenomenon, the sample consists of both 4th grade and 10th grade learners. These would possibly enable the researcher to provide the educational establishment some answers pertinent to learning and pedagogic styles, based on the different comprehension abilities and processing strategies.

1.5. Research questions:

What is relationship between predominant hemispheric processing styles, left versus right and errors made in reading comprehension, literal versus inferential?

Do differences in demographics serve as confounding variables within the study?

Chapter 2: Method section:

2.1. Research design:

The current research made use of a cross sectional, between and within groups, ex-post facto design. This design allowed the researcher to replicate systematic experimental procedures on a selected sample and report associative results. The researcher had no intentions of directly controlling the variables under investigation, but was able to infer effects (Whitley, 2002). Thus, within the current study, there was no manipulation of variables however, associative relationships between hemispheric processing styles, operationalised as the approach to the copy of the Rey-Osterrieth Complex Figure (ROCF) and its influences on the type of errors made in reading comprehension, literal versus inferential, as measured on the Stanford Diagnostic Reading Test (SDRT), were investigated. Although the sampled individuals were not randomly designated to experimental and control categories, the cross sectional design involving 4^{th} grade and 10^{th} grade learners, allowed the researchers to project developmental implications of the phenomenon. The total scores achieved on each assessment were analyzed to determine whether the learner demographics had any influence on the differences within the groups. The strategies used to complete each assessment were considered to establish the error patterns and comprehension difficulties exhibited on the SDRT.

2.2. Sample:

The sample was selected from a single schooling district and included both primary and high school learners. The headmasters of the selected schools were approached and permission to access their grade 4 and grade 10 learners was requested. The differentiation between the education levels allowed the researcher to infer comprehension and visual spatial constructional heuristics over a developmental period, which further allowed the researcher to establish whether these constructional heuristics were constant throughout development. The Department of Education (DoE) and

the headmasters of the respective schools granted access (appendix 6) to the researcher. Grade 4 and grade 10 learners and their parents (within the respective schools) were issued with consent documents (see appendices 1-3), which were requested to be returned to assigned educators. The majority of the sampled grade 4 learners returned their signed consent forms from their parents however; there was a disappointing response from the grade 10 learners' parents. For this reason, the schools granted the researcher permission to obtain signed consent from the grade 10 learners themselves, all of whom were over the age of 15 years. At the grade 4 level, 2 classes were made available and at the grade 10 level, 3 classes were selected. The difference in the number of classes was due to the variance in the number of learners in each of the grade 10 classes and the attempt to gather data from equivalently sized samples.

The assessments were conducted during school periods pre-determined by the educators so as not to impact on the students' academic work. The resultant sample was multi-racial and across gender. These were not specifically selected by the researcher, but were reliant on the classes that were assigned for the study. The age of the individuals correlated with the grade they were in when the research was conducted namely, grade 4 learners were selected based on them being midway through primary school and grade10's were midway through high school. Given government policy that a child enters formal schooling in the year that they turn 7 years of age, the grade 4 learners were on average 10 years of age and the grade 10's were on average 16 years of age the year they were assessed, which included the learners who had failed a year previously. These individuals were later excluded when the normative data on the different assessments were calculated.

Furthermore, inclusion criteria required that learners must not have had a history of specific learning barriers or serious head injuries. This was in an attempt to screen for possible learning and brain functioning deficits that may impact on the reading comprehension assessment results. All primary and high school students were required to have always attended an English

medium, model C school (no time spent at private schools, township schools or in home schooling) in an attempt to standardise for modes of instruction and educational culture. Although the educational levels of the learners' parents were investigated, there was no exclusion criteria associated with this. All aforementioned background information was obtained with the use of a demographic questionnaire (see appendix 4) completed by the learners' parent/ guardian(s) or alternatively by the grade 10 pupils themselves. Based on the inclusion criterion of only attending English medium schools, the researcher was able to assume that the participants had appropriate language proficiency and able to understand instructions in English. This was necessary based on the researchers own ability to communicate as such and secondly, the current research examined the participants comprehensive skills based on their language of learning in a single medium school.

2.3. Procedure:

Ethical clearance was obtained from the University of Witwatersrand, the Gauteng department of Education, educators and the headmasters of the selected schools via ethical clearance and information sheets (see appendix 5 & 6). All relevant information concerning the current research was disclosed and any further questions and concerns raised were answered.

Subsequently, students were approached in their classrooms supplied with information sheets, consent documents (one for the parent/guardian (s) and one for each participant, written in the style appropriate for each recipient) (see appendices 1-3) and background questionnaires (appendix 4) which the parents were required to complete or the grade 10 individuals. When consent had been obtained from all relevant parties, the learners were first requested to complete the SDRT, followed by the administration of the ROCF. The SDRT included a standard 40 minutes reading comprehension test, for those individuals who required a few minutes extra time; this was allowed as the researcher required all the questions to be answered in full. It is acknowledge that the added time is a deviation from the standardised assessment procedure, but as the research was mainly concerned with the types of errors on the comprehension task and less on the standardised score, it was

necessary for all the learners to complete all the questions. For the ROCF, the test was completed in an average of 5 minutes; although there was once again no time restriction as all learners were required to complete the entire diagram (further information pertaining to these two assessments will follow later in the chapter). Both tests were completed in a classroom test situation, under the supervision of the researcher. All necessary material was placed on the pupils' desk prior to their entering the classroom. After the completion of both assessments, the documentation for each learner was bound together along with their consent and demographic forms. The only personal details required were the names of the parents and their child on the demographic sheet, these sheets were assigned numbers, which correlated with the numbers placed on the assessments.

The data obtained from both assessments was subjected to correlation analyses, chi squared tests, analyses of variances (ANOVAs) and logistic regressions. And finally results and associative conclusions were drawn.

2.4. Instruments:

2.4.1. Stanford Diagnostic Reading Test (SDRT):

The SDRT is a diagnostic assessment that enables the researcher to administer the test within a group setting and continues to provide both valid and reliable class summaries. This test assists in highlighting the strengths and limitations of assessed individuals based on vital reading components and literacy skills. This is achieved through scoring methods that allow for the development of trends in reading achievement and comprehension to become apparent, both within the individual and group levels of micro and macro levels (Karlsen & Gardner, 1995). The content of the assessment is motivating and age appropriate as each section is specifically selected for a particular age range. The Green level is appropriate for grade 3 and 4 pupils and has an emphasis on reading comprehension with the ability to establish both literal and inferential scores. The Blue level is recommended for individuals completing their grade 8 year through to the culmination for their basic education (grade 12). The Blue level not only distinguishes between literal and inferential scores but textual, functional or recreational material

scores too (Karlsen & Gardner, 1995). These additional scores were not taken into consideration in the current research as the researcher required the information obtained to be consistent with that of the grade 4 students, given the cross sectional developmental nature of the research design. Further advantages associated with the SDRT is that researchers are able to implement the assessment in a variety of settings in order to allow for flexibility in scheduling (Karlsen & Gardner, 1995), this is vital especially when operating in a school environment where individuals would require breaks and time allocated for their own lessons, although this was not a necessary feature in the current research.

With reference to the previously mentioned literal and inferential comprehension scores, these are assessed by means of textual, functional and recreational reading materials which are followed by appropriate questions. The information presented to the individuals in the assessment had been extracted from the natural and social sciences, human interest stories, fiction and poetry. As previously stated, these are written at readability levels appropriate, for both the primary and high-school levels respectively (Karlsen & Gardner, 1995). Literal comprehension scores required the students to comprehend explicitly stated meanings and details contained in the different passages. For the grade 4 level, this included 24 items and for the grade 10 level, 30 items. The Inferential comprehension scores required the individuals to draw conclusions and make generalisations from what had been stated within the passages. For the grade 4 level, this included 24 items and for the grade 10 level, 30 items (Karlsen & Gardner, 1995). Each individual participating in the research received a booklet, they were asked to read through passages of the subtest of the SDRT provided to them and instructed to complete the questions in a multiple choice format within a certain time limit (Lesaux & Siegel, 2003), this instructed time was a time motivation given the deviation from the normal administration. The questions involved indicating a word or phase that was the same or similar to the one stated in the question or inferred in the passage (Nagy, Berninger & Abbott, 2006). Although the SDRT allowed for the assessment of word decoding, vocabulary and reading rate, in this study only the reading comprehension subtest was

administered(Huang, 1993), more specifically, the literal and inferential components of the test. The reading comprehension was scored by means of hand scorable answer keys associated with the levels utilised in the study. The researcher obtained overall comprehension scores for each grade, with a maximum of 48 for grade 4s and 60 for grade 10s, as well as literal and inferential scores, whereby students obtained a maximum score of 24 or 30 for each, for grade 4 and grade 10 levels respectively.

2.4.2. Rey Osterreith complex figure (ROCF):

The ROCF is a standardised test that is quick, inexpensive and simple to administer (Patton et al., 2004). The ROCF is extensively utilised within both clinical and research settings in order to asses a variety of cognitive processes. The ROCF consists of directly drawing/coping a complex figure. This figure is either projected on a screen or placed in directly in front of an individual (Caffarra, Vezzadini, Dieci, Zonato & Venneri, 2002). The purpose of the test within the current research was to asses the visual spatial constructional heuristic and investigating hemispheric differences (Lezak, Howieson, Loring, Hannay & Fischer, 2004.; Caffarra et al., 2002). The ROCF is used to assess individuals between the ages of 6- 93 years (Lezak et al., 2004).

The procedure followed in this research replicated the methodology of the study conducted by Lezak (1983, pp 395): the investigator administered this test to relatively normal cognitive functioning individuals (based on previously mentioned exclusion criteria) and they were tested in a group/class setting. The figure was projected onto the screen mounted on the front wall of the classroom with the use of an overhead projector and transparencies. The individuals were instructed to copy the diagram on a blank piece of paper, so that the length runs along the individual's horizontal plane. 8 Coloured pencils were used to asses the individual's procedural method, where the final pencil was utilised to complete the remaining information of the diagram, without any time limit. The researcher signalled to the individuals to begin drawing/coping the ROCF with a selected coloured pencil, after a limited amount of time had elapsed, the individuals were instructed to change to another coloured pencil.

The sequence of colours utilised was noted in order to analyse the procedural method adequately. The time limits did not differ dependent upon on the grade level, both fourth grade and tenth grade students were allowed 20 seconds to elapse before alternating colours. By controlling the colours of the order in which they were used, the researcher was able to determine the sequence in which the elements of the figure were completed and the strategy followed. It has been reported by (Lezak et al., 2004) that the pencil switching method results in better qualitative scores and allows for significantly faster scoring. The researcher was personally responsible for monitoring the adherence to these methods in a classroom test setting.

