

https://dspace.org/

Exploring the relationship between language experience and the cognitive functions: divergent thinking and working memory in linguistically diverse adoleecents

Anthony, Kirstin

2018

https://hdl.handle.net/10539/27105

Anthony, Kirstin Joan (2018) Exploring the relationship between language experience and cognitive functions: divergent thinking and working memory in linguistically diverse adolescents, University of the Witwatersrand, Johannesburg, https://hdl.handle.net/10539/27105

Downloaded from a DSpace repository. https://dspace.org/

Psychology
School of Human & Community Development
Private Bag 3, Wits 2050, South Africa. Telephone: +27 11-717-4500/2/3/4. Fax: +27-11-717-4559

Masters Research Report

Exploring the relationship between language experience and the cognitive functions: divergent thinking and working memory in linguistically diverse adolescents

By: Kirstin Anthony
Supervised by: Aline Ferreira Correia

A research project submitted in partial fulfilment of the requirements of MA in Psychology by Course Work and Research Report in the Faculty of Humanities, University of the Witwatersrand, Johannesburg.

Declaration

I, Kirstin Anthony, declare that this research project is my own, unaided work. It has not been submitted before any other degree or examination at this or any other university.

_____

Kirstin Anthony

Date: 13 July 2018

Masters Psychology: Research Report
Plagiarism Declaration Cover Page

Surname: Anthony

First name/s: Kirstin Joan

Student no.: 385411

Course Code: PSYCH7022

Supervisor: Aline Ferreira Correia

Research Report due date:

TWO BOUND copies **of the Research Report must be submitted**

Declaration

I, Kirstin Anthony, know and accept that plagiarism (i.e., to use another's work and to pretend that it is one's own) is wrong. Consequently, I declare that

- the following research report is my own work.
- I have correctly acknowledged all direct quotations **and** paraphrased ideas/ content. **In addition** I have provided a complete, alphabetised reference list, as required by the APA method of referencing.
- I have not allowed, and will not allow, anyone to copy my work with the intention of passing it off as his or her own work.
- the word count (excluding the Reference List) given above is correct.

Signed: _____

Date:

Table of Contents

Acknowledgments **1**

Abstract **2**

Chapter 1: Introduction **3**

Chapter 2: Literature Review **5**
2.1 Language Experience **5**
2.2. Working Memory **8**
2.3 Divergent Thinking **11**
2.2.1 Rationale **17**
2.3.1 General Aims **18**
2.4.1 Research Questions **19**
2.5.1 Hypothesis **19**

Chapter 3: Methodology **20**
3.1 Research Design **20**
3.2 Sample and Sampling **20**
3.3. Instruments **21**
3.3.1 Demographic Questionnaire 21
3.3.2 Selective Questions of the Language Experience and Proficiency Questionnaire (LEAP-Q) 22
3.3.3 The Oral Expression of the Wechsler Individual Achievement Test – Third Edition (WIAT –III) 23
3.3.4 Working Memory Inventory of the Wechsler Intelligence Scale for Children Revised - Fifth Edition (WISC-V) 23
3.4 Procedure **27**

Chapter 4: Results **29**
4.1 Language Descriptives **30**
4.2 Testing for Normality **32**
4.3 Correlations **32**
4.3.1 Validity of the Selective Questions of the LEAP-Q 33
4.3.2. Correlation of Language Experience and Working Memory 34
4.3.3 Correlation of Language Experience and Divergent Thinking 35
4.3.4 Working Memory and Divergent Thinking 35
4.3.5 Correlations of certain demographic variables and the cognitive functions, working memory and divergent thinking 37

Chapter 5: Discussion and Conclusion **38**
5. 1 Discussion **38**
4.2 Conclusion **43**
4.3 Limitations of the Study and Recommendations for Future Research **44**

Reference List **47**

Appendix 1: Demographic Questionnaire **57**

Demographic Questionnaire **57**

Appendix 2: Selective Questions of the Language Experience and Proficiency Questionnaire (LEAP-Q) **59**

Appendix 3: Letter to the Principle **61**

Appendix 4: Parent/Guardian Information Sheet **63**

Appendix 5: Consent Form **65**
Appendix 6: Respondents Information Sheet **67**
Appendix 7: Assent Form **68**
Appendix 8: Permission from Private School Principle **69**
Appendix 9: Ethics Certificate **70**

Table of Figures

Figure 1: The modified Multi-Component Model of Working Memory (Baddeley, 2000). 9
Figure 2: Hypothetical illustration of divergent thinking components: fluency, originality, flexibility, and elaboration (Akbari Chermahini, 2011) 12

Table of Tables

Table 1.1.1. The demographic frequencies (%) of the government and private school respondents..... 20

Table 1.2.1 Mean results for the number of acquired languages and overall English proficiency for government and private school respondents..... 30

Table 1.3.1 Language proficiency of each language for government and private school respondents..... 31

Table 1.4.1 Language frequencies (%) of the government and private school respondents..... 31

Table 2.1.1 Correlations of the Oral Expression, the selective questions of the LEAP-Q and number of acquired languages 33

Table 2.2.1 Correlations of language experience (language acquisition and proficiency) and working memory subtests and total..... 34

Table 2.3.1 Correlation of language experience (language acquisition and proficiency) and AUT scores..... 35

Table 2.4. 1 Correlations of AUT scores and working memory subtests and total 36

Table 2.5.1 Correlations of gender/age/school type and the AUT scores and overall working memory total 37

Acknowledgments

I would like to acknowledge the contribution of the following individuals to this study:

To my supervisor Aline Ferreira Correia, thank you for your guidnace and sharing your knowledge and insight with me.

To the co-researcher Jaime Abrahams, thank you for the assistance in the macro study as well as for the support you have given me during the course of the year.

To my mother, Jacqueline Anthony and my sister, Bianca Anthony, thank you for allowing me to continue to study and dream big. I appreaciate the encouragement, love and support you both have given me throughout this study as well as in everything that I do.

To my unlce, Wayne Hatton-Jones and aunt, Debby Hatton-Jones, for supporting me through my studies and allowing me to achieve my goals.

To Raquel De Canha, Eva Kirsch, Luis Ferreira, Stephen Teixeira, Natasha Maio and Roberto Teixeira, thank you for going above and beyond friendship. I appreciate all the support and encouragement you have all shown me.

Research Report has been approved for MA degree in Psychology by the University.

Abstract

This study aimed to contribute to understanding the association between language experience and the cognitive functions, working memory and divergent thinking. There is a gap in literature when it comes to these cognitive constructs even though there is extensive evidence for language acquisition as an influential factor in other cognitive functions. As bi/multilingualism is a South African norm it is significant to explore the effect it has on working memory and divergent thinking constructs that are needed to successfully function in life. The sample consisted of 69 learners aged between 12 and 14 years of age from a private and government school in the Johannesburg area. The learners between spoke two and five languages determined by the selective questions of the Language Experience and Proficiency Questionnaire. (LEAP-Q). Language experience was measured according to the number of acquired languages and the reported proficiency of each language. These were correlated with the scores from the following instruments: the Working Memory Inventory (WMI) from the Wechsler Intelligence Scale for Children – Fifth Edition, and the Alternate User Test (AUT). The study concluded that language experience (both acquired language and language proficiency) did not correlate with any of the working memory subtests or total working memory, yet there was a negative association between language acquisition and the AUT scores for the government school. The government school respondents also demonstrated a positive correlation between their Alternate User Test (AUT) scores and the picture span subtest and total working memory. The study also found that the demographic variable age is significant when it comes to the total working memory and the AUT task. As a means of confirming the validity of the selective questions of the LEAP-Q, it was correlated against a benchmark test, the Oral Expression of the WIAT-III, which indicated that the test might not be a reliable measure of language proficiency. The possibility of these results was discussed as well as the limitations of the study as a means to improve future research in this area.

Research Report has been approved for MA degree in Psychology by the University.

Chapter 1: Introduction

Human beings are constantly surrounded by language in nearly everything that they do. It is an essential part of existence as it allows one to understand their place in the world and gives life meaning. Language is an instrument for communicating thoughts and ideas as well as connecting with others. In most global societies more than one language is being operationalised, producing bi/multilingual individuals. Therefore, the consequences of knowing more than one language have on cognitive processes involved in daily life become a topic of great interest (Marian & Shook, 2012).

Cognitive processes such as working memory and divergent thinking seem to share common practices with language acquisition. These cognitive processes have been found to be associated to language experience as working memory is important to communication skills (Alloway, 2014) and divergent thinking has been linked to language acquisition and proficiency (Baker, 1988; Haarmann, O'Rourke, & Ragusa, 2013). However, there is a notable gap in the literature concerning research that pertains to the relationship between language experience, working memory and divergent thinking.

We, as humans, are constantly faced with having to remember information as well as generate multiple solutions to situations. Learning environments favour having the ability to retain, manipulate and recall information efficiently. The ability to temporarily store information such as a person's name, directions and something someone has said is the cognitive function working memory. It is a concept that is rewarded because it is considered to be necessary to perform successfully in daily living and is a significant classroom skill (Alloway, 2014).

The ability to provide more than one approach to a problem is a valuable concept in being considered creative (Reynolds & Fletcher–Janzen, 2007). However, just providing multiple answers is an insufficient method of solving the problem, as the solution needs to be reduced to one correct answer (convergent thinking) (Webb, Little, Cropper & Roze, 2017). This is why academic environments and aspects of society such as the workforce do not often encourage original ideas and divergent solutions; instead, they reward the concept of providing one correct answer for a

Research Report has been approved for MA degree in Psychology by the University.

problem (Reynolds & Fletcher –Janzen, 2007). Although divergent thinking is not a concept that is highly valued, it is significant to have the ability to produce new ideas that have not previously been explored, which allow for society to develop and grow (Guilford, 1967). The under-valuing of this cognitive function has not provided an interest in research, allowing the study to take advantage of the gap in the literature by exploring divergent thinking and areas that have been extensively investigated.

The current international studies exploring the relationship between languages, divergent thinking, and working memory do not have samples that have similar characteristics to the South African population. Diversity in language is easily available in South African populations and is suitable for exploring any connection it may have to working memory and divergent thinking. Learners in South Africa are exposed to various languages on a daily basis. Most of these educational environments have English as the medium of instruction (Alexander, 2013), but classrooms are still multilingual in nature as other languages are used for conversational purposes (Hacksley, Jeffery, Mesthrie, Reddy, Wildsmith-Cromarty, 2007). Therefore, the population provides an opportunity to contribute to research in this area in a setting where language is an essential part of society.

The study aims to explore the relationship between language experience and the cognitive functions of working memory and divergent thinking with a South African sample aged between 12 and 14 years from a government and private school. The aims were explored using a common language proficiency questionnaire and well supported cognitive tests.

Research Report has been approved for MA degree in Psychology by the University.

Chapter 2: Literature Review

2.1 Language Experience

Language experience is a term used by the study that includes aspects of language such as language acquisition and language proficiency. Language experience is a central part of communication that is determined by values, cultural environments and language exposure (Martí, et al., 2005).

Language is a complex phenomenon, initiating various approaches to classifying the number of languages acquired. The categorical approach refers to language acquisition according to rigid categories of monolingual, bilingual or multilingual. These categories are defined according to the number of languages one claims to have developed (Cenoz & Genesee, 1998). Chomsky's linguistic paradigm falls into this homogeneous approach and views language competence as being in a constant position and based on linguistic performance. However, this rigid approach may be unrealistic and critiqued for not accounting for code switching and an individual's ability to manipulate language according to their environment (Locke, 2011). Therefore, a more non-categorical, continuous approach should be taken.

One such non-categorical, continuous view is the Dynamic Model of Multilingualism (DMM) by Herdina and Jessner (2002), stating that language is a non-linear process and that language systems are interdependent. This model takes a dynamic approach by viewing language as constantly being in motion, caused by the social demands placed on the individual. These social demands result in outcomes, such as language maintenance and language loss - consequences of change. In order for language knowledge to be sustained, it has to be used constantly, thus demonstrating an association between language use and language maintenance. Language use is determined by the environment, language aims, and social demands. A consequence of lack of maintenance is language attrition. This kind of 'loss' of language or 'up keep' of language determines one's proficiency of that language.

When considering the usage of languages it is also important to review the proficiency of these languages (Cenoz & Genesee, 1998). The degree of proficiency

Research Report has been approved for MA degree in Psychology by the University.

is established according to the individual's ability to communicate in a specific language across a range of areas as well as the capability to alternate languages according to the demands of their surroundings (Webb, 2002, Kemp 2009).

Lambert and associates (refer to Lambert, Havelka, & Gardner, 1959 and Peal, & Lambert, 1962) described proficient bi/multilingualism according to the measure of equivalence between languages by using the terms balanced and unbalanced. Balanced bilinguals present similar levels of proficiency in both languages (Schwieter, 2016) as well as the ability to respond in a similar speed (time) in both their first language and second language (Chin & Wigglesworth, 2007). This is a fractional view of language acquisition and considers being bilingual as having developed two independent languages – both languages being equivalent to the proficiencies of two monolinguals (Cenoz & Genesee, 1998).

Unbalanced bilinguals have a higher proficiency in one language (Schwieter, 2016) and there is a considerable difference in the response speeds (time) between their two languages (Chin & Wigglesworth, 2007). These notions and views on bilingual proficiency can be extended to multilingual acquisition and proficiency. According to Bialystok (cited in Kecskes & Albertazzi, 2007) bilinguals have a cognitive advantage regardless of the individual's degree of bilingualism. Ricciardelli (1992) is an opposing position to Bialystok, as a certain level of language competency is required in order for there to be any meaningful advantage and that there is a distinct bilingual advantage only in higher proficient bilinguals. Another factor that needs to be considered when looking at proficiency is the age of acquisition. The critical period hypothesis is built on the assumption that age of acquisition affects second language (L2) proficiency (Bialystok, 1997; Bialystok & Hakuta, 1998).

An assessment that is used to capture the proficiency and daily use of language is the Language Experience and Proficiency Questionnaire (LEAP-Q). It is an instrument that determines proficiency through self-report and allows a linguistic profile to be established based on linguistic history and exposure (Marian, Blumenfeld & Kaushanskaya, 2007). Self-report has been described as being beneficial when it comes to assessments because they are time efficient and they parallel the individual's

Research Report has been approved for MA degree in Psychology by the University.

actual linguistic performance. It also does not include non-linguistic elements that are often found in objective assessments (Gertken, Amengual & Birdsong, 2014).

Therefore, according to this study language experience is based on the non-categorical continuous approach and language proficiency. The term bi/multilingualism will be used to describe language acquisition as language use and proficiency will be based according to self-report and determined by the individual.

In South Africa, the language of instruction in most educational institutions is English, even though for the majority of the population their first language is one of the country's African languages (Alexander, 2013). There often is no formal learning when it comes to African languages but they are spoken in various informal environments (Hacksley, et al., 2007). Therefore, there is the possibility that South African individuals will be unbalanced bi/multilinguals. Making the assessment of language acquisition and proficiency essential when investigating a relationship between language and cognitive processes.

Research has shown that it is not the number of languages that an individual passively knows, but it is how the languages are used that gives the individual a cognitive advantage. There has been increased interest in the relationship between the number of languages acquired and cognitive functions and whether there is a cognitive advantage of being bi/multilingual (Bialystok, 2005; Byrd, 2012; Marian & Shook, 2012;). Hakuta and Diaz (1985) investigated whether individuals with enhanced cognitive abilities are inclined to learn more than one language, or if being bilingual enhances cognitive ability. They tested bilingual's cognitive ability with the Raven's Progressive Matrices. The study concluded that the degree of bilingual proficiency predicted cognitive ability. Therefore, the proficiency of language (being bilingual) affects one's cognitive performance; this could mean that higher cognitive performance could result in greater ability to acquire more than one language.

Research has also provided evidence that knowing more than one language puts bilinguals at a disadvantage when it comes to language fluency (Sandoval, Gollan, Ferreira, Salmon, 2010). The Oral Expression of the Wechsler Individual

Research Report has been approved for MA degree in Psychology by the University.

Achievement Test-Third Edition (WIAT-III) is a means of measuring language fluency and an individual's ability to retrieve words. Therefore, the study uses the oral expression as an instrument for checking the validity of self-reporting in the Leap-Q.

Other studies have agreed that bilinguals have an advantage when it comes to cognitive control processes (Bialystok, 1999; Bialystok & Viswanathan, 2009; Craik & Bialystok, 2005). Language experience has also been linked to other cognitive functions that also involve cognitive control such as working memory and divergent thinking.

2.2. Working Memory

The theoretical concept of working memory suggests that there is a system of restricted capacity whose purpose is the short-term storage and maintenance of visual and auditory stimuli (Baddeley, 2010). It seems that age may affect aspects associated with working memory such as attentional resources, time taken to process information and inhibitory control (Glisky, 2007).

Miller, Galanter & Pribram were the first to introduce the term 'working memory', and in the 1960s various models were developed regarding the concept of short-term memory (Baddeley, 2010). Although many other equally feasible models exist, one of the most well-known and best-fit models for working memory experiments is Baddeley and Hitch's (1974) Multi-Component Model of Working Memory. The influential model states that the temporary senses process environmental stimuli into limited short-term storage.

The Multi-Component Model of Baddeley and Hitch (1974) works on the notion that working memory is made up of components that temporarily stores phonological and visuospatial information. The initial model consisted of three subsystems: the central executive, the visuospatial sketchpad, and the phonological loop. The phonological loop is the most developed subsystem of the model. Temporary auditory information is stored in the loop; however, unless the information is rehearsed it will deteriorate within a few seconds. There are two components that make up the phonological loop,

the phonological store, and the articulatory rehearsal, which are necessary for speech perception and production. The loop is also a valuable system in second (or more) language acquisition. The visuospatial sketchpad is involved in the limited storage of visual and spatial information. The central executive controls the coordination of the phonological loop and visuospatial sketchpad. It manipulates the information that is being temporarily held in these systems (Baddeley, 2000).

However, it was found that there were particular irregularities with the model where some phenomena do not fit into the model, and therefore needed to be modified with another subsystem, the episodic buffer. The modified model can be seen in Figure 1, as taken directly from Baddeley's (2000). The episodic buffer is a subsystem store and assimilates information from different sources in a multidimensional code (Baddeley, 2000). This model also accounts for remembering sequential digits such as those used in the Digit Span of the Working Memory Inventory (WMI) in the Wechsler Intelligence Scale for Children – Fifth Edition (WISC-V). The phonological loop is necessary for the remembering of such sequential information.

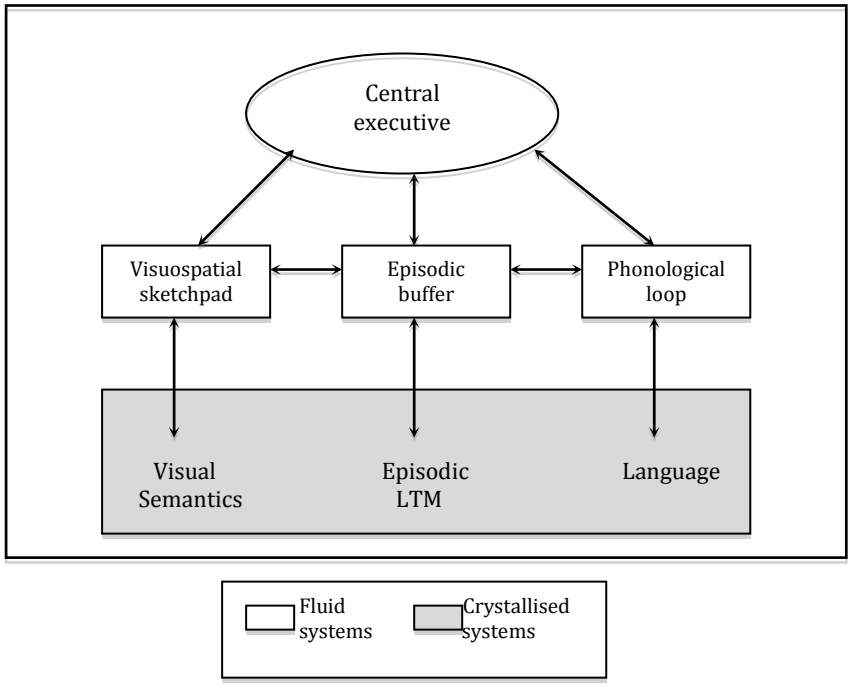


Figure 1: The modified Multi-Component Model of Working Memory (Baddeley, 2000).