2.4.2.1. Scoring:

Individuals obtained 2 scores during the assessment of the ROCF. Firstly a quantitative copy score was given for the reproduction of the diagram, this was done in accordance to Taylor's (1958) as described by Lezak (1995) 36 point scoring criteria. By assessing 18 individual elements for accuracy of reproduction and placement, a score of 2, 1, ½ or 0 was given to each of the elements drawn allowing for a maximum of 36 points per diagram. These points were assigned to each item based on the accuracy, distortion and location of the reproduced items and a score of 0 awarded to items that were absent or not recognisable (refer to Lezak et al., 2004, pp822-823). The total score therefore reflected the accuracy in which the individuals copied the projected figure and is a further measure of their visual constructional ability. Secondly, based on the use of the different coloured pencils, one was able to determine whether the individuals were exercising gestalt, piecemeal or analytic/ traditional approaches. Diagrams were categorised as traditional if learners drew the large rectangle first and then subsequently added the other details in relation to it. Diagrams were also considered traditional if they were part orientated, that is when the learners divided the diagram into sections and completed it from left to right or right to left. The gestalt approach indicates that the learner completed the larger, outer framework (not specifically distinguishing the rectangle and triangle) of the figure and then completed the finer inner details. Figures were categorised as piecemeal when learners copied the diagram by drawing the discrete detailed items one

by one without any semblance of an organised strategy. These results were then compared both within and between groups.

2.4.2.2. Psychometric properties:

As previously mentioned, the ROCF is a widely used and reliable assessment tool. The internal reliability of the ROCF was achieved by researchers considering each item on the figure as independent of one another and obtained split half and alpha coefficients. This information indicated that the reliabilities were greater that 0.6 for the ROCF (Lezak et al., 2004). The test retest reliability scores were obtained from recall scores of the test and measures indicated that the immediate recall reliability was r=0.76 and delayed recall was r.0.89 (Lezak et al., 2004). These are convincingly high reliability scores however, one needs to keep in mind that these were obtained from adult samples, but it has been previously discussed that the ROCF is an acceptable test for both adults and children. As for the scoring of the test, the inter-rater reliability for the scoring of the different criteria yielded a high score of greater that 0.8 (Lezak et al., 2004). It is therefore conclusive that this test is a reliable test to utilise within the current research.

2.5. Data Analysis:

1-way Analyses of Variance (ANOVA) and Chi squared analyses were not only used to determine the influence of predominant modes of processing on errors made on reading comprehensions, but were also utilized to determine whether any of the demographics obtained from the sample would act as confounding variables and influence either the approach used to complete the ROCF or the reading comprehension skills based on the SDRT.

Chi-squared tests are useful for the analyses of nominal data and determine whether there are associations between categorical variables in a sample and are they likely to reflect real associations between variables in the population. This test may also be used to determine if there is a difference between these variables (Huck, 2008). 1- way ANOVAs deal with differences between

sample means and has no restriction to the number of means. 1-way ANOVAs are utilized when groups are defined by only one independent variable, as is the case in the current research (Huck, 2008).

Correlational analyses were used to determine the strength of the relationship between the literal and inferential SDRT scores. This was done to determine whether these scores could be considered in conjunction or whether the information could be best served separately. Correlational analyses were also used to determine the implications of the ROCF processing strategies on the components of learner's reading comprehension. Correlations are important as they allow researchers to determine whether two phenomenon are related as well as, the direction and the magnitude of these relationship (Huck, 2008).

Logistic regression was used to predict the changes in the dependent variable in response to the independent variables and the magnitude to which the dependent variable is explained by the independent variables (Huck, 2008). This analyses was used to determine the effect of demographic characteristics on the approaches used to complete the ROCF.

All analyses were conducted with a confidence interval of 95%.

2.6. Ethical considerations:

The head masters of the selected schools were approached and informed of the research via an information sheet (appendix 5) as well as an interview for further questions regarding the current research. Once consent (appendix 6) was obtained from these individuals, teachers within available classes were approached and informed of the research via the same information procedure. This process was necessary to obtain permission to approach their students and conduct the research within their class. The subjects and their parents/ guardians received information sheets (appendix 1) attached to consent forms (appendices 2&3) and were asked to complete a demographic form (appendix 4) if consent was granted (these were returned to the school via the child or personally by the parent/s). The only personal details required on the

demographic sheets were the names of the parents and their child. These sheets were assigned numbers, which correlated with the numbers placed on the assessments. Information pertaining to the subjects was kept strictly confidential, with access only available to the researcher and supervisor. All personal and identifying information will be destroyed at the completion of the project and once qualification has been obtained. Should parents request, a single page summary, written in a manner that would ensure understandable pedagogy, will be released to the participant's educator on the conclusion of the research. The instruments and techniques utilised are non invasive and are considered harmless to the individuals. Due to the inclusion criterion, participants are not considered to be a vulnerable population however; the individuals that do not meet the specified criterion but have given consent were assessed to prevent them from being labelled by other students. The data collected from these individuals were not analysed or included in the result section.

Chapter 3: Results section:

(Refer to appendix 7 for corresponding analyses tables)

3.1. Demographic and summary information of the sample:

This section summarises the demographic information obtained from the background information sheets of the sample and the summary statistics for the total scores obtained on the ROCF and SDRT assessments as well as the literal and inferential scores of the comprehension subtest.

Table 3.1.1 Demographics of the Grade 4 learners in percentages %.

Grade 4 Learner demographics							
Variables:							
Gender	**Male**	**Female**	**Unknown**				
	45.71	51.43	2.86				
Ethnicity	**Black**	**White**	**Coloured**	**Indian**	**Unknown**		
	37.14	34.29	17.14	5.71	5.71		
Home language	**English**	**Zulu**	**Afrikaans**	**Sotho**	**Xhosa**	**Other**	
	57.14	11.43	8.57	5.71	2.86	11.43	
Failures	**Failed a year**	**Never failed**	**Unknown**				
	14.29	80	5.71				
Mother's age	**25-30**	**31-35**	**36-40**	**41-45**	**46-50**	**51<**	**Unknown**
	17.4	28.57	34.29	14.29	2.86	0	2.86
Mother's education	**Grade 10 only**	**Matric only**	**College diploma**	**University Degree**	**Unknown**		
	17.4	37.14	20	22.86	2.86		
Father's age	**25-30**	**31-35**	**36-40**	**41-45**	**46-50**	**51<**	**Unknown**
	15.71	20	31.43	20	8.57	2.8	11.43
Father's education	**Grade 10 only**	**Matric only**	**College diploma**	**University Degree**	**Unknown**		
	8.57	28.57	14.29	37.14	11.43		

Table 3.1.1 and 3.1.2 (below) depict the within sample demographic distributions and indicates approximately equal gender representation, similarly even ethnic distribution across levels with both African and white individuals being the majority, both samples were just over 50% English home language and the remaining majority being an African home language. The African home language majority incorporated the other category as no other languages besides Afrikaans was specified by the learners. Based on school grade failures approximately 15-20% of each sample was excluded from final

analysis. The majority of mother/female guardian(s) were between the ages 31-40 years for the grade 4 learners and between 36-50 years for the grade 10 learners. For the father/male guardian(s) the average age was between 31-45 and 41- 51 years and older, for the grade 4 and grade 10 learners respectively. The majority the father/male guardian(s) only obtained at highest either a matric or university level education. Alternatively the mother/ female guardian(s) results varied across the board for all levels of education

Table 3.1.2. Demographics of the Grade 10 learners in percentages %.

Grade 10 Learner demographics in %							
Variables:							
Gender	**Male**	**Female**	**Unknown**				
	50	46.15	3.85				
Ethnicity	**Black**	**White**	**Coloured**	**Indian**	**Unknown**		
	44.23	35.45	11.54	3.85	3.85		
Home language	**English**	**Zulu**	**Afrikaans**	**Sotho**	**Xhosa**	**Other**	
	55.77	5.77	5.77	9.26	9.26	13.46	
Failures	**Failed a year**	**Never failed**	**Unknown**				
	19.23	78.85	1.93				
Mother's age	**25-30**	**31-35**	**36-40**	**41-45**	**46-50**	**51<**	**Unknown**
	0	7.69	19.23	32.69	19.23	7.69	13.46
Mother's education	**Grade 10 only**	**Matric only**	**College diploma**	**University Degree**	**Unknown**		
	11.54	26.92	7.69	19.23	34.62		
Father's age	**25-30**	**31-35**	**36-40**	**41-45**	**46-50**	**51<**	**Unknown**
	0	0	7.96	25	19.23	11.54	36.54
Father's education	**Grade 10 only**	**Matric only**	**College diploma**	**University Degree**	**Unknown**		
	3.85	19.23	5.77	21.15	50		

Table 3.1.3. Summary statistics of grade 4 learner's scores .

Grade 4: summary statistics					
	mean	**Std.Dev**	**Var.**	**Skewness**	**Kurtosis**
ROCF Total	24.517	4.17	17.381	-0.482	0.5334
SDRT Total	33.667	9.0884	82.599	-0.814	0.0306
Literal Scores	17.767	4.5113	20.351	-0.825	0.269
Inferential Scores	15.9	4.932	24.329	0.696	0.303

Table 3.1.4. Summary statistics of grade 10 learner's scores .

Grade 10: summary statistics					
	mean	**Std.Dev**	**Var.**	**Skewness**	**Kurtosis**
ROCF Total	26.25	4.3437	18.868	-0.58	0.153
SDRT Total	41.442	8.73	76.212	0.305	0.332
Literal Scores	21.135	5.217	27.217	-0.3	0.663
Inferential Scores	20.308	4.0023	16.021	-0.382	0.1768

Table 3.1.5. Summary of the distribution of the data.

Central tendencies						
	Grade 4:			**Grade 10:**		
	mean	**median**	**mode**	**mean**	**median**	**mode**
ROCF total	24.516	24.75	23	26.25	27	27
SDRT total	33.66	36	43	41.4	42.5	43
Literal scores	17.76	19	16	21.134	21.5	21
Inferential scores	15.9	17	20	20.307	21	22

3.2. Normality of the data:

It is important to determine normality as it is an indicator of data that clusters around the mean. Any random variable with a normal distribution has a mean and a standard deviation that indicates how much the data as a whole deviates from the mean. Data that is symmetrical in fashion indicates that most of the results are situated around the probability's mean and values are equally likely to plot either above or below the mean. As with any distribution, the distributions mean, skewness and kurtosis coefficients should be calculated in order to determine the distribution of the data and whether it deviates from the norm. The normal distribution is important for statistical

analysis as the majority of hypothesis tests that are used, assume that the random variable being considered has an underlying normal distribution. If the variables are not normal, alternative nonparametric tests should be considered; however, such tests are typically less powerful in terms of conclusions that can be inferred. Table 3.1.3 & 3.1.4 contain the skewness and kurtosis co-efficients and table 3.1.5 indicates the distribution of the data for both samples, all of which are necessary to determine the normality of the data.

Data relevant to the performance on the ROCF indicates that both grade 4's and grade 10's skewness [gr4:(-0.482), gr10: (-0.580)] and kurtosis [gr4:(0.533), gr10: (-0.152)] co-efficients are both comfortably within the range of 1 and -1 and suggests that both sets of data are normally distributed. Examination of the plotted histogram and central tendencies indicates comparatively even distribution. The data applicable to the performance on the SDRT indicates that both grade 4's and grade 10's skewness [gr4:(-0.814), gr10: (-0.305)] and kurtosis [gr4:(0.0305), gr10: (-0.332)] co-efficients are both comfortably within the range of 1 and -1 and although the examination of the plotted histogram and the central tendencies suggest slight skewness for the grade 4 sample, both data sets remain within the range of a normal distribution.