The further development of the model also states that the phonological loop is involved in the language processing system and it is not just a linguistic storage space

Research Report has been approved for MA degree in Psychology by the University.

(Baddeley, 2010). It has been proposed that a strong association exists between the phonological loop and language skills, phonological learning, vocabulary development and foreign language acquisition. The evidence to support a relationship between this working memory component and language has been demonstrated in children who have greater vocabularies (receptive and expressive) performing better in phonological working memory tasks (Adams & Willis, 2001). The phonological loop also seems to be essential for learning to generate new words. The type of word is influential in the short-term storage, such as if there is difficulty in recalling words immediately if they sound similar as well as when the length of the words increase. Contrarily, when the words have a similar meaning it does not have a negative effect on immediate recall (Baddeley, 2010).

Deficits in these cognitive areas also demonstrate a possible relationship between them. If a child has working memory impairment and cannot maintain phonological information in their working memory, there are negative consequences for language such as, difficulty in gaining new language knowledge (Adams & Willis, 2001; Baddeley, 2010). However, there is contradictory evidence that shows that older children with phonological loop deficits but adequate executive processes can manage acquiring language (Baddeley, 2010). Therefore, this could suggest that if there is a deficit in the phonological loop the executive processes assist in language acquisition. Although this is not an aim of the research it demonstrates a link between language acquisition and working memory and age and working memory. As children grow older their phonological loop abilities increase such as being able to maintain more information, the rate of memory scanning needed in retrieval and output of information. Children younger than the age of seven usually depend on the visuospatial sketchpad; however, after seven years of age unprompted rehearsal occurs and picture type material is recoded into phonological structures. Therefore, working memory seems to follow a developmental trajectory from around the age of six to adolescence (Gathercole, Pickering, Ambridge, & Wearing, 2004).

Working memory's executive control is an essential aspect needed to hold, maintain and manipulate information. (Baddeley, 2000; Engle, 2010). Bialystok and Viswanathan (2009) researched the executive control of 8-year-old bilinguals with the anti-saccade task called the face task. The study had three groups: bilinguals from

Research Report has been approved for MA degree in Psychology by the University.

India, bilinguals from Canada and monolingual from Canada. Their study found that both bilingual groups performed faster in inhibitory control and cognitive flexibility (also see Bialystok, Craik & Ryan, 2006). This suggests that bilnguals perform bettter in certain aspects of working memory.

Calvo, Ibáñez and García (2016) reviewed research in the area and concluded that bilingualism does not improve working memory as a whole but enhances specific features. However, there have been studies that have demonstrated no difference between monolinguals and individuals that have acquired more than one language when it comes to working memory. de Abreu (2011) conducted a longitudinal study to examine whether working memory was affected by bilingualism. The sample consisted of 44 bilingual and monolingual, whose working memory was tested with simple span and complex span tasks. They found that over the three years there was no difference between the monolingual and bilingual individuals on the development of working memory, suggesting that controlling several languages does not affect their working memory (also see Bialystok, Craik & Luk, 2008; Namazi & Thordardottir, 2010). Yet, this aspect of control is also common in divergent thinking, as cognitive control is needed to shift between ideas (Hommel, Colzato, Fischer & Christoffels, 2011).

2.3 Divergent Thinking

Divergent thinking has been defined within the paradigm of cognitive theory as an individual's ability to produce original ideas (Runco & Acar, 2012). It is a developmental concept yet it is unclear how age affects one's ability to produce divergent thoughts (Palmiero, Giacomo & Passafiume, 2014). This cognitive function was first introduced by Binet through tests such as the Sentence Invention and Ink Blots (Binet & Henri, 1896) as a means of measuring the development of open-ended, multiple solutions - what is now considered as divergent thinking (Barron & Harrington, 1981). Fluency as a mental ability was later introduced in 1927 by Hargreaves (in Runco, 1991). However, it is Guilford that is often known as the pioneer of divergent thinking even though his research was only many years later. As a leading researcher in the field, Guilford (1967) states that divergent thinking is a fundamental part of creativity and creativity cannot be observed in unity, but instead

Research Report has been approved for MA degree in Psychology by the University.

should be considered as a collection of different components, such as divergent thinking and convergent thinking and the dimensions of which they consist.

Divergent thinking is the ability to generate ideas from various sources of knowledge to establish one's place in the world and it is a productive-thinking factor that is essential during all stages of the creative process. Guilford considered creativity as the notion of thinking 'outside the box' (Guilford, 1967). This ability to generate ideas encompasses four elements: a) originality is the ability to produce unique, novel ideas and considered a major component of creativity, b) fluency is being able to produce many ideas, c) the diversity of these ideas from abstract categories is termed flexibility, and d) elaboration - when an individual has the ability to follow an associative pathway for some distance (Runco & Acar, 2012). These four elements of divergent thinking were illustrated by Akbari Chermahini (2011) showing fluency (number of circles), flexibility (same shading of circles), originality (black circle) and elaboration (size of the circle) (refer to Figure 2). Therefore, divergent thinking is an element of creativity and yet, there is contradictory research where divergent thinking has been defined as a concept equal to creativity.

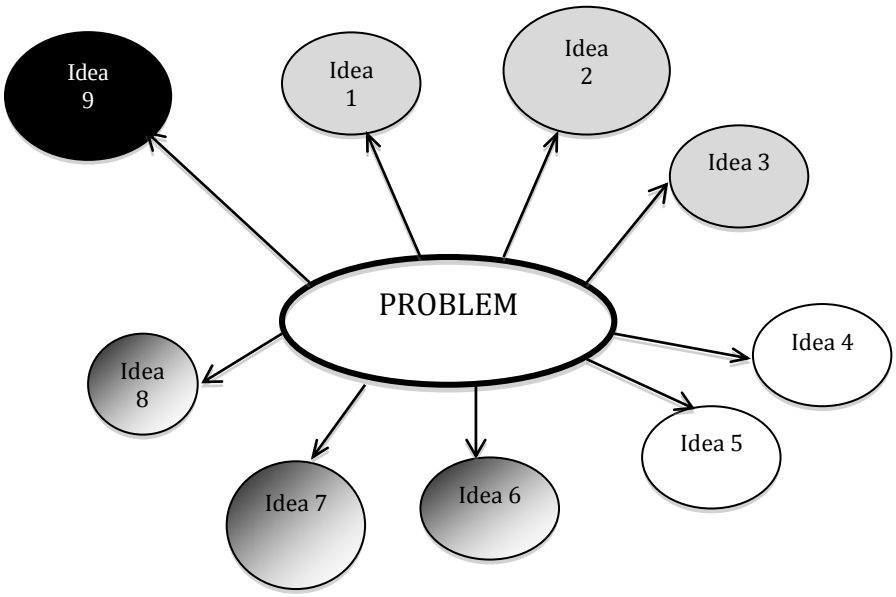


Figure 2: Hypothetical illustration of divergent thinking components: fluency, originality, flexibility, and elaboration (Akbari Chermahini, 2011)

Research Report has been approved for MA degree in Psychology by the University.

Over the years the concept of creativity and divergent thinking has been a great point of interest. For the most part Guilford's notion of divergent thinking has been supported; however, there has been contradictory research, where divergent thinking has been defined as a concept equal to creativity. There is the common notion that creativity and orginality are practically the same and divergent thinking tests are considered to be a reliable indicator of creativity as a whole (Gruber, & Bödeker, 2005). However, Runco and Acar (2012), state that someone does not have to perform or participate in creative activities in order to do well in divergent thinking tests. Divergent thinking tests provide a potential estimate of creativity (Runco & Acar, 2012).

Guilford, Christensen, Merrifield & Wilson (1960) designed the Alternate Uses Test as a means of measuring divergent thinking. This test can be seen as a measurement of creativity. Over the next 20 years, there was great investment in divergent thinking tests, with contradictory evidence on their ability to measure creative performance. Barron & Harrington (1981) reviewed studies, investigating divergent thinking, available up to the date of their review, in order to comment on the validity of divergent thinking tests. More than 70 studies concluded significant positive relationships between the results of divergent thinking tests and tasks that do not measure creative performance or achievement. Their review also concluded that divergent thinking scores often fail to correlate significantly with tasks of creative performance or achievement. Therefore, indicating that divergent thinking is not synonomous with creativity. The AUT measures and is scored according to the components that Guilford (1960) used to define divergent thinking: fluency, originality, flexibility, and elaboration. These components involve various cognitive aspects, working simultaneously to provide various original ideas or solutions.

Divergent thinking processes allow an individual to change from one thought to another without being influenced. This type of cognition requires 'weakly' distributed cognitive control; the same cognitive processes involved in operating more than one language (Hommel, et al., 2011). Hommel, et al., (2011) hypothesised that, since inhibitory skills are positively influenced by bilingualism, it should evidently result in greater divergent thinking abilities. Their investigation demonstrated contradictory

Research Report has been approved for MA degree in Psychology by the University.

results, by revealing that being bilingual does not have a positive effect on divergent thinking. Therefore indicating that bilinguals do not have a cognitive advantage when it comes to divergent thinking abilities. This study went beyond language acquisition and also investigated the effect of language proficiency on divergent thinking. Bilinguals that have a low proficiency perform better in the Alternate User Test (AUT) than highly proficient bilinguals.

Kharkhurin's (2007, cited in Kecskes & Albertazzi, 2007) study demonstrated different results to Hommel et al., (2011) by illustrating that high-proficient bilinguals are more successful in managing various ideas during the thought process, as high language proficiency correlates positively with the elaboration process. This study is in agreement with the previously mentioned claim under 'language experience' that high levels of proficiency need to be acquired in order to have a bilingual advantage. However, these studies provide combined scores for creativity and the tasks used did not look purely at divergent thinking, making it difficult to predict a view on just that component. Other literature has agreed with this observation, that the acquisition of more than one language has a positive influence on divergent thinking (Herdina & Jessner, 2002; Leiken, 2013, Leiken & Tovli, 2014; Ricciardelli, 1992).

There is very limited research in this area and some studies have investigated whether training divergent thinking is beneficial in bilingual individuals. Haarmann, Rourke, and Ragusa (2013) did a review on divergent thinking training and language and found that bilingual children have better results in fluency, originality and flexibility. However, previous research by Cummins and fellow associates (in Baker, 1988) found that bilinguals out performed monolinguals in originality, but not in fluency and flexibility.