The data pertinent to the performance on the SDRT subtests indicates that both grade 4's and grade 10's skewness for literal scores [gr4:(-0.825), gr10: (-0.300)] and inferential scores [gr4:(-0.692), gr10: (-0.383)] as well as their kurtosis co-efficients, literal scores [gr4:(0.269), gr10: (-0.663)]; inferential scores [gr4:(-0.305), gr10: (0.177)] are all comfortably within the range of 1 and -1. Examination of the plotted histogram and central tendencies of the grade 4 sample suggest skewness to the left, both literal and inferential data sets remain within the range of a normal distribution. It is assumed that the slight skewness of the literal and inferential resulted in the overall SDRT data to be slightly skewed, but remains within a normal distribution. Examination of the plotted histogram and central tendencies for the grade 10 data, indicates

comparatively even distribution. On the whole, all data is considered normally distributed and allows for the use on parametric analyses.

3.3. Correlations:

Correlational analyses allow researchers to determine whether two phenomenons are related and the magnitude of this relationship. In this section, the correlation analyses are used to determine how strongly related the literal and inferential Stanford scores are, in order to determine whether these scores should be considered in conjunction to one another or whether the information can be analysed separately. In addition, in order to determine the implications of the ROCF processing strategies on the components of learner's reading comprehension, it would be advisable to determine whether these assessment scores are related and if so, how strongly.

3.3.1. The relationship between the SDRT literal and inferential scores:

Due to the slight indication of skewness in section 3.2, both Pearson's [r= 0.852 (p< 0.0001)] and Spearman's [r=0.817 (p<0.0001)] correlation analyses were consulted for the grade 4 sample to determine the relationship between the Stanford literal and inferential scores. These results indicate that there is a significant and a strong positive relationship between the literal and inferential scores of the SDRT sub-test, which was re-iterated by the grade 10 Pearson's co-efficient [r= 0.79 (p< 0.0001)].

This suggests that due to their strong relationship, any further analyses the literal and inferential scores should be considered in union and infer that they contribute to the overall scores obtained on the SDRT comprehension sub-test.

3.3.2. The relationship between ROCF total score and the SDRT comprehension scores:

As the literal and inferential scores contribute significantly to the overall SDRT scores and concerns were raised in section in 3.3.1. regarding the distribution of the data, both Pearson's [r=0.125 (p=0.338)] and Spearman's [r= 0.106

(p=0.419)] correlations analyses were used in this section. These co-efficients suggested there is a weak, non-significant relationship between scores obtained an the ROCF assessment and the Stanford reading comprehension sub-test. These results were contrary to the Pearson's analyses [r=0.472 (p=0.0004)] of the grade 10 sample, which indicates that there is a significant yet moderate, positive relationship between the ROCF total scores and the Stanford reading comprehension scores.

3.4. Chi squared tests:

3.4.1. Gender as a factor of reading comprehension strategy

Gender was associated with the literal and inferential strategies utilised within the SDRT reading comprehension for the primary school cohort (P=0.003< 0.05; chi2= 9.1304), with the females being more literal based and less inferential based than the males who were categorised more as utilising inferential strategies than that of the females. This did not hold true for the high school cohort (p value=0.299> 0.05; chi2=1.0792), for whom gender was not associated with the literal and inferential strategies utilised within the SDRT.

3.4.2. Gender as a factor of reading comprehension strategy

The analyses of the copies of the complex figure indicated that there is no association (Grade 4: chi2=0.6274, p=0.731; Grade 10: chi2=4.4271, p=0.109) between the gender of the individual and the strategy utilised to complete the ROCF. However from the patterns in the result obtained for both groups, one is able to notice but not infer that females were more associated with traditional approaches to the ROCF and males were more associated with a piecemeal approach.

3.4.3. Ethnic background and language as a factor of Literal vs Inferential strategy on the SDRT

Ethnicity in the study is considered a contributor based on the criterion of adherence to indigenous African languages as home language which is thought to be the second language of learning versus a language of western tradition (English) as home language and is considered the first language of learning. For further information refer to section 4.1.4. to follow.

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Ethnicity was not associated with the strategy (literal vs inferential) utilised in reading comprehension (grade 4 :chi2=0.0951, p=0.758; grade 10: chi2=0.4501, p=0.502). However, although in the grade 4 subgroup home language is not associated with the literal and inferential strategies utilised within the SDRT (p value=0.397> 0.05; chi2=1.0792), an examination of the pattern of numbers suggests that English home language speaking individuals are more literal based than African speaking individuals and used more inferential strategies. The importance of this must however be interpreted with caution as there was only a few percentage difference and one is reminded that there is insufficient evidence to determine these patterns. Based on a P=0.044< 0.05 (chi2=4.0413) a similar analysis of the data generated by the grade 10 participants one is able to determine that language is associated with the literal and inferential strategies utilised in the SDRT task in the older group. An examination of the pattern of numbers generated by these more educated participants reveals that English home language speaking individuals are more literal based and less inferential based than African language speaking individuals. Although reflecting only a few percentage point difference, the African home language individuals tended to use more inferential strategies.

3.4.4. Ethnic background and language as a factor of the approach to the ROCF

With p value= 0.007< 0.05 (chi2=9.8804) for the grade 4 sample and p value= 0.014< 0.05 (chi2=8.4984) for the grade 10 sample, one is able to determine

that there is an association between the ethnicity of the individual and the strategy utilised to complete the ROCF. However the pattern in the analyses of the drawing produced by the younger sample indicates that white individuals utilise a more piecemeal approach to the completion on the ROCF, followed by the use of traditional methods and least likely the gestalt approach. As for the African individuals, they were more inclined to use gestalt strategies to complete the ROCF, followed by traditional methods and then piecemeal approaches. It must be noted that African individuals utilised the traditional method more frequently than that of white individuals. On the other hand, in the older high school group the pattern of the analyses indicates that white individuals utilise a more traditional approach to the completion on the ROCF, followed by the use of gestalt methods and least likely the piecemeal approach. As for the African learners, they were more associated with the use of piecemeal approaches to the completion of the ROCF, followed by gestalt methods and then traditional approaches. It must be noted that African individuals utilised the gestalt method more frequently than that of white individuals.

The analyses relevant to home languages indicated that there is no significant association (Grade 4: p=0.226, chi2=2.9732 and Grade 10: p=0.183, chi2=3.3953) between the strategies utilised to complete the ROFC and the home language of the individuals.

3.4.5. The relationship between the approaches to the ROCF and reading comprehension

Although the analysis was considered not significant (chi2=0.7531, p=0.686), by considering the pattern of numbers, it is noted that the grade 4 individuals who were categorised as constructing their ROCF as traditional, were associated more strongly with both the literal and inferential based comprehension strategies than those who completed their ROCF in a piecemeal manner. By comparison, although once again the analyses were considered not significant (chi2=2.2208, p=0.329), for the grade 10 participants, by considering the pattern of numbers it is noted that individuals who were categorised as constructing their ROCF as piecemeal were more

likely to be associated with literal based comprehension strategies, which was closely followed by a traditional approach to the ROCF. Individuals that had a more gestalt approach to the ROCF were more associated with inferential based comprehension strategies. This was once again closely followed by the traditional approach to the ROCF.

3.5. One -way ANOVA analyses:

1-way Analyses of Variance (ANOVA) were not only used to determine the influence of predominant modes of processing on errors made on reading comprehensions, but were also utilized to determine whether any of the demographics obtained from the sample would act as confounding variables and influence either the approach used to complete the ROCF or the reading comprehension skills based on the SDRT.

3.5.1. Failures and SDRT total results:

There is a significant difference between the mean scores of the SDRT comprehension test between learners that have reported failing a school year and those that had not failed a school year for grade 4 learners ($F= 6.85$, $p=0.0136$) and grade 10 learners ($F= 3.87$, $p=0.0549$). It is reported that the learners who have not previously failed a school year obtained higher overall comprehension scores than that of the learners that had failed.

3.5.2. Education level of the learner's parents and SDRT total results:

There is insufficient evidence at the grade 4 level ($F=0.66$, $p=0.4216$) and the grade 10 level ($F=0.86$, $p=0.3609$) to suggest that the education levels of the mother/female guardian(s) influences the mean scores obtained on the SDRT comprehension test. Furthermore, there is also insufficient evidence for both the grade 4 ($F=1.55$, $p=0.2233$) and grade 10 ($F=1.20$, $p=0.2848$) learners to suggest that the education levels of the father/male guardian(s) influences the mean score obtained on the SDRT comprehension test.

3.5.3. Gender on SDRT total results:

Interestingly there is a variation in the capabilities of males and females at different age levels, as the results indicate that at the grade 4 levels (F= 6.15, p=0.0186) there is sufficient evidence to suggest that gender has an influence on the overall scores obtained on the SDRT comprehension test. Whereby the female grade 4 learners obtained higher test scores than males of a similar age. This was not the case at the level of the grade 10's, where there is insufficient evidence (F=1.87, p=0.1773) to suggest that there is a difference in test means between the male and female grade 10 learners.

3.5.4. Gender and ROCF total:

The overall statistical analyses of gender influencing the scores obtained on the ROCF for both grade 4 (F=0.07, p=0.7912) and grade 10 (F=0.04, p=0.8384), states that there is insufficient evidence to suggest that there are differences in means between males and females when considering the overall score for the ROCF test.

3.5.5. Language and SDRT total results:

The conflicting evidence regarding home language suggests that the different age levels may influence the effects on reading comprehension. There is insufficient evidence at the grade 4 learner level (F=1.84, p=0.1844) to suggest that language is an influencing factor on the overall score on the SDRT comprehension. However at the grade 10 level (F= 7.47, p=0.0087), there is sufficient evidence to suggest that the learner's home language (English home language and African home language) influences their test result on the SDRT comprehension assessment. With English home language individuals obtaining a higher overall comprehension scores than that of the African home language individuals.

3.5.6. Language and literal scores:

There are once again conflicting results with respect to grade 4 and grade 10 statistical results. Whereby the grade 4 levels results signify that there is

insufficient evidence (F=3.13, p=0.0863) to suggest that the home language of the individuals influences the literal mean scores obtained on the SDRT comprehension test. Where the grade 10 learners results indicate that there is a significant difference between the literal mean scores obtained on the SDRT comprehension test between English home language individuals and African home language individuals (F= 8.85, p=0.0045), with English home language individuals obtaining a higher literal comprehension score than that of African home language individuals. This could be due to the age of the individuals or due to the complexity of the language in the assessment being influenced by first and second language students.

3.5.7. language and inferential scores:

As with language results above (3.5.6) pertaining to literal scores obtained on the SDRT, the same pertains to the statistical results obtained for the inferential scores. There is insufficient evidence for the grade 4 learners (F=0.80, p=0.3784) to suggest that the home language of the individuals influences the inferential mean score obtained on the SDRT comprehension test. Alternatively the grade 10 results propose that there is a significant difference between the inferential mean scores obtained on the SDRT comprehension test between English home language individuals and African home language individuals (F= 4.28, p=0.0438), with English home language individuals obtaining a higher inferential comprehension score than that of African home language individuals. This could once more be due to the age of the individuals or due to the complexity of the language in the assessment being influenced by first and second language students.