The literature presented suggests that language experience may affect this component of creativity (Hommel, et al., 2011). Therefore, this study is in agreement with Runco (2014) and the effects of language experience will not be related to creativity as a whole, but only the divergent thinking component that underlies creativity (Hommel, et al., 2011). This study is also aware that the proficiency of the acquired languages may determine the influence language has on divergent thinking.

Determining if there is a relationship between divergent thinking and working memory is even less clear than the relationship between divergent thinking and language experience. This is due to limited research on whether divergent thinking specifically, is associated with working memory. There have been various studies that have examined working memory and creativity (Shi, Wang, Yang, Zhang & Xu, 2017; Vandervert, Schimpf, & Hesheng, 2007) but not the implication of working memory on divergent thinking directly. Vandervert, et al., (2007) presented that creativity originates in working memory because working memory involves piecing together diverse ideas. However, the study was interested in examining how creativity is generated by the relationship between working memory and the cerebellum. They believed that working memory involves the cerebellum when it comes to creative ability.

The research involved in creativity and working memory presents opposing ideas on whether creativity and divergent thinking are linked. De Dreu, Nijstad, Baas, Wolsink, & Roskes (2012), proposed that the ability to maintain new information, and executive control as well as identifying information, associated with working memory, has a positive correlation with creative performance. Their conclusions related to this study showed that fluency and originality (associated with divergent thinking) are closely correlated with working memory.

A contradictory study by Wiley and Jarosz (2012) investigated whether the attentional focus associated with working memory benefits creative problem solving. They presented that working memory ability allows focused attention and restricts the capacity to produce a broad search of knowledge and ideas in order to solve a problem. Their review of available research concluded that various studies have demonstrated that focusing too much is a disadvantage in tasks involving creative-problem solving. This review did not examine divergent thinking directly and can only be used as a source of information to make inferences.

However, information on the processes involved in each of these concepts shows shared commonalities between divergent thinking and working memory. The purpose of working memory is to keep information heightened and manage irrelevant and

Research Report has been approved for MA degree in Psychology by the University.

relevant information (Furley & Memmert, 2015). Divergent thinking involves the maintenance and management of attentional concepts to produce multiple ideas, therefore requiring some working memory processes (Vartanian, Jobidon, Bouak, Nakashima, Smith, Lam & Cheung, 2013).

A study by Takeuchi, Taki, Hashizume, Sassa, Nagase, Nouchi, & Kawashima (2011) found that training verbal working memory had a negative correlation with respect to creative (divergent thinking) ability. The study did not investigate working memory and divergent thinking directly. The researchers were instead interested in examining how training working memory affected other cognitive functions. Working memory was measured using mental calculations and the digit symbol task from the WAIS-III and The S-A creativity test was used to measure creativity. The S-A creativity test relies on divergent thinking ability to determine creativity. They suggested that that attentional procesess are not directly associated with creativity because divergent thinking indicated a positive association with the inability to reorganise attention. Vartanian, et al., (2013), also investigated whether short temporary training in working memory would result in a better performance in the divergent thinking test, Alternate User Test (AUT), with a functional magnetic resonance imaging (fMRI) scanner. The study tested 34 neurologically healthy individuals who were distributed into two groups (experimental and active control), which was matched by age and gender. The experimental group received three sessions of working memory training and the active control group received training in reaction time tasks that were not associated with working memory. The experimental group displayed significant progress in the working memory task but there was no difference in the AUT performances between the groups. However, the fMRI revealed that the experimental group had lower activation in two areas, which play a critical role in divergent thinking: the ventrolateral prefrontal and dorsolateral prefrontal cortices. Therefore, their results displayed lower prefrontal activation is a consequence of training working memory, which is a neural indicator for divergent thinking.

Southard (2014) researched the relationship between working memory and creativity. Creativity was measured by divergent thinking and creative achievement. The study looked at 166 students from the University of North Florida from different ethnic

Research Report has been approved for MA degree in Psychology by the University.

backgrounds. Creativity was measured for all participants using the AUT, and the Consequences Task while the Alloway Working Memory Assessment was used to assess the working memory of the students. The study concluded that working memory is related to creativity, but there was no correlation between verbal working memory and divergent thinking for the AUT scores and the association was only seen in the Consequences task. The study states that this could be because of the nature of the tests. Therefore, the type of divergent thinking test may account for these inconsistencies in the literature. This study is aware that divergent thinking tasks may produce varying results but viewing divergent thinking as not being a unitary concept, but rather a process that involves originality, fluency, flexibility, and elaboration, the AUT is the best-suited measurement of divergent thinking.

The gap in research regarding divergent thinking and working memory could be due to studies investigating creativity as a whole and not according to its components as well as working memory as an element of intelligence. However, the indirect studies and the training research may not investigate a direct correlation but they suggest that there should be some association, whether positive or negative, between the creative component divergent thinking and working memory.

2.2.1 Rationale

It has been thoroughly investigated that language affects cognition (Bialystok, 2005; Byrd, 2012; Marian & Shook, 2012). One cognitive function that seems to benefit from language is cognitive control (Bialystok, 1999; Bialystok & Viswanathan, 2009; Craik & Bialystok, 2005), which is a central aspect in working memory (Baddeley, 2000; Engle, 2010). Although it has been proposed that the phonological loop in working memory is involved in language processes the research around the question of whether there is a relationship between the two concepts presents conflicting answers. Divergent thinking is a cognitive ability that also seems to rely on constructs affected by multilingualism. Yet, the direct relationship between language experience and divergent thinking has not been explored in its own right. The study, therefore, aims at exploring whether language experience affects these two cognitive functions.

Furthermore, there is also the view that working memory and divergent thinking are opposing constructs, because of training in working memory having a negative association to processes involved in divergent thinking (Takeuchi et al., 2011; Vartanian, et al., 2013), and yet they seem to share the common aspect of both needing cognitive control in order to function correctly. The literature regarding an association between divergent thinking and working memory is also extremely limited, as most research has been done regarding creativity and not the component of divergent thinking. The opposing opinions and the gap in the literature provide an important reason as to why more research needs to be conducted in this field. Therefore, the study aims to determine if this common aspect is enough for there to be a significant association between these functions.

All the literature presented is also based on foreign studies, as there are no South African studies available on the relationship between these variables. This is significant as it is often difficult to generalise foreign findings to South Africa because of the country's diverse environments and linguistic knowledge. South Africa's eleven official languages as well as other languages due to the high foreign population are used on a daily basis in various environments and have no distinct boundaries. Gauteng is also the region with the widest linguistic range, where all official languages are utilised (Hacksley, et al., 2007), yet it is the smallest province and has the largest population (Statistics South Africa, 2016). These linguistic characteristics of daily environments make multilingualism common in South African societies (Hacksley, et al., 2007). The location of the study is therefore multilingual (Clark, 2003) with varying language proficiencies (Webb, 2002) and provides a significant reason to explore the role of language experience as being beneficial in cognitive functions. The aims of this study provide an opportunity to contribute to the language implications in South Africa.

The study also finds it significant that sample of the study consists of government and private school learners; two different school types that may differ in the quality of education. It has also been suggested that quality of education has an affect on cognitive performance (Bonn, Janeke, & Kruger, 2009*;* Shuttleworth-Edwards & Van der Merwe, 2015). Therefore, the study will examine whether the hypothesised relationships will vary when each school type is investigated separately.

2.3.1 General Aims

The main focus of the study was to explore the relationship between language experience and the cognitive concepts of working memory and divergent thinking in a

multilingual sample of students. The study also aims to investigate whether divergent thinking and working memory have a relationship and if demographic variables such as age, gender (male and female), and type of school (government and private) affect these cognitive functions.

It is important to note that that socio economic status (SES) is not an aim of this study. A distinction is being made between type of school simply to evaluate if there are variations among the groups and the cognitive functions, and it is not being assessed as a covariate of SES.

2.4.1 Research Questions

1. Is there a relationship between language experience and working memory in Grade 7 – 9 learners?
2. Is there a relationship between language experience and divergent thinking in Grade 7-9 learners?
3. Is there a relationship between divergent thinking and working memory in Grade 7-9 learners?
4. Are the demographic variables; gender, age and type of school correlated to working memory and divergent thinking?

2.5.1 Hypothesis

1. There is a moderate positive relationship between language experience and working memory in Grade 7 – 9 learners.
2. There is a moderate positive relationship between language experience and divergent thinking.
3. There is a weak positive relationship between divergent thinking and working memory.
4. There is a moderate positive relationship between the specific demographic variables and the cognitive functions working memory and divergent thinking.

Chapter 3: Methodology

3.1 Research Design

The study was quantitative in approach as it made use of statistical measures to investigate observations based on theory (Blessing & Chakrabarti, 2009). The design of the study was a non-experimental correlational and cross-sectional in design, as there was no manipulation of the variables and the study was interested in the relationship between the variables, as the sample stood, at the time of testing (Huck, 2012).

3.2 Sample and Sampling

The study consisted of 66 respondents aged between 12 to 14 years from two separate schools; government (n= 39) and private (n=27), in the Johannesburg area. The individuals were either in Grade 7 (44%), 8 (30%) or 9 (26%) and the majority of them were female (70%). The family background of the particpants demonstrated that 52% came from households with married parents, and 51% of the parents have secondary education while 27% have a tertiary education. Therefore, some respondent's parents have received less than a secondary school education (refer to Table 1.1.1).

Table 1.1.1. The demographic frequencies (%) of the government and private school respondents

		Government School Learners n=39 Frequency (%)	Private School Learners n=27 Frequency (%)	Total Learners n=66 Frequency (%)
Gender	Male	11 (28%)	9(33%)	20(30%)
	Female	28 (72%)	18(67%)	46(70%)
Age	12	9(23%)	2(7%)	11(17%)
	13	18(47%)	12(44%)	30(45%)
	14	9(23%)	6(22%)	15(23%)
	15	3(8%)	7(26%)	10(15%)
Current Grade	7	21(54%)	8(30%)	29(44%)
	8	8(21%)	12(44%)	20(30%)
	9	10(26%)	7(26%)	17(26%)
Attended Preschool	Yes	35(90%)	27(100%)	62(94%)
	No	4(10%)	0(0%)	4(6%)
Parents Martial status	Married	14(36%)	20(74%)	34(52%)
	Divorced/ Separated	6(15%)	2(7%)	8(12%)
Maternal Education	Secondary	14(36%)	8(30%)	22(33%)
	Tertiary	9(23%)	14(52%)	23(35%)
Paternal Education	Secondary	9(23%)	4(15%)	13(20%)
	Tertiary	11(28%)	13(48%)	24(36%)

Research Report has been approved for MA degree in Psychology by the University.