3.5.8. Ethnic background and SDRT total results:

There is variation in the influence of ethnicity between the grade 4 learners (F=3.77, p=0.0615) and the grade 10 learners (F= 7.02, p=0.0109). The results indicate that there is insufficient evidence to suggest that one's ethnicity (African and white) influences the comprehension test scores at a younger age, but there is sufficient evidence at the grade 10 levels to indicate that there is an ethnic demographic effect on the overall SDRT

comprehension tests scores. The results at the older level suggest that white individuals obtained higher tests scores on the SDRT than did African learners, during their assessment.

3.5.9. Ethnic background and literal scores:

There is conflicting evidence at the different levels of education and age to suggest the influence of ethnicity on the learner's SDRT literal scores, whereby there is insufficient evidence at the grade 4 levels (F=3.07, p=0.0897) to suggest that the ethnicity of the individuals influences the literal mean score obtained on the SDRT comprehension test and there is significant evidence at the grade 10 level (F= 5.76, p=0.0203) to suggest it has an influencing effect. The grade 10 results indicate that there is a difference in the mean scores of the literal comprehension results obtained on the SDRT, where white learners obtained higher literal scores than their African counterparts.

3.5.10. Ethnic background and inferential scores:

There is insufficient evidence (F=3.64, p=0.0656) to suggest that the ethnicity of the learners influences the inferential mean score obtained on the SDRT comprehension test for the grade 4 level. On the other hand, statistical results for the grade 10 learners indicated that there is a significant difference between the inferential mean scores obtained on the SDRT between white and African individuals (F= 6.88, p=0.0116), with white learners obtaining a higher inferential comprehension score than that of African learners.

3.5.11. Ethnic background and ROCF total:

There is variation in the influence of ethnicity between the grade 4 learners (F=2.04, p=0.1632) and the grade 10 learners (F= 6.57, p=0.0135). The results indicate that there is insufficient evidence to suggest that one's ethnicity (African and white) influences the ROCF scores at a younger age, but there is sufficient evidence at the grade 10 level to indicate that there is an

ethnic demographic effect on the overall ROCF scores. The results at the older level suggest that white individuals obtained higher tests scores on the ROCF assessment than did African learners.

3.5.12. ROCF strategies influencing SDRT overall scores and components:

There is insufficient evidence for both the grade 4 (F=0.11, p=0.9002) and grade 10 (F=0.44; p=0.646) learners to suggests that the approaches used to complete the ROCF has any influence on the overall scores obtained on the SDRT. This holds true for both educational levels on the literal [grade 4: F=0.14; p=0.869; grade 10: F=0.32; p=0.7355] and inferential [grade 4: F= 0.07; p=0.928; grade 10: F=0.98; p=0.3822] components.

3.6. Logistic regressions for ROCF strategy for grade 10 learners:

The use of a logistic regression was due to the grade 10 level obtaining more significant results and the researcher wanted to determine the extent to which the factors influence both the ROCF and later the SDRT results.

Logistic regression estimates	
Pseudo R2	0.1326

ROCF strategy	Odds ratio	P>|z|	95% conf interval	
Ethnicity	3.873911	0.102	.7648917	19.62001
Gender	.374922	0.133	.1041245	1.349985
Language	1.056963	0.950	.1855798	6.019894

Approximately 13% of the ROCF variance can be explained by Ethnic background, gender and home language, with ethnic background accounting for the majority (9.73%) of this change and is the greater predictor variable.

Chapter 4: Discussion and Conclusion section

4.1. Demographics serving as confounding variables:

It is important for the researcher to determine the relative influences of various demographic factors such as age, gender, home language and ethnicity on the test scores (SDRT & ROCF) to determine whether these could be significant contributors and account for the results discovered in the study as opposed to general hemispheric processing. These demographics are vital reflections considering the vast diversity of languages and ethnicities that construct South African population. All these characteristics are likely to have some form of influence on one's cognition, behaviour and being; these characteristics would then need to be taken into consideration to allow for optimal skills development throughout growth and learning.

4.1.1. Exclusion Criterion: School failures

The first two discussion areas are made available to indicate the equivalence of the comparison groups and to indicate that the results that follow are efficient enough to allow for viable inferences. Firstly, the failure rates between the two grades were approximately even across the number of learners who had and had not failed an academic year. Although there were minor differences between the percentages of learners who had failed; which were due to some learners not disclosing their demographic information and the expectation that there would be more failures for the grade 10 level as they would have had more years to fail; these however did not have a considerable influence on the equivalence of the overall numbers of the learners in each category. These categories indicated that learners who had previously failed an academic year had scored lower on their comprehension results, irrespective of their developmental level. These are logical findings as they may be experiencing some other learning difficulties which would reflect in their lower scores; it is therefore that these individuals were excluded from the analyses of mean scores on both the ROCF and the SDRT.

4.1.2. Group descriptors: Parent's age and education

The majority of mother/female guardian(s) were between the ages 31-40 years for the grade 4 learners and between 36-50 years for the grade 10 learners. This suggests good matching of the groups for age of the parents at time of birth. For the father/male guardian(s) the average age was between 31-45 and 41- 51 years and older, for the grade 4 and grade 10 learners respectively. The majority of the father/male guardian(s) descriptive information was not disclosed by the mother/ female guardian of the learners across both academic groups, as the father(s), were absent from the child's life at the time of the investigation. This holds true for the undisclosed information pertaining to the education level of the father/male guardian(s), where the majority the father/male guardian(s) only obtained at highest either a matric or university level education. Alternatively the mother/ female guardian(s) results varied across the board for all levels of education. These demographics are not tremendously important considering the analyses of this information did not yield any significant results and merely signifies the matching of the 2 groups across the developmental stages.

4.1.3. Gender:

In the present research, the demographics indicated that there was a relatively even distribution of males and females both within and across age groups. This once again signifies the matching of the two samples across gender. Further more, due to gender being a historically contentious issue, with many theorist having strong beliefs regarding its influences on cognition, it was vital to determine the extent, if any, to which gender influences cognitive functioning, reading comprehension and visuo-spatial perception. Populist explanations generally draw on biological theories that stress gender differences, in favour of girls, being rooted in differential brain organization and maturation rates.

4.1.3.1: Gender's influence on reading comprehension

The current studies results suggest a differential effect of gender across age groups. At a primary school level females demonstrated greater reading comprehension skills with regard to both their literal and inferential abilities, although not by a vast difference. However as skill development progress the variation between the literal and inferential results diminished and both males and females score similarly on the SDRT. For this reason, the research concludes that even though their might have been a variation in the results at a younger age, there is no evidence to suggest that gender as a whole vastly influences the reading comprehension abilities of South African males and females. This was affirmed by White (2007) where gender failed to account for any variance in reading achievement, using data from internationally and nationally large data scales, for similar age groups.

4.1.3.2. Gender's influence on ROCF

It is interesting to note that contrary to the literature (Lezak et al., 2004) and irrespective of developmental levels, the present group did not differ in their organisational strategy or their overall ROCF scores, as a factor of gender. Males do not outperform females and gender does not account for any variability in the scores obtained or inferences regarding hemispheric processing, given the age of the sample. The results may be contrary to previous findings as literature on this issue is generally outdated and minor differences in performances were reported as significant, even though the variances were minimal or almost non-existent, these seemed to form trends in gender studies throughout history. It would however be interesting to discover through future research, whether males and female use alternative tracts to develop and master the same educational skills (highlighted in 4.1.3.1 & 4.1.3.2) and what role teaching and learning plays.

4.1.4. Home language and Ethnic background:

South Africa is a unique country as it is comprised of 11 official languages and has varying associated ethnicities. The data collected from the learners indicated that the majority of the learners either spoke English, Afrikaans or one of the African languages, as their predominant home language. Although learners were requested to indicate if any other languages were spoken at home, such as Portuguese, Italian etc, none were disclosed. Thus more than half the entire sample indicated that English was their first home language and approximately 32-35% of the learners spoke an African language, which included Xhosa, Sotho and Zulu to name a few. The individuals who spoke English at home were considered first language learners based on the language of learning being English and those individuals who predominantly spoke an African language at home were characterized as second language learners. A cross tabulation of the predominant home languages and the learners' ethnicity may have indicated individuals who might be considered bilingual speakers but the researcher would have required further background information to ensure the accuracy of these assumptions, therefore the first and second language distinction was maintained. This categorization of first and second home languages makes the separation between social language and the language of learning. Although it was discussed that there were individuals who predominantly spoke Afrikaans in their homes, it was decided that this sample would be too small to make any inferential conclusions and they were excluded for this section of the analyses. As the sample in this study represents students who have always attended a Model C school, it is assumed that they should be proficient in English however; the separation into first and second language may further indicate their proficiency when analyzing their overall SDRT scores.

By separating the languages into first (English) and second (African) language speakers and by following the exclusion patterns of Afrikaans and other languages, it left the researcher with distinct categories to work with regarding the influence of the ethnicities of the learners. The demographic information

obtained from the learners indicated that there was a fairly even distribution of African and white learners across both developmental levels, which once again indicated equivalence in matching the sample. Furthermore, as the two ethnic categories that were developed formed the majority of the sample it allowed for simple and concise analyses of the data.

4.1.4.1. Home language and ethnicity's influence on reading comprehension:

The results specify that the influence of home language differs depending on the developmental level of the learner. At the primary school level, there was no variation on the overall scores obtained on the SDRT comprehension assessment however; the older cohort indicated that the home language of the learners act as a confounding variable. Akin to the literature (Bowyer-Crane & Snowling, 2005), the results indicated that English as a predominant home language (first language learners) scored higher on their SDRT comprehension assessment than their African home language counterparts or second language learners. Further analyses suggested that older English speaking learners were more literal based than their African speaking counterparts, who were simplistically categorized as being more inferential. As these results were contrary to the literature (Bowyer-Crane & Snowling, 2005) and the above mentioned results, the researcher deemed the results inadequate explanations of the patterns expected. It is therefore that one way ANOVA's were conducted to verify the findings and the results were more convincing. Similar to the Chi ^{2} results, the ANOVA findings suggested that home language has a differential effect across age groups. The older cohorts were found to be significantly influenced by their home language; with English speaking, first language learners, scoring higher on both the literal and inferential components of the SDRT assessment compared to the second language learners. These results reiterated the previously mentioned findings that first language learners obtained significantly higher overall comprehension scores and were further akin to the literature presented (Banich, 2004; Carpenter & Just, 1986; Jobard et al., 2003).

As ethnicity is represented in language and are strongly related, the ethnic categories developed were by-products of the separation of the sample into first and second language. As concerns have been raised in the above section and one's ethnicity is inextricably linked to language as well as being a defining South African characteristic, it was worthwhile to determine whether ethnicity was a contributing factor or show signs of similar patterns. From the results, one is able to confidently conclude that ethnicity too is a contributing factor to the overall comprehension scores obtained on the SDRT and language proficiency, with older white learners scoring higher on the comprehension section, than older African learners. These findings were reiterated by the SDRT strategy findings whereby ethnicity influenced the literal and inferential scores, which were also a function of the learners' developmental process. Older white learners score higher on literal and inferential SDRT approaches in comparison to African individuals. The fact that ethnicity does not influence the scores on the literal and inferential components earlier on in development may also be due to the simplicity of the language of the assessment at that level.