In order to minimise extraneous variables influencing the study, all the respondents met the following criteria for participation in the study: (1) no history of neurological compromising illnesses such as Epilepsy, Meningitis, or incidents such as Traumatic Brain Injury prior to the study, (2) have a minimum of 4 years English medium schooling, (3) live with a parent or permanent caregiver in order to obtain the necessary informed consent for participation, (4) have not previously failed a grade and (5) must be between the ages of 12 and 14. To ensure the inclusion criteria were met the information sheet stated the reasons a respondent would be excluded from the study asking parents and caregivers not to allow their child to participate if they did not meet the required conditions. The demographic questionnaire was also used as a tool to examine that the respondents met the necessary criteria. There were originally 69 respondents but three learners were excluded for not meeting one or more of the inclusion criteria. The study relied on non-probability purposive sampling as it was not interested in representing a particular population but based the selection of respondents according to inclusion criteria (Huck, 2012).

3.3. Instruments

3.3.1 Demographic Questionnaire

The Demographic Questionnaire (see Appendix 1) was used to collect biographical information as well as determine some of the required inclusion criteria such as age, grade, and language profile – home language and the number of spoken languages acquired. Questions included in the questionnaire were concerned with gender, medical history, as well as basic information of parents regarding their education. The questionnaire was also used to establish the socio-economic status (LSM) of the learners. The LSM is an aim for the other co-researchers study and was excluded for this study Parental education was only used for demographic descriptions and not statistically measured. The selective questions of the LEAP-Q were also attached to the demographic questionnaire.

3.3.2 Selective Questions of the Language Experience and Proficiency Questionnaire (LEAP-Q)

The proficiency and number of acquired languages involved in language experience were obtained from the selective questions of The Language Experience and Proficiency Questionnaire (LEAP-Q).

The LEAP-Q was designed by Marian, Blumenfeld and Kaushanskaya (2007) as a means to provide a dependable and valid measure of language status and can be used in bi/multilingual populations. The questionnaire creates a language profile by self-assessment. The self-reporting in the LEAP-Q relays the fluency for acquired language stated by the respondent (Hespos & Piccin, 2009).

The reliability and validity of a language test using self-assessment to create a language profile was investigated by Marian, et al., (2007) through a factor analysis. Internal validity was established as well as criterion based validity as self-report is a reliable form of providing language proficiency. The self-report of language proficiency signified accurate linguistic performance as well as reading performance of second language acquisition (refer to Marian, et al., 2007).

An adapted version of the LEAP-Q used in a previous study (Anthony, 2012), found that certain aspects were misunderstood such as the rating system and the wording of the questions. This adapted version was modified even further in order to account for the recommendations made by Anthony (2012), and to meet the requirements of the language acquisition and proficiency needed for this study (see Appendix 2) and to only include relevant questions. This newly adapted version also altered the rating scale by substituting simply writing a rating between 0 and 10, with a numerical rating scale from 0 to 10 for the individual to indicate by a tick or a cross their proficiency for each acquired language. The adapted version of LEAP-Q was piloted; like the other tests, on individuals with similar characteristics to the sample criteria such as age, attending school and having no history of neuropsychological deficits. The pilot demonstrated that the adapted version of the LEAP-Q was easily comprehensible and was adequate in providing information on acquistion and proficiency.

3.3.3 The Oral Expression of the Wechsler Individual Achievement Test – Third Edition (WIAT –III)

As the adapted LEAP-Q is self-reported, the study examined the construct validity of the questionnaire by testing the English proficiency of the respondents, with the Oral Expression subtest of The Wechsler Individual Achievement Test–Third Edition (WIAT-III). This test is suitable for Grades Pre-K to 12 (Psychological Corporation, 2009).

The Oral Expression subtest measures language knowledge according to expressive vocabulary and oral word fluency. These aspects of language are measured by the respondent's word retrieval ability (Psychological Corporation, 2009).

The internal consistency regarding the inter-item consistency within the subtests of has an average reliality coefficient varying from 0.80 to 0.98. The test-retest reliability demonstrated that the test is stable when it comes to age as well as over time as there are minor variances when it comes to standard score points (range 1 -4). The average stability coefficients range from 0.85 to .98. The validity of the Oral Expression demonstrated that it adequately measure the constructs that it intended to measure. The mean standard scores are consistent. (Psychological Corporation, 2009).

Although the WIAT- III has not been standardised in South Africa and has not yet been utilised in published South African research, yet the questions asked in the Oral expression subtest of the WIAT-III should be easily comprehended at a grade 7 – 9 level of education. It is assumed that English L2 learners will cope with this assessment because they attend schools where English is the medium of instruction.

3.3.4 Working Memory Inventory of the Wechsler Intelligence Scale for Children Revised - Fifth Edition (WISC-V)

Working Memory was obtained from the Working Memory Scale (WMI). The WMI is made up of the following subtests: the Digit Span (forwards, backwards and

sequencing), Picture Span and Letter-Number Sequencing, in the Wechsler Intelligence Scale for Children Revised - V (WISC-V) (Wechsler, 2014).

The Digit Span is comprised of three components, Digit Span Forward (DSf), Digit Backwards (DSb) and Sequencing (DSs), all of which account for the capacity of the phonological loop. The DSf is a measure of short-term memory requiring the respondent to repeat a series of numbers. With each item, the series of numbers increases in length; when the respondent can no longer rely on the ability to repeat and has to rehearse then working memory is required. The DSb measures the ability to manipulate (verbal) information that temporarily stored. The respondent listens to a series of numbers and repeats the sequence in reverse (backwards). While the DSs also requires the respondents to listen to a sequence of numbers they are required to repeat the numbers in ascending sequence. This goes beyond the capacity of the phonological loop and requires further demands of the working memory. Each component of the digit span contains nine items. Each correct response is awarded one point and the maximum points that can be achieved for each subtest is 18, therefore, a total raw score of 54 can be attained overall (Wechsler, 2014).

The Letter-Number Sequencing subtest is also a measurement of verbal short-term memory and entails the respondents listening to a string of numbers and letters and then repeating them in a particular order. There are 10 items in the subtest and scoring ranges between 0 and 3, with the total score that can be achieved of 30.

The picture span subtest measures the visual short-term memory and entails the respondents viewing images in a stimulus book and then select the correct pictures they previously saw from the available options, possibly in order. There are 26 items in the subtest with the scoring ranging from 0 to 2. The maximum raw score that can be achieved is 49 (Wechsler, 2014).

All these subtests combined are a measurement of working memory and the sum of scaled scores for the WMI will give a total raw data score for working memory (Wechsler, 2014).

Research Report has been approved for MA degree in Psychology by the University.

The WISC-V can be conducted on persons aged 6 years 0 months to 16 years 11 months. The standardization of the WISC-V involved children in different age groups equally divided based on gender, age, culture and socio-economic status.

The reliability coefficient of the WISC-V was obtained from the use of the split-half method (Wechsler, 2014). The composite score internal consistency reliability was calculated with a specific formula. The reliability coefficients for the overall WMI for the ages corresponding to the sample are 0.93 (age 12), 0.92 (age 13) and 0.92 (age 14)

The reliability of coefficients for each subtest measuring verbal working memory is the following: the overall digit span (DSf, DSb, and DSs) is 0.93 (age 12), 0.92 (age 13) and 0.92 (age 14) and for the Letter Number Sequencing, 0.85 (age 12), 0.86 (age 13) and 0.89 (age 14). For the measuring of visual working memory, the picture span results were 0.86 (age 12), 0.85 (age 13) and 0.80 (age 14).

The WISC-V has not been standardised in South Africa; however, the previous edition WISC-IV has test norms for first language Xhosa and Afrikaans Grade 7 individuals. Ethnicity and language had slight effects while the quality of education had more of an influence on IQ scores (Shuttleworth Edwards, 2013). It is assumed that the WMI of the WISV-V will have similar test norms for this sample because it involves letters and numbers. Letters and numerical information should be understood as the second language English respondents have English medium schooling and the WMI subtests are not associated to a particular culture.

3.3.5 Alternate User Test

The operationalisation of Divergent Thinking was obtained from the raw scores of the Alternate Uses Test (AUT). The AUT was developed by Guilford, Christensen, Merrifield, and Wilson (1960) in order to test divergent thinking abilities.

The test requires the participants listing uncommon uses for objects in a certain amount of time. The researcher presents the participant with a simple object and asks the individual to produce various uses for that object. For example, the researcher

will give the individual a pen and the individual will respond by saying that a pen can be used for writing, as a scratcher, opener (letters or plastic), a bookmark, to do a hair bun, etc. This test assesses four factors: fluency, flexibility, originality and elaboration, and provides an overall measure of verbal creativity.

The AUT answers are scored according to the four elements: fluency (number of accurate uses of the object given), flexibility (the various categories), originality (the degree of variance in responses when compared to the standard answers given), and elaboration (the degree of description given) (Hommel et al., 2011).

The AUT has not been standardised for a South African sample; however estimates of reliability for the test derived from a sample of three age groups: 6th grade, 9th grade, and adults. The data for each group came from different samples. The Grade 6 sample came from a four-item test known as, 'What to Do With It' from the Creativity Tests for Children (Guilford, et al., 1960) with a result of 0.78. For the Grade 9 group, the test contained six-items with a result of 0.75. The estimates of test-retest reliability were obtained from testing 484 children from Grade 5 to 7. The correlations for Form B range from 0.53 to 0.63.

The AUT's construct validity was tested with a factor analysis where separate large samples were used for the 6th and 9th Grades. The factor loading results for the divergent production of semantic classes (DMC) were 0.42 (6th Grade) and 0.53 (9th Grade) and 0.22 (6th Grade) (Guilford, et al, 1960).

The norms for the section of AUT used in the study, Form B came from the same sample that was used in the test-retest. The norms for Form B came from the same sample for the test-retest and were as follows, for a C score of 10, 16+ (5th Grade), 20+ (6th Grade), 21+ (7th Grade) and 99 (Centile equivalents) (Guilford, et al, 1960).