As discussed, these results may not therefore be due to the potential for language proficiency but rather the continued assimilation of proficiency from the foundational stages, based on exposure and schooling practice which impacts mostly on the second language learners. For example, through the continuous exposure to a language from a young age as is the case with first language learners, individuals repetitively come into contact with words and their meanings, thus an association is learned and stored as a visual lexicon (Jobard et al., 2003) and retrieval of the meanings of words for inferences during reading, are made simpler. For second language learners on the other hand, so many words appear to be "pseudo-words" or new, as there has not been that continuous exposure to words and their meanings and thus these learners require the phonological approach (sound to meaning) to allow for understanding and inferences during reading instead of visual lexicons, which

requires more time and effort. It is argued that as reading volume increases, contextual strategies should develop similar to the more skilled first language learners but these are never completely mastered (Banich, 2004; Carpenter & Just, 1986; Jobard et al., 2003) and variations in test scores remain. This begins to highlight the specific difficulties the groups have to face in order to demonstrate equal performances. Furthermore, the fact that the scores of the younger learners were not influenced detrimentally by their home language, may be due to the simplicity of the language and vocabulary of the assessments. Individuals at a younger age are only taught basic foundational rules from which they build and begin to master their language proficiency. The variations experienced at the older levels of development may also be due to the mismatch between the level of English used in the SDRT, which may not align with the knowledge and skills mastered by second language individuals, especially as they are exposed to a variety of foundational rules pertaining to multiple languages. In addition, the vocabulary in the assessment may be alienating the second language learners and does not reflect their true potential both in the SDRT assessment and during schooling.

The difference in the performance of first language and second language learner's lie in the strategies utilized during reading and the ability to use general knowledge to interpret the information presented (Bowyer-Crane & Snowling, 2005). It is argued that the more skilled readers are able to make vital inferences and develop representations of the written material, where as the less skilled readers do not benefit from reading text in context as they do not coherently integrate the information presented to them and infer meaning. With questions regarding comprehension scores, the more skilled first language readers obtain higher scores due to their ability to infer meaning and provide the necessary answers. As inferences are extensions of word meanings and vocabulary, second language learners may not be aware of standard meanings of the words or their default senses, thus alienating them. Despite some areas of overlap, word meanings vary significantly from language to language therefore second language learners may require, once

again, more time and effort processing such vocabulary and their meanings than first language learners (Littlemore & Low, 2006), this is particularly evident when the level of learning and the curriculum become more complex later in development. Thus the idea of selecting reading material with clear inferences rather than more abstract metaphors may allow the second language learners to not only develop semantic vocabulary but visual lexicons, integral to reading skills.

Given the serious challenges in South Africa pertaining to learner achievement and the long history of engagement in various aspects underpinning this situation, the mismatch between language of learning and home language is one of the most important factors that this country has to overcome in order for the youth of this country to achieve academically. The current circumstances, practices, perceptions and experiences in the schooling system are considerably complex and in order for the learners to achieve the desired outcomes, researchers need to find the solutions, which begin with highlighting that reading anomalies may be due to use of the right hemisphere for perceptual coding that is inappropriate for the demands made by the comprehending text and insufficient for academic success for the use of conventional reading instructions (Kershner, 1977). This may be rectified through the use of alternative reading matter or exploring different teaching practices to account for the variations evident in South African classrooms. Through further research on this topic, including consideration for the socioeconomic status of the learners, the education department may begin to make headway of the problems this country faces concerning the poor academic results.

4.1.4.2. Home language and Ethnicity influencing ROCF.

Individual's preferred home language has no bearing on the approaches to the ROCF. This could be inferred logically based on the fact that the ROCF investigates visuo-spatial ability and is a non-verbal assessment. Although

what might have been predicted through a survey of the literature (Rosselli & Ardila, 2003) is, cultural practice impacted on the approach to visuo-spatial analysis as determined by the approach to the ROCF which later infers hemispheric processing. As the scores differ for ethnicity it implicates a cultural variable that is not language based. African primary school learners demonstrated a predisposition towards gestalt analysis as opposed to White South African learners who engaged more specifically with individual components. This trend reversed somewhat at a high school level with white learners using a more traditional approach to the completion of the ROCF compared to the piecemeal approached used by their African equivalent. Given that the study was cross sectional rather than longitudinal one cannot state with certainty that this represents a developmental strategy reflective of second language learning or whether a cultural shift has occurred over time, despite the many years difference between the groups.

Nevertheless one could speculate that these results infer what is represented in the literature concerning the influence of developmental processes across ethnicity, on the approaches utilized for the completion of the ROCF. More specifically that there is a relationship between brain processing; organization, planning and conceptual strategies and the learners stage of development. The complexity of the patterns within the figure is thought to influence the integration of the elements and the organizational strategies during development. Although younger individuals should exhibit a more piecemeal approach, this was not the case for African individuals, although they still had not mastered the more traditional/logical organizational approach. For the older learners, there too was a variation in the patterns across ethnicities for development. Here the researcher found the white individuals used the traditional approach in the completion of the figure, where the majority of the older African learners focused on piecemeal organizations. For an alternative explanation for these patterns, one could refer back to the information concerning culture itself influencing the results on “standardized non-verbal” tests. Rosselli & Ardila (2003) and Henry (2001) highlighted the influence of

one's culture on cognitive functioning, especially visuo-spatial processing. The results in this study may rather suggest that one's cultural background influence the cognitive functioning of the learner instead of developmental processes.

When investigating the influence of ethnicity on the overall scores obtained on the ROCF, there is once again, variation across age. One is reminded that although the strategies used for the completion of the ROCF may vary across age and ethnicity, individuals may have the same overall scores if the elements are placed in the appropriate places and without distortion. Whilst taking this into account it was found that ethnicity has no influence on the overall scores attained by African and white learners, in the younger learners. On the other hand, ethnicity was a contributing factor for the older learners. It was discovered that white individuals had higher overall scores than African learners. From previous research, it was determined that the overall accuracy of the completion of the diagram improves considerably with use of more structured and logical approaches (Henry, 2001; Dumont-Willis, 2003; Kirkwood et al., 2001; Smith & Zahka, 2006). This may signal better problem-solution-evaluation patterns and the ability to understand one entity in terms of another entity (Littlemore & Low, 2006). The variances in the overall scores on the ROCF for ethnicity may thus be explained by the above mentioned results where African learners use a more unstructured and piecemeal approach to their reproductions and lends itself once again to the alternative cultural explanation for the result discovered.

4.2. The implications of the approaches to the ROCF on the components of reading comprehension (literal and inferential).

Analyses of the relationship between the overall ROCF scores and the overall SDRT comprehension scores, suggest that there is a moderate positive relationship between the two only at the grade 10 level. This in comparable to

Dumont-Willis' (2003) study which suggested that poorer performance and organizational strategies on the ROCF in the copying phase related to poorer reading skills of individuals, who exhibited no learning difficulties. The variation based on age suggests that visuo-spatial/perceptual skills only begin to influence reading comprehension skills later on in development, where reading assessments may require further analytical processing and understanding. This may hold true for many of the skills assessed in the current research, considering many of the differences were only evident later on in development, in the older learners. The more analytical processing may include the supporting functions of the different hemispheres, although the results were not considerably strong. The researcher is unable to confidently confirm that there is a relationship between the hemispheric predominant modes of processing influencing reading comprehension as contrary to the hypothesis that the approaches to the completion of the ROCF influenced the literal and inferential components of reading comprehension, as there were no significant statistical implications for this. Although the patterns in the results began to resemble what the literature was preempting, such that the traditional approaches to the ROCF not only scored higher on the overall comprehension scores, relating back to the usefulness of a more strategic and logical approach aiding comprehension skills, but they indicated that the traditional strategies allowed for a more inferential approach. Furthermore, the patterns suggested piecemeal approaches followed a more literal approach to the completion of the SDRT and the gestalt methods followed the more global traditional approach to the completion of the ROCF. These findings may rather suggest that the scores obtained on both the literal and inferential components of the SDRT may be significantly more influenced by the home language and the ethnicity of the learners, as discussed in sections 4.1.4.1 and 4.1.4.2. than the strategies used to complete the ROCF.

4.3. Conclusion:

From the patterns that have immerged in the current study and the review of the literature, the researcher now suggests but does not confidently conclude, given the emergence of patterns with little significant statistical grounding, further possible explanations for the results discovered in the research. Firstly, less proficient and younger learners may be more likely to make use of the indirect route for reading, which makes use of more literal strategies on the SDRT and more piecemeal strategies of the ROCF. From these patterns and in relation to the literature, the researcher would assume that these learners were more left hemispheric dominant and based on the results, were described as second language African learners. On the other hand, one assumes that the more proficient and older learners are more likely to make use of the direct route for reading, which allows for not only literal but more inferential strategies on the SDRT and the traditional or logical approaches to the ROCF. Once again, based on the results in the current study in relation to the literature, the researcher assumes that this would categorize white, first language learners as being more right hemispheric dominant.

As there were no strongly significant results for the above explanations, the researcher is more confident in concluding that the demographics of the learners were the main contributors and account for the results discovered in the study as opposed to general hemispheric processing. This suggests that age, ethnicity and home language have a more defining influence on reading comprehension and visuo-spatial scores.

4.3.1. Norms :

Due to the concerns raised regarding the influence of second language learning and ethnicity on both the ROCF and SDRT scores and the

conclusion that the characteristics of the learners were the main contributors in the study, it is imperative that we consider the impact of these on the norm scores in relation to the South African population. As the mean scores for the ROCF out of a possible 36 points were 24.5 and 26.25 for the primary and high school levels respectively, one is able to determine that the grade 4 learners' fell within the lower half of the norm range for the appropriate age group of the ROCF, which was 27.20 with a standard deviation of 7.58. What is important to note is that the scores got worse and the older cohort's performance measured below the international standard, which was 33.60 (2.98). The older learners did not score noticeably higher on the ROCF assessment than the younger learners and the lack of improvement over their developmental period raises questions as to the influence of the education system utilized in the country in comparison to international standards. This is especially disconcerting considering the average scores on the SDRT were 33.67/48 (70%) for the grade 4 learners and 41.44/60 (69%) for the grade 10 learners. It is clear to see that the learners have not improved or worsened on their reading comprehension scores, which is surely to be explained by the influence of second language learning and the literacy skills of the learners. This once again highlights the needs for the education system to take in to account the variances between the cultural and linguistic backgrounds of the learners and how these may influence their ability or methods when mastering knowledge and the school curriculum.

Although there are many challenges facing South Africa, one of the more important challenges is the improvements required in the education system. There is a need to understand the unique dynamics within the country and link them to policy design and hence to real, tangible improvements. This research seeks to obtain a deeper understanding of the dynamics through which individuals grow, learn, change and act. Education and learning are vital components of one's development as they allow for the accumulation of knowledge to ensure that individuals have the basic foundations required for future development. There is a need to focus on school effectiveness, the

outcomes of basic education, and whether these adequately prepare individuals for future development. OBE has received extremely negative press of late, blaming the system for poor educational outcomes at school and questioning whether it is it an adequate learning platform. The current research calls on educators to explore alternatives to their teaching practices and respond to the complex and changing needs of their students. Models need to be developed which include the problematized aspects of literacy, promote critical reflection and action instead of constraining frameworks of instruction. Although second language learning has made significant headway into mainstream pedagogical practice and in the designs of teaching materials (Littlemore & Low, 2006) there are still significant improvements to be made.

4.3.2. Limitations of the current study and future research suggestions:

The current study was unable to address all components that are vital contributors of reading comprehension research, including text structure, previous knowledge, concept formation and its application as well as letter identification skills, phonological skills and memory skills, as the expansion of such research is beyond the scope of the level of the study. The educational levels were used as a means to contrast between and within group differences, but the study was unable to fully infer developmental effects as this would require future longitudinal studies. The reading achievement outcomes may not be generalisable to other educational jurisdictions as it focussed primarily on model C learners in an urban setting. Future research of such studies should include analyses of a variety of schools in the different socio-economic environments. As the research was unable to acquire significant in-depth information regarding language acquisition and proficiency of bilingual learners, the research was unable to infer hemispheric processing and influences of these learners. Due to the disappointing response regarding the demographic information of the learner's parents, this study was unable to fully ascertain the influence the family environment might have on the student's comprehension results. Lastly, as the logistic regression analyses indicated that only 13% of the ROCF strategy variance can be explained by

gender, ethnicity and language. Future research would need to consider what the other factors explain the remaining 87% variance

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Appendix 1
Information Sheet

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OF THE
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Private Bag 3, Wits 2050, Johannesburg,
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Tel: (011) 717-4500 Fax: (011) 717-4559
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July 2009

Dear Parent(s),

My name is Shawn Rogers and I am currently conducting research as partial fulfilment of the requirements for the degree of Masters in the field of Research Psychology, at the University of the Witwatersrand. The current study looks to investigate the assumption held by many that language is exclusively processed by the left hemisphere (Bryan, 1995). The study aims to investigate the developmental implications of predominant areas of processing in the brain, for reading comprehension and proposes to examine the performance of grade 4 and grade 10 learners on selected reading comprehension and drawing tasks. The participation of the grade 4 and grade 10 learners would allow the researcher to determine the comprehension abilities of individuals both before puberty and once individuals have reached maturity and determine whether reading comprehension abilities are constant throughout development. It is hoped that an understanding of this relationship might enable the researcher to provide the educational establishment with some answers pertinent to learning and educational styles and facilitate a more individualised selection of reading matter for specific students.

Participation in the study is **voluntary** and your child will in **no** way be advantaged or disadvantaged through participation and may choose to withdraw from the study at any stage without fear of penalty. The assessments are developmentally appropriate and after the completion of the study, all participants will be debriefed as deemed appropriate by the researcher. I would however like to invite your child to participate in the study.

The study will consist of three parts. The first part consists of parent(s) completing demographic and consent forms. After completing the requested information, please return to the school with your son / daughter. Please be sure to return the consent and demographic forms, otherwise your information and child cannot be used in the study.

The second and third part of the study consists of your child participating in an assessment consisting of drawing task and a reading comprehension test. These will be administered during your child's regular class lessons and should require approximately 60 minutes**,** this would not interfere with normal schooling.

Each completed form and the test will only be identifiable to the researcher. Participants will be assigned confidential numbers, which will allow only the

researcher to identify who completed which form / test. The information will be destroyed no later than 31st May 2010.

Should you have any further questions, or would like to obtain a summary of the results after completion, please do not hesitate to contact me or my supervisor, Mrs. Enid Schutte, at any time.

Yours truly,

Shawn Rogers
E-mail: shawn.angel@telkomsa.net
Cell: 0825668126

Supervisor: Mrs. Enid Schutte
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Appendix 2
Consent Form

Parent/Guardian(s) Consent Form

UNIVERSITY
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Tel: (011) 717-4500 Fax: (011) 717-4559
Email: 018lucy@muse.wits.ac.za

Should you agree to allow your child to participate in this study you will be asked to complete a demographic form. Your permission will also allow the researcher to administer a drawing task and a reading comprehension test to your child. These are standardise measure that allow the research to determine the affect of processing styles on reading comprehension. Participants are required to copy a figure presented in front of the class using coloured pencils as well as read extracts from the assessment and answer the relevant multiple choice questions.

Each completed form and the test will only be identifiable to the researcher. Participants will be assigned confidential numbers, which will allow only the researcher to identify who completed which form / test. The information will be destroyed no later than 31st May 2010.

The above mentioned assessments are developmentally appropriate and after the completion of the study, all participants will be debriefed as deemed appropriate by the researcher. There is no risk of harm to any participant involved in the study.

Participation to this study is **voluntary**, and refusal to participate will involve **no** penalty or loss of benefits to which you or your child as a result of participation within the study. You or your child may discontinue participation at any time without penalty or loss of benefits.

AUTHORISATION: I have read the above and understand the nature of this study. I understand that I may contact the researcher (Shawn Rogers- 0825668126), or her supervisor (Enid Schutte - 082 920 6731), at any time.

I agree to allow my child, _____, to participate in this study. I understand that I may withdraw my participation and that of my child at any time. I understand that this consent form will be valid for 12 months from the date below.

Parent's name:_____

Parent's signature: _____
Date: _____

Appendix 3
Consent form

Child Consent Form

UNIVERSITY
OF THE
WITWATERSRAND,
JOHANNESBURG

School of Human and Community Development
Private Bag 3, Wits 2050, Johannesburg,
South Africa
Tel: (011) 717-4500 Fax: (011) 717-4559
Email: 018lucy@muse.wits.ac.za

Hi, my name is Shawn Rogers and I am completing research for school. I would like your help.

You are being asked to help complete a study about how your brain works. If you would like to participate, you will complete a drawing task and a reading comprehension test. This is similar to reading stories and drawing pictures. I will then use your results in my research.

Your parents have agreed to allow you to participate, however if you decide not to, that is okay too. You decide whether or not you would like to be in this study or not, and no-one will be upset if you decide not to, or even if you decide to withdraw later on.

You may ask questions at any time, and if you have questions at a later stage you may phone me (Shawn) at 0825668125.

Would you like to participate: (Tick appropriate box)

☐ Yes ☐ No

Signing at the bottom of this form means that you agree to participate.

Thank you very much for your time.

Shawn Rogers

Signature of child: _____
Date: _____

Appendix 4
Demographic Questionnaire

Child's name: _____

Age: _____

Level of study: _____

Please circle appropriate answer

Gender: male/female

Race: White/African/Coloured/Indian

Home language: English/Afrikaans/Xhosa/Sotho/Zulu/Other: _____

Previous failure of a school year: Yes/No

Any known learning disabilities: Yes/ No

Has the child always attended an English medium model C school: Yes/No

If No, then what other schools has the child attended:
Private school/ Township School/ Home school

What Pre-School did the child attend: _____

Has your child ever experienced any serious head injuries or illnesses (eg meningitis):
Yes/No

If Yes, please specify: _____

Parent/Guardian information:

Mother's age: _____ Father's age: _____

Mother's level of education: _____ Father's level of education:_____

Mother's occupation:_____ Father's occupation: _____

Appendix 5
Principal Information Sheet

UNIVERSITY
OF THE
WITWATERSRAND,
JOHANNESBURG

School of Human and Community Development
Private Bag 3, Wits 2050, Johannesburg,
South Africa
Tel: (011) 717-4500 Fax: (011) 717-4559
Email: 018lucy@muse.wits.ac.za

July 2009

Dear Sir/Madam,

Good day, my name is Shawn Rogers and I am currently conducting research as partial fulfilment of the requirements for the degree of Masters in the field of Research Psychology, at the University of the Witwatersrand. The current study looks to explore the relationship between hemispheric processing and reading comprehension errors. To determine which reading matter, based on a selected reading comprehension test is better suited for analytical styles using a selected drawing task. These would possibly enable the researcher to provide the educational establishment with some answers pertinent to learning and educational styles.

To study this relationship, I would require a sample of grade 4 and 10 learners. These would allow the researcher to determine the comprehension abilities of individuals both before puberty and once individuals have reached maturity. This would further allow the researcher to determine whether reading comprehension abilities are constant throughout development. I would like to request permission to approach the teachers and their classes in order to invite the students and their parents to participate in the current research.

The study will consist of three parts. The first part consists of parent(s) completing demographic and consent forms. After completing the requested information (consent and demographic forms), the parents will be asked to return the forms to the school via their child or in person.

The second and third part of the study consists of students participating in an assessment, consisting of a drawing task and a reading comprehension test. These would be administered during the child's regular class lessons and should require approximately 60 minutes**,** this would not interfere with normal schooling. I will then use the data to establish what the relationship is between hemispheric processing and reading comprehension.

Each completed form and the test will only be identifiable to the researcher. Participants will be assigned confidential numbers, which will allow only the researcher to identify who completed which form / test. The information will be destroyed no later than 31st May 2010.

The above mentioned assessments are developmentally appropriate and after the completion of the study, all participants will be debriefed as deemed appropriate by the researcher. There is no risk to any participant involved in the study.

Participation in this study is **voluntary**, and refusal to participate will involve **no** penalty to the individuals or the school. Participants and the school may discontinue participation at any time without penalty.

Should you have any further questions, or would like to obtain a summary of the results after completion, please do not hesitate to contact either myself or my supervisor, Mrs. Enid Schutte, at any time.

Yours truly,

Shawn Rogers
E-mail: shawn.angel@telkomsa.net
Cell: 0825668126

Supervisor: Mrs. Enid Schutte
Cell: 0829206731

Appendix 6
Principal Consent Form

UNIVERSITY
OF THE
WITWATERSRAND,
JOHANNESBURG

School of Human and Community Development
Private Bag 3, Wits 2050, Johannesburg,
South Africa
Tel: (011) 717-4500 Fax: (011) 717-4559
Email: 018lucy@muse.wits.ac.za

July 2009

Should you agree to allow your Students to participate in this study, their parents will be asked for their consent and to complete a demographic form. Your permission will also allow the researcher to administer a drawing task and a reading comprehension test to the students. These are standardized measures that allow the researcher to determine the affect of processing styles on reading comprehension. Participants are required to copy a figure presented in front of the class using colour pencils as well as read extracts from the assessment and answer the relevant multiple choice questions.

Each completed form and the test will only be identifiable to the researcher. Participants will be assigned confidential numbers, which will allow only the researcher to identify who completed which form / test. The information will be destroyed no later than 31st May 2010.

The above mentioned assessments are developmentally appropriate and after the completion of the study, all participants will be debriefed as deemed appropriate by the researcher. There is no risk to any participant involved in the study.

Participation in this study is **voluntary**, and refusal to participate will involve **no** penalty to the individuals or the school. Participants and the school may discontinue participation at any time without penalty.

AUTHORISATION: I have read the above and understand the nature of this study. I understand that I may contact the researcher (Shawn Rogers - 0825668126), or her supervisor (Enid Schutte - 082 920 6731), at any time.

I agree to allow the researcher to approach the students within the school, to request participation in this study. I understand that this consent form will be valid for 12 months from the date below.