The AUT has not been standardised in South Africa. However, the psychometric tests on the AUT were completed using a similar sample to the one being used in this study. As stated before the tests were piloted, the learners were able to complete the test.

3.4 Procedure

This study is involved in a macro study investigating the relationship between divergent thinking and working memory and the effect language experience and academic performance may have on such a relationship, involving another Master student, Jaime Abrahams (MA in Educational Psychology, University of the Witwatersrand). The co-researcher Jaime Abrahams aimed at researching the relationship between academic achievement and the cognitive constructs working memory and divergent thinking to determine which construct is a better predictor.

Kirstin Anthony conducted the required tests and collecting the data for the private school sample and Jaime Abrahams fulfilled the same role but for the government school sample. All the letters consent, forms and assent forms were the same for both the private and government school because of the same data collection, which was shared between the researchers and the relevant information was used in both micro studies.

Separate ethical clearance was obtained for each study due to them targeting different aims. For this particular project, the study attained ethical clearance from the University of the Witwatersrand Human Research Ethics Committee (refer to Appendix 8). Gaining clearance consisted of submitting a proposal that highlighted the aims and reasoning for this research and motivating the involvement of a vulnerable sample.

A letter was sent to the private school principal (see Appendix 3) and consent was obtained (see Appendix 8) to gain access to their students. However, in order to gain access to the public school students, the process involved gaining verbal permission from the principal as well as ethical clearance from the Government Education Department (GED) (obtained by Jaime Abrahams). Once GED clearance was received written consent from the public school principal was obtained.

The parents/guardians of all Grade 7, 8 and 9 pupils received an information sheet (see Appendix 4) that stipulated the purpose of the research as well how the research will be accomplished, the operationalisation of the information and their rights when

partaking in the study and details of the research. The parent or guardian completed a written consent form (see Appendix 5), if they were willing to permit their child to partake in the study.

The students that were given consent by their parents received a participant information sheet (refer to Appendix 6), assent form (refer to Appendix 7) and the demographic questionnaire with the attached LEAP-Q to complete at home. Parental assistance was given in some cases when answering the biographical questionnaire; as respondents may not of known the answer to particular questions such as parental level of education.

The cognitive test batteries that were used to implement the study were obtained through the Emthonjeni Centre at the School of Human and Community Development at the University of the Witwatersrand. The researchers undertook training on the administration and scoring of the tests with the supervisor, who is a registered clinical psychologist with the HPCSA (PS0122742).

The individuals that met the inclusion criteria stipulated in the study as well as had all the required documentation completed were tested at their respective schools; this was to ensure minimum interference in schoolwork. The participants were tested in an allocated private room that was well lit, with a table and chairs and there were minimum distractions.

The testing was carried out at each school by the respective researchers as explained above. The consent form, assent form, the demographic questionnaire and the selective questions of the LEAP-Q were checked again before proceeding with the cognitive tests. The cognitive tests were administered in the following order: Oral Expression subtest of the WIAT-III, AUT, and WMI (WISC-V) individually to one participant at a time. The academic records of each participant were collected from the school for the purpose of the macro study.

The testing was between 50 minutes to an hour. Throughout the administration of the test, the researcher enquired on how the respondent was feeling and checked in

between tests if the respondent was willing to continue to the next activity. This was done to ensure that they experienced a minimum amount of distress.

Chapter 4: Results

The program Statistical Package for Social Sciences (SPSS) V.24.0 was employed to perform all the statistical analysis. The first analysis involves the descriptive statistics which provide the means, standard deviations and frequencies from the demographic questionnaire such as age, current grade, school type, maternal/parental education and parental marital status, and the selective questions of the Language Experience and Proficiency Questionnaire (LEAP-Q) such as language acquisition, language dominance, language of preference, and proficiency in speaking, understanding, reading and writing. The statistical measures of means, range, Skewness and Kurtosis were used to determine the normality of the data provided from for the selective questions of the LEAP-Q, subtests of working memory (overall digit span, picture span and letter number sequencing), Alternate User Test (AUT) and Oral Expression of the WIAT -III. The study investigated the government school and private school separately as well as a combined total, to explore if there were any difference between the groups. The type of school including gender and age were also correlated against the AUT and working memory subtests and total. The hypothesized statistical relationships between the variables were measured by parametric correlations (Pearson).

A multiple regression was also conducted in order to see which independent variables (age, gender, and type of school, language proficiency and number of languages) better explained variances of Working Memory and Divergent Thinking. However, the overall models were not significant and were excluded from the results. As the study is only interested in whether there are relationships between the specified variables, correlations are sufficient in demonstrating any associations. Comparing the private school and government school is not a main aim and the study only interested in determining if there are relationships.

4.1 Language Descriptives

Table 1.2.1 Mean results for the number of acquired languages and overall English proficiency for government and private school respondents

		Government School n=39	Private School n=27	Total Respondents n=66
Number of Languages	Mean (SD)	3.59 (1.019)	3.33(.784)	3.48 (.932)
	Range	3	3	3
	Minimum	2	2	2
	Maximum	5	5	5
Overall Proficiency	Mean (SD)	6.2707 (1.12943)	6.2259 (1.21453)	6.2524 (1.15597)
	Range	4.38	4.50	4.88
	Minimum	4.00	3.50	3.50
	Maximum	8.38	8.0	8.38
Overall English Proficiency	Mean (SD)	8.6538 (1.00756)	8.0556 (1.15470)	8.4091 (1.10213)
	Range	3.75	4.75	4.75
	Minimum	6.25	5.25	5.25
	Maximum	10.00	10.00	10.00

The overall proficiency was the composite ratings of the self-reported proficiency for all listed languages across all domains (speaking, understanding, reading, and writing). Overall English Proficiency was calculated using the self-reported proficiency for English in all domains (speaking, understanding, reading and writing).

All learners considered themselves bi/multilingual (ranged from 2 to 5 languages). The overall proficiency and overall English proficiency consisted of self-reported proficiency in the areas of speaking, understanding, reading, and writing. The overall proficiency for total respondents ranged from below average (3.50) to good (8.38), while overall proficiency in English proficiency ranged from average (5.25) to excellent (10.00).

The government school respondents stated a slightly higher average for overall self-reported proficiency ($\bar{x}$ = 6.2707) and overall English proficiency ($\bar{x}$ = 8.6538) than the private school respondents ($\bar{x}$ = 6.2259; $\bar{x}$ = 8.0556). Yet, their minimum self-reported proficiency for English was lower than the private schools (refer to Table 1.2.1)

The study investigated proficiency more in-depth by looking at the mean proficiencies for each area (speaking, understanding, reading, and writing) for each language (L1 to L5) (refer to Table 1.3.1).

Table 1.3.1 Language proficiency of each language for government and private school respondents

		Government School			Private School		
		Mean (SD)	Minimum	Maximum	Mean (SD)	Minimum	Maximum
Speaking	L1	8.03 (1.739)	4	10	7.3 (1.938)	2	10
	L2	7.00 (2.103)	2	10	6.59 (2.117)	2	10
	L3	5.88 (2.253)	2	10	4.87 (2.201)	0	9
	L4	4.89 (2.494)	2	10	4.25 (1.288)	2	6
	L5	5.40 (2.221)	3	9	5	5	5
Understanding	L1	8.79 (1.824)	3	10	8.41 (1.67)	5	10
	L2	7.77 (2.146)	1	10	7.30 (1.996)	2	10
	L3	6.44 (2.452)	3	10	5.57 (2.569)	0	10
	L4	6.44 (2.595)	2	10	4.58 (1.782)	1	7
	L5	5.30 (2.163)	1	10	6	6	6
Reading	L1	5.85 (3.990)	0	10	6.70 (2.985)	0	10
	L2	6.41 (3.260)	0	10	6.59 (2.650)	0	10
	L3	5.74 (3.127)	0	10	4.87 (2.849)	0	10
	L4	3.89 (3.123)	0	10	4.75 (3.049)	0	9
	L5	4.60 (3.307)	0	10	2	2	2
Writing	L1	6.03 (3.565)	0	10	6.59 (2.721)	1	10
	L2	6.46 (3.508)	0	10	6.11 (2.940)	0	10
	L3	5.94 (3.171)	0	10	4.74 (2.848)	0	10
	L4	3.78 (3.490)	0	10	4.75 (2.800)	0	8
	L5	4.20 (3.259)	0	10	3	3	3
Overall Proficiency	L1	7.28 (2.247) n=39	3	10	7.33 (1.778) n=27	4	10
	L2	7.03 (2.109) n=39	3	10	6.74 (2.194) n=27	1	10
	L3	6.12 (2.171) n=34	2	10	5.32 (2.169) n=22	1	10
	L4	4.83 (2.149) n=18	2	8	4.75 (1.865) n=12	2	7
	L5	5.10 (2.283) n=10	2	9	n=1	4	4

All the participants have acquired 2 or more languages. There are participants who have stated to know a language but then have rated themselves as having no proficiency or very low proficiency in reading and writing in the language. Some government school respondents stated a minimum rate of 0 for reading and writing from L1 to L5, while some private school respondents reported a 0 rate in reading from L1 to L4 and in writing for L2 to L4. Therefore some individuals cannot read or write in their first language, as well as other languages they claim to have acquired. The private school has slightly higher self-reported proficiency in L1 ($\overline{x}$ = 7.33) but lower self-reported proficiency in all other languages when compared to the government school. This could be circumstantial depending on the environments and language use in those environments.

Research Report has been approved for MA degree in Psychology by the University.

Table 1.4.1 Language frequencies (%) of the government and private school respondents

	Home Language		First Language Acquisition		Most Dominant Language		Preferred Language	
	Gov	Private	Gov	Private	Gov	Private	Gov	Private
	Freq(%)	Freq(%)	Freq(%)	Freq(%)	Freq(%)	Freq(%)	Freq(%)	Freq(%)
English	12(31%)	12(44%)	16(41%)	14(52%)	15(38%)	20(74%)	24(62%)	20(74%)
Afrikaans			1(3%)			1(4%)		
Zulu	11(28%)	3(11%)	12(31%)	3(11%)	10(26%)	3(11%)	8(21%)	2(7%)
Xhosa	2(5%)		1(3%)	1(4%)	2(5%)			
Sotho		3(11%)		3(11%)		1(4%)		3(11%)
Tswana	4(10%)		1(3%)		2(5%)			
Venda	1(3%)		1(3%)				1(3%)	
Ndebele	2(5%)		2(5%)		3(8%)			
Sepedi	2(5%)		1(3%)		3(8%)			
Shona					1(3%)			
Portuguese	2(5%)	2(7%)						
French	3(8%)	6(22%)	1(3%)	5(19%)		2(7%)	1(3%)	1(4%)
Other		1(4%)	3(8%)	1(4%)	3(8%)		5(13%)	1(4%)
Total	39	27	39	27	39	27	39	27

10 of the 11 official languages (English, Afrikaans, Zulu, Xhosa, Sotho, Tswana, Venda, Ndebele, Sepedi, Shona) were present in the study as well as common foreign languages in South Africa such as Portuguese and French. English was not stated as the home language for the majority the respondents, yet English had a high frequency for language of preference (government school = 38% and private school = 74%) as well as the most dominant language.

Although only 38% of the government school students consider English to be their dominant language, for 62% English is their language of preference. This may be due to English being their language of schooling and the fact that they may be the only one in their social group at school that speaks their L1 or home language, such as the only learner in the study reporting the acquisition of Venda.

4.2 Testing for Normality

To analyse the normality of the data the Skewness and Kurtosis were run. The data of the selective questions of the LEAP-Q, Oral Expression and working memory subtests (overall digit span, picture span, and letter number sequencing) are all normally distributed between 1 and -1. However, the AUT data measuring divergent thinking did not fall within the parameter of 1 and – 1 (Nussbaum, 2013) in either Skewness (1.310) or Kurtosis (2.657), indicating that this data is skewed. The skewness is also evident in the mean (6.41) and the range of results (1 -19). In order to normalize this data the statistical method of a log transformation was done (Feng, Wang, Lu, Chen, He, Lu & Tu, 2014). This method was the best approach to normalizing the AUT data instead of a non-parametric approach because the data for the other variables are normally distributed. Therefore, the AUT data had to be transformed so as to run parametric Pearson correlations to test the study's hypotheses. The log transformation resulted in the AUT data's Skewness equalling -.697 and Kurtosis .612 which are between 1 and -1, making it normally distributed.

4.3 Correlations

Parametric Pearson correlations were used to explore the relationship language experience has on the cognitive functions working memory and divergent thinking, and whether these cognitive functions are associated. The study also used a correlation analysis to test the construct validity of the selective questions of the LEAP-Q and explore the hypothesis that demographic variables (gender, age, and type of schooling) may influence these cognitive functions. The study decided to look at school types separately as well as a total of the sample to distinguish if there were any significant differences between the government and private school. As previously mentioned there seems to be an inconsistency in the quality of education between government and private schools. The study wanted to determine whether there were differences between school types when it came to cognitive constructs.

4.3.1 Validity of the Selective Questions of the LEAP-Q

As previously stated the LEAP-Q does not measure proficiency, but is a self-reported figure of proficiency, therefore, to assess the validity of this language measurement it was correlated with the results from the Oral Expression of the WIAT-III. The Oral expression is a verbal English test that only requires speaking and understanding proficiency of English; so only the self-reported proficiencies for English speaking and understanding from the selective questions of the LEAP-Q were combined and used for comparison.

A correlation analysis was administered to verify the construct validity of the selective questions of the LEAP-Q (refer to Table 2.1.1). The results demonstrate that there is no relationship (r = .109, p = .383) between the English proficiency determined by the selective questions of the LEAP-Q and the Oral Expression. This means that the LEAP-Q may not be a reliable measure of language proficiency.

The number of languages one knows does not correlate with the oral expression scores either. This may be due to respondents stating they know a language even when they have very low proficiency in that language.

Table 2.1.1 Correlations of the Oral Expression, the selective questions of the LEAP-Q and number of acquired languages

	Oral Expression		
	Government n=39	Private n=27	Total n=36
Number of Languages	-.230	.238	-.090
(p-value)	(.160)	(.231)	(.473)
English Proficiency	-.039	.377	.109
(p-value)	(.814)	(.053)	(.383)

** Correlation is significant at the 0.01 level (2-tailed)
* Correlation is significant at the 0.05 level (2 –tailed)

Research Report has been approved for MA degree in Psychology by the University.

4.3.2. Correlation of Language Experience and Working Memory

A Pearson correlation was used to test the hypothesis that there is a relationship between language experience (Overall proficiency and number of languages) and working memory (digit span, picture span and letter number sequencing subtests and overall working memory) (refer to Table 2.2.1).

Table 2.2.1 Correlations of language experience (language acquisition and proficiency) and working memory subtests and total

	Digital Span			Letter/Number Sequencing			Picture Span			Total Working Memory		
	Gov	Private	Total	Gov	Private	Total	Gov	Private	Total	Gov	Private	Total
Overall Profiencey (p-value)	-.021	.242	.090	-.040	.107	.027	-.090	.368	.126	-.067	.349	.116
	(.900)	(.223)	(.470)	(.811)	(.596)	(.832)	(.581)	(.059)	(.314)	.686	(.075)	(.355)
Number of Languages (p-value)	-.237	.246	-.073	-.266	-.101	-.126	-.172	.099	-.057	-.254	.182	-.093
	(.0146)	(.216)	(.561)	(.102)	(.618)	(.312)	(.295)	(.624)	(.650)	(.119)	(.363)	(.460)

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

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

There were no significant differences between language experience (number of acquired languages and proficiency) and any of the working memory subtests or total working memory for the government school, private school and total respondents (refer to Table 2.2.1). This indicates that language experience has no influence on their ability to store temporary information, therefore disproving the hypothesis that there is a relationship between the number of languages, the competence of language and working memory.

4.3.3 Correlation of Language Experience and Divergent Thinking

The hypothesis that there is a relationship between language experience and divergent thinking was evaluated using a correlation analysis by using the number of languages, and overall language proficiency with the AUT scores (refer to Table 2.3.1).

Table 2.3.1 Correlation of language experience (language acquisition and proficiency) and AUT scores

	Alternate User Test		
	Government	Private	Total
Overall Proficiency	-.207	-.180	-.195
(p-value)	(.207)	(.370)	(.116)
Number of Languages	-.435**	.069	-.266*
(p-value)	(.006)	(.734)	(.031)

**Correlations is significant at the 0.01 level (2-tailed)
*Correlations is significant at the 0.05 level (2-tailed)

There is no significant difference present for the government school, private school or total respondents between language proficiency and AUT scores. Therefore, the sample does not rely on language proficiency when generating multiple ideas.

However, language acquisition did correlate negatively with divergent thinking for both the government school (r = -.435, p = .006) and total respondents (r = -.266, p = .031) (refer to Table 2.3.1). This suggests that knowing multiple languages is a disadvantage when it comes to generating many original ideas.

4.3.4 Working Memory and Divergent Thinking

To test the hypothesis that there is a relationship between divergent thinking and working memory correlations between the AUT results and each working memory subtests (overall digit span, picture span, and letter number sequencing) as well as overall working memory were submitted to a correlation analysis (refer to Table 2.4.1).

Table 2.4. 1 Correlations of AUT scores and working memory subtests and total

	Digital Span			Long Letter/Number			Picture Span			Total Working Memory		
	Gov	Private	Total	Gov	Private	Total	Gov	Private	Total	Gov	Private	Total
AUT	-181	-.125	.055	.250	.204	.227	.337*	.162	.242	.317*	-.102	.217
	(.271)	(.534)	(.660)	(.124)	.308	(.067)	(.036)	(.419)	(.051)	(.049)	(.612)	(.081)

**Correlation is significant at the 0.01 level (2-tailed)
*Correlation is significant at the 0.05 level (2 –tailed)

The government school's AUT scores correlated weakly with the picture span subtest (r = .337, p = .036) and total working memory (r = .317, p = .049) (refer to Table 2.4.1). This suggests that the common aspect of control that is needed in both working memory (Baddeley, 2000; Engle, 2010), and divergent thinking (Hommel, et al. 2011) may be present in government school learners and provides a link for these two cognitive constructs. However, for the private school and total respondents, there are no correlations between AUT scores and the working memory subtests and total working memory. Therefore, the hypothesis that working memory and divergent thinking are correlated is only true for the government school for certain aspects of working memory.

4.3.5 Correlations of certain demographic variables and the cognitive functions, working memory and divergent thinking

The study hypothesised that age, gender and type of school influence working memory and divergent thinking ability. To test this the study submitted the variables to a correlation analysis (refer to Table 2.5.1).

Table 2.5.1 Correlations of gender/age/school type and the AUT scores and overall working memory total

	Demographic Variables		
	Gender	Age	Type of school
Working Memory	.103	.326**	-.020
(p-value)	(.411)	(.008)	(.872)
AUT Scores	.201	.371**	.161
(p-value)	(.106)	(.002)	(.198)

**Correlation is significant at the 0.01 level (2-tailed)
*Correlation is significant at the 0.05 level (2 –tailed)

There is a weak positive relationship (r = .326) between age and total working memory (p = .008). This agrees with the literature that working memory ability may improve with age, as it is a developmental cognitive function (Glisky, 2007).

Age was also weakly correlated with divergent thinking (r = .326; p = .002). Divergent thinking ability is also a cognitive function that develops over time, yet the extent to which age affects divergent thinking is not known (Palmiero, et al., 2014). There is no significant difference for gender and type of school, with working memory and divergent thinking. This indicates that there is no difference between males and females as well as whether one receives a private school or government school education when it comes generating various ideas and maintaining and recalling information.

Chapter 5: Discussion and Conclusion

5. 1 Discussion

Being bi/multilingual results in having to switch between languages and inhibit language, which requires cognitive control (Hommel, et al, 2011), an aspect that is necessary for storing, maintaining and manipulating temporary information in working memory (Baddeley, 2010). Therefore, the study's central aim was to investigate whether language experience; an advantage to cognitive control (Bialystok, 1999; Bialystok & Viswanathan, 2009; Craik & Bialystok 2005) has a relationship with other cognitive functions that rely on cognitive control, such as working memory and divergent thinking. The study also investigated whether cognitive control is a connection between working memory and divergent thinking. In order to answer the study's hypothesis: language experience (number of acquired languages and language proficiency), working memory and divergent thinking were identified as the result of the cognitive tests. The results of the tests were assessed using quantitative correlation statistics for the government and private schools separately, as well as together to give a combined total.