Headmaster's signature: _____

Date: _____

Appendix 7
Results

Grade 4 results:

Chi squared tests:

1. Ethnicity affecting Stanford Literal vs Inferential

	Stanford reading comprehension test		
Ethnicity	Literal	Inferential	Total
White	8 36.36	3 42.86	11 37.93
African	14 63.64	4 57.14	18 62.07
Total	22 100	7 100	29 100

Pearson chi2(1) = 0.0951 Pr = 0.758

2. Gender affecting Stanford Literal vs Inferential

	Stanford reading comprehension test		
Gender	Literal	Inferential	Total
Male	8 34.78	7 100.00	15 50.00
Female	15 65.22	0 0.00	15 50.00
Total	23 100	7 100	30 100

Pearson chi2(1) = 9.1304 Pr = 0.003

3. Language affecting Stanford Literal vs Inferential

	Stanford reading comprehension test		
Home language	Literal	Inferential	Total
English	17 73.91	4 57.14	21 70.00
African	6 26.09	3 42.86	9 30.00
Total	23 100	7 100	30 100

Pearson chi2(1) = 0.7187 Pr = 0.397

4. ROCF strategy affecting Stanford Literal vs Inferential

	Stanford reading comprehension test		
ROCF strat	Literal	Inferential	Total
Traditional	10 41.67	4 57.14	14 45.16
Gestalt	7 29.17	2 28.57	9 29.03
Piecemeal	7 29.17	1 14.29	8 25.81
Total	24 100	7 100	31 100

Pearson chi2(2) = 0.7531 Pr = 0.686

5. Ethnicity affecting ROCF strategy

	ROCF strategy			
Ethnicity	Traditional	Gestalt	Piecemeal	Total
White	6 40.00	1 8.33	5 83.33	12 36.36
African	9 60.00	11 91.67	1 16.67	21 63.64
Total	15 100	12 100	6 100	33 100

Pearson chi2(2) = 9.8804 Pr = 0.007

6. Gender affecting ROCF strategy

	ROCF strategy			
Gender	Traditional	Gestalt	Piecemeal	Total
Male	6 40.00	6 50.00	4 57.14	16 47.06
Female	9 60.00	6 50.00	3 42.86	18 52.94
Total	15 100	12 100	7 100	34 100

Pearson chi2(2) = 0.6274 Pr = 0.731

7. Language affecting ROCF strategy

	ROCF strategy			
Home	Traditional	Gestalt	Piecemeal	Total

language				
English	11 73.33	6 50.00	6 85.25	23 67.65
African	4 26.67	6 50.00	1 14.29	11 32.35
Total	15 100	12 100	7 100	34 100

Pearson chi2(2) = 2.9732 Pr = 0.226

One -way ANOVA analyses:

1. **Ethnicity and Stanford comprehension total**

	Summary of Stanford comprehension total		
Ethnicity	Mean	Std.Dev	Freq
White	38.666667	7.4752116	12
African	32.571429	9.2766989	21
Total	34.787879	9.0476433	33

	Analysis of Variance				
Source	SS	df	MS	F	Prob>F
Between groups	283.705628	1	283.705628	3.77	0.0615
Within Groups	2335.80952	31	75.3486943		
Total	2619.51515	32	81.8598485		

Bartlett's test for equal variances: chi2(1) = 0.6086 Prob>chi2 = 0.435

2. **Gender on Stanford comprehension total**

	Summary of Stanford Total		
Gender	Mean	Std.Dev	Freq
Male	30.5625	9.7088877	16
Female	37.833333	7.3424631	18
Total	34.411765	9.1754536	34

	Analysis of Variance				
Source	SS	df	MS	F	Prob>F
Between groups	447.797794	1	447.797794	6.15	0.0186
Within Groups	2330.4375	32	72.8261719		
Total	2778.23529	33	84.1889483		

Bartlett's test for equal variances: chi2(1) = 1.2044 Prob>chi2 = 0.272

3. Language and Stanford comprehension total

	Summary of Stanford comprehension total		
Home language	Mean	Std.Dev	Freq
English	35.869565	8.8897507	23
African	31.363636	9.4262689	11
Total	34.411765	9.1754536	34

	Analysis of Variance				
Source	SS	df	MS	F	Prob>F
Between groups	151.081144	1	151.081144	1.84	0.1844
Within Groups	2627.15415	32	82.0985672		
Total	2778.23529	33	84.1889483		

Bartlett's test for equal variances: chi2(1) = 0.0461 Prob>chi2 = 0.830

4. Failures and Stanford comprehension total

	Summary of Stanford comprehension total		
Failures	Mean	Std.Dev	Freq
No	36.464286	7.0735927	28
Yes	26.4	12.177849	5
Total	34.939394	8.6129967	33

	Analysis of Variance				
Source	SS	df	MS	F	Prob>F
Between groups	429.714502	1	429.714502	6.85	0.0136
Within Groups	1944.16429	31	62.714977		
Total	2373.87879	32	74.1837121		

Bartlett's test for equal variances: chi2(1) = 2.4479 Prob>chi2 = 0.118

5. Mothers education and Stanford comprehension total

	Summary of Stanford comprehension total		
Mothers Education	Mean	Std.Dev	Freq
Tertiary	36.066667	6.9741018	15
secondary	33.473684	10.647735	19
Total	34.617647	9.1751136	34

	Analysis of Variance		

Source	SS	df	MS	F	Prob>F
Between groups	56.3592363	1	56.3592363	0.66	0.4216
Within Groups	2721.67018	32	85.052193		
Total	2778.02941	33	84.1827094		

Bartlett's test for equal variances: chi2(1) = 2.5683 Prob>chi2 = 0.109

6. <u>Fathers education and Stanford comprehension total</u>

	Summary of Stanford comprehension total		
Fathers Education	Mean	Std.Dev	Freq
Tertiary	34.444444	8.6311489	18
secondary	38.076923	7.0647191	13
Total	35.967742	8.0931406	31

	Analysis of Variance				
Source	SS	df	MS	F	Prob>F
Between groups	99.6002206	1	99.6002206	1.55	0.2233
Within Groups	1865.36752	29	64.323018		
Total	1964.96774	30	65.4989247		

Bartlett's test for equal variances: chi2(1) = 0.5291 Prob>chi2 = 0.467

7. <u>Ethnicity and literal scores</u>

	Summary of Stanford literal comprehension total		
Ethnicity	Mean	Std.Dev	Freq
White	20	3.7658755	12
African	17.285714	4.5402958	21
Total	18.272727	4.41781	33

	Analysis of Variance				
Source	SS	df	MS	F	Prob>F
Between groups	56.2597403	1	56.2597403	3.07	0.0897
Within Groups	568.285714	31	18.3317972		
Total	624.545455	32	19.5170455		

Bartlett's test for equal variances: chi2(1) = 0.4598 Prob>chi2 = 0.498

8. <u>Ethnicity and inferential scores</u>

	Summary of Stanford Inferntial comprehension total		
Race	Mean	Std.Dev	Freq
White	18.666667	4.2283316	12
Black	15.285714	5.2263071	21
Total	16.515152	5.0936309	33

	Analysis of Variance				
Source	SS	df	MS	F	Prob>F
Between groups	87.2900433	1	87.2900433	3.64	0.0656
Within Groups	742.952381	31	23.9662058		
Total	830.242424	32	25.9450758		

Bartlett's test for equal variances: chi2(1) = 0.5868 Prob>chi2 = 0.444

9. <u>Language and literal scores</u>

	Summary of Stanford Literal comprehension total		
Home Language	Mean	Std.Dev	Freq
English	19	4.1120665	23
African	16.181818	4.8128616	11
Total	18.088235	4.4813935	34

	Analysis of Variance				
Source	SS	df	MS	F	Prob>F
Between groups	59.0989305	1	59.0989305	3.13	0.0863
Within Groups	603.636364	32	18.8636364		
Total	662.735294	33	20.0828877		

Bartlett's test for equal variances: chi2(1) = 0.3400 Prob>chi2 = 0.560

10. <u>language and inferential scores</u>

	Summary of Stanford Inferential comprehension total		
Home Language	Mean	Std.Dev	Freq
English	16.869565	5.1549125	23
African	15.181818	5.1539923	11
Total	16.323529	5.1388042	34

	Analysis of Variance				
Source	SS	df	MS	F	Prob>F

Between groups	21.1961172	1	21.1961172	0.80	0.3784
Within Groups	850.245059	32	26.5701581		
Total	871.441176	33	26.4073084		

Bartlett's test for equal variances: chi2(1) = 0.0000 Prob>chi2 = 0.999

11. Gender and ROCF total

	Summary of ROCF total		
Gender	Mean	Std.Dev	Freq
Male	24.5625	5.6269441	16
Female	24.972222	3.1034716	18
Total	24.779412	4.4041839	34

	Analysis of Variance				
Source	SS	df	MS	F	Prob>F
Between groups	1.42197712	1	1.42197712	0.07	0.7912
Within Groups	638.673611	32	19.9585503		
Total	640.095588	33	19.396836		

Bartlett's test for equal variances: chi2(1) = 5.2979 Prob>chi2 = 0.021

12. Ethnicity and ROCF total

	Summary of ROCF total		
Race	Mean	Std.Dev	Freq
White	26.25	3.4476606	12
Black	23.97619	4.843749	21
Total	24.80303	4.4702828	33

	Analysis of Variance				
Source	SS	df	MS	F	Prob>F
Between groups	39.4816017	1	39.4816017	2.04	0.1632
Within Groups	599.988095	31	19.3544547		
Total	639.469697	32	19.983428		

Bartlett's test for equal variances: chi2(1) = 1.4608 Prob>chi2 = 0.227

13. ROCF strategies and SDRT total

	Summary of Stanford comprehension total	

ROCF strategy	Mean	Std.Dev	Freq
Traditional	35.333333	7.5938572	15
Gestalt	33.75	11.786934	12
Piecemeal	34.125	7.9000452	8
Total	34.514286	9.0598384	35

	Analysis of Variance				
Source	SS	df	MS	F	Prob>F
Between groups	18.2845238	2	9.1422619	0.11	0.9002
Within Groups	2772.45833	32	86.6393229		
Total	2790.74286	34	82.0806723		

Bartlett's test for equal variances: chi2(1) = 2.6783 Prob>chi2 = 0.262

14. ROCF strategies and SDRT literal

	Summary of Stanford comprehension total		
ROCF strategy	Mean	Std.Dev	Freq
Traditional	18.6	3.7947332	15
Gestalt	17.666667	5.7735027	12
Piecemeal	18.125	3.720119	8
Total	18.171429	4.4423478	35

	Analysis of Variance				
Source	SS	df	MS	F	Prob>F
Between groups	5.8297619	2	2.91488095	0.14	0.8697
Within Groups	665.141667	32	20.7856771		
Total	670.971429	34	19.7344538		

Bartlett's test for equal variances: chi2(1) = 2.6687 Prob>chi2 = 0.263

15. ROCF strategies and SDRT inferential

	Summary of Stanford comprehension total		
ROCF strategy	Mean	Std.Dev	Freq
Traditional	16.733333	4.4153412	15
Gestalt	16.083333	6.3023565	12
Piecemeal	16	4.7509398	8
Total	16.342857	5.0639607	35

	Analysis of Variance				
Source	SS	df	MS	F	Prob>F
Between groups	4.03571429	2	2.01785714	0.07	0.9285
Within Groups	867.85	32	27.1203125		
Total	871.885714	34	25.6436975		

Bartlett's test for equal variances: chi2(1) = 1.6349 Prob>chi2 = 0.442

Grade 10 results.

Chi squared tests:

1. **Ethnicity affecting Stanford Literal vs Inferential**

	Stanford reading comprehension test		
Race	Literal	Inferential	Total
White	11 39.29	5 29.41	16 35.56
Black	17 60.71	12 70.59	29 64.44
Total	28 100	17 100	45 100

Pearson chi2(1) = 0.4501 Pr = 0.502

2. **Gender affecting Stanford Literal vs Inferential**

	Stanford reading comprehension test		
Gender	Literal	Inferential	Total
Male	12 42.86	10 58.82	22 48.89
Female	16 57.14	7 41.18	23 51.11
Total	28 100	17 100	45 100

Pearson chi2(1) = 1.0792 Pr = 0.299

3. **Language affecting Stanford Literal vs Inferential**

	Stanford reading comprehension test		
Home language	Literal	Inferential	Total
English	20 71.43	8 42.11	28 59.57
African	8 28.57	11 57.89	19 40.43
Total	28 100	19 100	47 100

Pearson chi2(1) = 4.0413 Pr = 0.044

4. ROCF strategy affecting Stanford Literal vs Inferential

	Stanford reading comprehension test		
ROCF strat	Literal	Inferential	Total
Traditional	10 35.71	7 36.84	17 36.17
Gestalt	7 25.00	8 42.11	15 31.91
Piecemeal	11 39.29	4 21.05	15 31.91
Total	28 100	19 100	47 100

Pearson chi2(2) = 2.2208 Pr = 0.329

5. Ethnicity affecting ROCF strategy

	ROCF strategy			
Ethnicity	Traditional	Gestalt	Piecemeal	Total
White	11 61.11	6 37.50	2 12.50	19 38.00
African	7 38.89	10 62.50	14 87.50	31 62.00
Total	18 100	16 100	16 100	50 100

Pearson chi2(2) = 8.4984 Pr = 0.014

6. Gender affecting ROCF strategy

	ROCF strategy			
Gender	Traditional	Gestalt	Piecemeal	Total
Male	6 33.33	9 56.25	11 68.75	26 52.00

Female	12 66.67	7 43.75	5 31.25	24 48.00
Total	18 100	16 100	16 100	50 100

Pearson chi2(2) = 4.4271 Pr = 0.109

7. Language affecting ROCF strategy

	ROCF strategy			
Home language	Traditional	Gestalt	Piecemeal	Total
English	14 73.68	11 64.71	7 43.75	32 61.54
African	5 26.32	6 35.29	9 56.25	20 38.46
Total	19 100	17 100	16 100	52 100

Pearson chi2(2) = 3.3953 Pr = 0.183

One -way ANOVA analyses

8. Gender on Stanford comprehension total

	Summary of Stanford Total		
Gender	Mean	Std.Dev	Freq
Male	39.884615	9.3992635	26
Female	43.291667	8.0783079	24
Total	41.52	8.8692084	50

	Analysis of Variance				
Source	SS	df	MS	F	Prob>F
Between groups	144.867821	1	144.867821	1.87	0.1773
Within Groups	3709.61218	48	77.2835871		
Total	3854.48	49			

Bartlett's test for equal variances: chi2(1) = 0.5340 Prob>chi2 = 0.465

9. Gender and ROCF total

	Summary of ROCF total	

Gender	Mean	Std.Dev	Freq
Male	26.115385	4.7964731	26
Female	26.375	4.0946678	24
Total	26.24	4.4299998	50

	Analysis of Variance				
Source	SS	df	MS	F	Prob>F
Between groups	.841153846	1	.841153846	0.04	0.8384
Within Groups	960.778846	48	20.016226		
Total	961.62	49	19.624898		

Bartlett's test for equal variances: chi2(1) = 0.5823 Prob>chi2 = 0.445

10. <u>Ethnicity and Stanford comprehension total</u>

	Summary of Stanford comprehension total		
Ethnicity	Mean	Std.Dev	Freq
White	45.526316	6.7195273	19
African	39.064516	9.2193112	31
Total	41.52	9.2193112	50

	Analysis of Variance				
Source	SS	df	MS	F	Prob>F
Between groups	491.87219	1	491.87219	7.02	0.0109
Within Groups	3362.60781	48	70.0543294		
Total	3854.48	49	78.6628571		

Bartlett's test for equal variances: chi2(1) = 2.0596 Prob>chi2 = 0.151

11. <u>Ethnicity and ROCF total</u>

	Summary of ROCF total		
Ethnicity	Mean	Std.Dev	Freq
White	28.184211	3.5008353	19
African	25.048387	4.5650024	31
Total	26.24	4.4299998	50

	Analysis of Variance				
Source	SS	df	MS	F	Prob>F
Between groups	115.837317	1	115.837317	6.57	0.0135
Within Groups	845.782683	48	17.6204726		
Total	961.62	49	19.624898		

Bartlett's test for equal variances: chi2(1) = 1.4684 Prob>chi2 = 0.226

12. Language and Stanford comprehension total

	Summary of Stanford comprehension total		
Home language	Mean	Std.Dev	Freq
English	43.90625	7.1091008	32
African	37.5	9.7737565	20
Total	41.442308	8.7299652	52

	Analysis of Variance				
Source	SS	df	MS	F	Prob>F
Between groups	505.108173	1	505.108173	7.47	0.0087
Within Groups	3381.71875	50	67.634375		
Total	3886.82692	51	76.2122926		

Bartlett's test for equal variances: chi2(1) = 2.4196 Prob>chi2 = 0.120

13. Failures and Stanford comprehension total

	Summary of Stanford comprehension total		
Failures	Mean	Std.Dev	Freq
No	42.536585	8.0996838	41
Yes	36.6	10.362325	10
Total	41.372549	8.8021833	51

	Analysis of Variance				
Source	SS	df	MS	F	Prob>F
Between groups	283.326447	1	283.326447	3.87	0.0549
Within Groups	3590.59512	49	73.2774515		
Total	3873.92157	50	77.4784314		

Bartlett's test for equal variances: chi2(1) = 0.9486 Prob>chi2 = 0.330

14. Mothers education and Stanford comprehension total

	Summary of Stanford comprehension total		
Mothers Education	Mean	Std.Dev	Freq
Tertiary	44.071429	8.9911434	14
secondary	41.15	9.0801982	20
Total	42.352941	9.0248222	34

	Analysis of Variance				
Source	SS	df	MS	F	Prob>F
Between groups	70.2861345	1	70.2861345	0.86	0.3609
Within Groups	2617.47857	32	81.7962054		
Total	2687.76471	33	81.4474153		

Bartlett's test for equal variances: chi2(1) = 0.0015 Prob>chi2 = 0.970

15. <u>Fathers education and Stanford comprehension total</u>

	Summary of Stanford comprehension total		
Fathers Education	Mean	Std.Dev	Freq
Tertiary	42.714286	7.9074315	14
secondary	46.416667	9.356168	12
Total	44.423077	8.635615	26

	Analysis of Variance				
Source	SS	df	MS	F	Prob>F
Between groups	88.5723443	1	88.5723443	1.20	0.2848
Within Groups	1775.77381	24	73.9905754		
Total	1864.34615	25	74.5738462		

Bartlett's test for equal variances: chi2(1) = 0.3252 Prob>chi2 = 0.569

16. <u>Ethnicity and literal scores</u>

	Summary of Stanford literal comprehension total		
Ethnicity	Mean	Std.Dev	Freq
White	23.421053	4.2073453	19
African	19.903226	5.4672043	31
Total	21.24	5.27048	50

	Analysis of Variance				
Source	SS	df	MS	F	Prob>F
Between groups	145.778744	1	145.778744	5.76	0.0203
Within Groups	1215.34126	48	25.3196095		
Total	1361.12	49	27.7779592		

Bartlett's test for equal variances: chi2(1) = 1.4313 Prob>chi2 = 0.232

17. Ethnicity and inferential scores

	Summary of Stanford Inferntial comprehension total		
Ethnicity	Mean	Std.Dev	Freq
White	22.105263	3.0165237	19
Black	19.16129	4.2747068	31
Total	20.28	4.0760125	50

	Analysis of Variance				
Source	SS	df	MS	F	Prob>F
Between groups	102.096978	1	102.096978	6.88	0.0116
Within Groups	711.983022	48	14.8329796		
Total	814.08	49	16.6138776		

Bartlett's test for equal variances: chi2(1) = 2.4819 Prob>chi2 = 0.115

18. Language and literal scores

	Summary of Stanford Literal comprehension total		
Home Language	Mean	Std.Dev	Freq
English	22.71875	4.1522196	32
African	18.6	5.8255336	20
Total	21.134615	5.216974	52

	Analysis of Variance				
Source	SS	df	MS	F	Prob>F
Between groups	208.788942	1	208.788942	8.85	0.0045
Within Groups	1179.26875	50	23.585375		
Total	1388.05769	51	27.2168175		

Bartlett's test for equal variances: chi2(1) = 2.7407 Prob>chi2 = 0.098

19. Language and inferential scores

	Summary of Stanford Inferential comprehension total		
Home Language	Mean	Std.Dev	Freq
English	21.1875	3.4495208	32
African	18.9	4.494441	20
Total	20.307692	4.0026386	52

	Analysis of Variance				
Source	SS	df	MS	F	Prob>F
Between groups	64.4019231	1	64.4019231	4.28	0.0438
Within Groups	752.675	50	15.0535		
Total	817.076923	51	16.0211161		

Bartlett's test for equal variances: chi2(1) = 1.6659 Prob>chi2 = 0.197

20. **ROCF strategies and SDRT total**

	Summary of Stanford comprehension total		
ROCF strategy	Mean	Std.Dev	Freq
Traditional	42.894737	9.3802081	19
Gestalt	41	9.6760012	17
Piecemeal	40.1875	7.0068	16
Total	41.442308	8.7299652	52

	Analysis of Variance				
Source	SS	df	MS	F	Prob>F
Between groups	68.5999494	2	34.2999747	0.44	0.6464
Within Groups	3818.22697	49	77.9229995		
Total	3886.82692	51	76.2122926		

Bartlett's test for equal variances: chi2(2) = 1.7572 Prob>chi2 = 0.415

21. ROCF strategies and SDRT literal

	Summary of Stanford comprehension total		
ROCF strategy	Mean	Std.Dev	Freq
Traditional	21.842105	6.0024362	19
Gestalt	20.470588	5.6360186	17
Piecemeal	21	3.7771241	16
Total	21.134615	5.216974	52

	Analysis of Variance				
Source	SS	df	MS	F	Prob>F
Between groups	17.2960824	2	8.6480412	0.31	0.7355

Within Groups	1370.76161	49	27.9747267		
Total	1388.05769	51	27.2168175		

Bartlett's test for equal variances: chi2(1) = 3.4196 Prob>chi2 = 0.181

22. ROCF strategies and SDRT inferential

	Summary of Stanford comprehension total		
ROCF strategy	Mean	Std.Dev	Freq
Traditional	21.052632	3.7189258	19
Gestalt	20.529412	4.4316708	17
Piecemeal	19.1875	3.8508657	16
Total	20.307692	4.0026386	52

	Analysis of Variance				
Source	SS	df	MS	F	Prob>F
Between groups	31.4567605	2	15.7283803	0.98	0.3822
Within Groups	785.620163	49	16.0330645		
Total	817.076923	51	16.0211161		

Bartlett's test for equal variances: chi2(1) = 0.5690 Prob>chi2 = 0.752