Language experience was assessed through the self-reported selective questions of the Language Experience and Proficiency Questionnaire (LEAP-Q) and the number of languages the respondents stated to have acquired. It requires honest self-reporting of proficiency and relies on the individual's ability to understand their proficiency, in terms of it being a point of reference for comparison purposes (Marian, et al., 2007). This study wanted to ensure the validity of this test according to its sample because tests can behave differently in diverse contexts. To determine construct validity of the selective questions of the LEAP-Q it was correlated with the Oral Expression of WIAT-III. However, correlating the proficiency in English speaking and understanding from the LEAP-Q and the Oral Expression did not show an association (r = .109, p = .383), therefore disproving the construct validity of the selective questions of the LEAP-Q. Considering these results, this may not be a reliable measure of proficiency and a more robust LEAP-Q should be used in future.

While working memory was assessed using the Working Memory Subtests (Forward, Backwards, Sequence Digit Span, Picture Span, and Letter Number Sequencing) requiring the respondents to hear information, maintain it and in some cases manipulate it before repeating it back to the assessor. The total from the sum of the subtests was used to obtain a total working memory score. A correlation analysis was used to determine if the study's hypothesis was correct in saying there is a relationship between language experience and working memory. The correlations indicated that both elements of language experience: number of languages acquired and overall proficiency of language, do not have a significant relationship with the working memory subtests, and total working memory. The study's hypothesis that there is a moderate positive relationship between language experience and working memory has been disproved by these results. The literature by Bialystok and Viswanathan (2009) and Bialystok, et al., (2006) showed that bilinguals had an advantage when it came to who the executive control function of working memory.

There are various potential explanations as to why no correlation was found between working memory and language experience such as a) the tests by Bialystok and Viswanathan (2009) and Bialystok, et al., (2006) used different instruments to measure working memory and their samples were different to this study, b) the proficiency obtained came from the selective questions of the LEAP-Q which may not be a reliable measurement according to their being no correlation between the questionnaire and the Oral Expression (refer to table 2.1.1), b) even though this study used the digit span subtests (associated to the phonological loop) as a measurement of working memory it did not look specifically at the component of the phonological loop, which is the component of working memory associated with language (Baddeley, 2010) c) the studies procedures may be more in line with the research conducted by de Abreu (2011), Bialystok, et al., (2008); Namazi and Thordardottir, (2010).

Divergent thinking was assessed through the Alternate User Test (AUT), which required the participants to give multiple uses for everyday objects. The correlations to assess language experience and divergent thinking indicated that the government school's number of acquired languages has a moderate negative (r = -.435; p = .006)

relationship with the AUT results, while the total respondents demonstrated a weak negative relationship (r = -.266; p = .031). The more languages the government school and total respondents know the poorer their AUT task ability is. There was no relationship between the number of languages and AUT scores for the government school; therefore, only the number of acquired languages element is associated with divergent thought for the government school respondents. There was no relationship between language experience and divergent thinking for the private school and a negative relationship for the government school and total respondents invalidating the study's hypothesis that language experience and divergent thinking have a moderate positive relationship. The government schools and total respondents significant results and the non-significant private school results contradict the literature that suggests language acquisition of more than one language has a positive effect on divergent thinking (Herdina & Jessner, 2002, Leiken, 2013; Leiken & Tovli, 2014; Ricciardelli, 1992).

The study's aim to investigate if there is a link between working memory and divergent thinking was assessed with correlation analyses between the AUT scores and the digit spans, letter number sequencing, picture span and total working memory. The correlations produced results that indicated that there is no relationship between working memory and divergent thinking for the total respondents as the study had hypothesised. Yet, when each school type was analysed separately, there was a weak positive relationship between divergent thinking and the picture span subtest *(*r = .337; p = .036) as well as with the total working memory *(*r = .317; p = .049) for the government school. This suggests that the government school may have more established cognitive control ability which is supposed to be the link between these two cognitive constructs (Hommel, et al., 2011) than the private school students, which could be due to there being environmental differences between the two school groups. However, if this is so the difference is slight and not enough to indicate a relationship when investigated as part of the total respondents. These findings do not correspond with the literature by De Dreu, et al., (2012); however, this study looked at creativity and not divergent thinking as a single component. It also did not agree with Takeuchi et al., (2011) and Vartanian, et al., (2013) as they proposed that training verbal working memory has a negative association with divergent thinking.

Southard (2014) found that there is a positive relationship between working memory and divergent thinking, however not with the AUT test used. Therefore, the AUT test used to assess divergent thinking may be problematic in demonstrating a relationship between these cognitive constructs.

From all the demographic variables measured only age seems to be associated with the cognitive constructs, which is what the literature indicates (Gathercole, et al., 2004; Glisky, 2007). It is interesting that the type of school did not demonstrate a correlation with these cognitive constructs. This may be due to the fact that there is more variability in age than in school types as well as the developmental component associated to age (Glisky, 2007), which is what usually occurs in neuropsychological assessment. As the study was viewing the results of the sample as government and private school as well as total, it was necessary to investigate whether the type of schooling would have a relationship with variables being examined. The correlation is non-significant suggesting the type of school is not relevant in working memory and divergent thinking ability. Therefore, the previous results that demonstrate the government school learners having a) a weak - moderate positive correlation between their Oral Expression scores and the letter number sequencing, picture span subtest and total working memory, b) a moderate negative relationship between their number of acquired languages and the AUT scores, and c) a weak positive relationship between AUT scores and total working memory that were not present in the private school as they only demonstrated a moderate negative relationship between Oral Expression scores and AUT scores, is not due to the type of schooling. These differences in relationships are probably due to other aspects that differentiate government and private school learners. However, as this is not one of the study's aims it was not investigated.

The majority of the learners were female (70%), aged 13 (45%) and in Grade 7 (44%). 94% of the respondents from both school types have attended preschool. This is surprising in a low SES environment, as attending a preschool are additional educational costs that are not compulsory (National Department of Basic Education, (1998). This may be due to all caregivers needing to work because of financial constraints and no one is able to look after their child during the day. In some cases sending a child to preschool is cheaper than paying for a full-time caretaker. The

Research Report has been approved for MA degree in Psychology by the University.

maternal and parental education indicates that some of the learners' parents have not completed secondary education. This may be a contributing factor or effect of low social-economic status (SES). However, as the study was not interested in the SES backgrounds of the sample, but merely as a means of describing the sample, it was not explored further.

The language preference and dominant language for most of the sample is English, even in cases where English is not the participants L1. The language preference of the sample does not always correspond with the participant's first language, therefore, indicating that their later learned language is their first choice for communication. The self-reported overall proficiency for L1 was rated between 2 and 10. This could be due to the L1 not being used frequently and English being the language of medium in school. The descriptives of the language proficiencies indicated that there are some respondents that cannot read or write in their first language. As presented in the literature many South Africans do not receive formal education in their L1 (or even L2) if it is an African language (Hacksley, et al., 2007).

There are also participants with very low proficiency in their L4 and L5 and yet they consider themselves having acquired the language. The proficiency for speaking and understanding of these languages is higher than reading and writing, which again reiterates that only speaking and understanding is considered necessary to acquire a language. Participants mainly use language for communication purposes except in school learners are accessed on speaking, understanding, reading and writing in language subjects. These findings indicate the use of language in South African society as being primarily for communicative purposes (Hacksley et al, 2007).

The study's conclusions are based on the fact that the results are exploratory and preliminary, and therefore should not be generalised. It is also important to consider limitations of the tests in a South African context and other extraneous variables.

Research Report has been approved for MA degree in Psychology by the University.

4.2 Conclusion

This study set out to investigate the connection between language experience, working memory and divergent thinking, in early adolescence. These constructs were examined according to government school group, private school group and a total of both groups. Additionally, the researcher also regarded it important to examine the validity of the selective questions of LEAP-Q, as it is a self-reported score, which was done by using an Oral Expression of the WIAT-III as a benchmark test. The results indicated the following conclusions:

The study found no relationship between language experience; overall proficiency and the number of acquired languages and the digit span, letter number sequencing, picture span and total working memory score. According to the correlations of these tests, the interaction between language experience and working memory is not as the study had hypothesised.

The government school and total respondents had a significant negative relationship between the number of acquired languages and the AUT scores, which was not present in the private school. There was also no significant interaction between overall proficiency and the AUT scores for any of the groups. These deductions suggest that there is no moderate positive relationship between language experience and divergent thinking as the study had hypothesised.

The government school had a weak positive correlation between their AUT scores and total working memory but no interaction with the other working memory subtests. There was also no significant relationship between the AUT scores and the digit spans, letter number sequencing and picture span for the private school and total respondents, indicating that divergent thinking and working memory are not connected as the study had hypothesised.

The study aimed to evaluate whether particular demographics such as age, gender and type of school have a significant association to divergent thinking and working memory. Therefore, the study's hypothesis is only applicable to the demographic variable age. Gender and type of school do not demonstrate a significant relationship

Research Report has been approved for MA degree in Psychology by the University.

with the digit spans, letter number sequencing, picture span, and total working memory as well as the AUT scores. Therefore, the variables gender and type of school are not associated with working memory and divergent thinking as the study's hypothesis suggested.

The correlation of the proficiency for English Speaking and Understanding from the selective questions of the LEAP-Q with the Oral Expression of the WIAT-III indicated that there is no relationship between these two language assessments. This finding is problematic as although this is a questionnaire that is based on self-report it was considered a valid, reliable means of reporting language proficiency. However, as this is self-report there is the possibility that individuals may rate their language proficiency higher (or lower) than it really is.

All learners considered themselves as acquiring two or more languages. Overall proficiencies in each language are not equal and some are more dominant than others. Therefore, each language is not considered equivalent to monolingual proficiency and they are what Lambert (1959, 1962) considered to be unbalanced. The sample still considers having acquired a language even if they cannot read or write in that language. Therefore, language acquisition is based according to their speaking and understanding skills in that language. The answers to the selective questions of the LEAP-Q reveal that the dynamic approach to language is best suited for this sample, as many of them declared their L1 as not being their dominant and preferred language. This demonstrates how unfixed and adaptable language experience is in a South African context.

4.3 Limitations of the Study and Recommendations for Future Research

- **Sample Characteristics:** The study accounted for characteristics such as age, English as a school medium and never having failing a grade. However, the sample is still demographically heterogeneous due to their school environments and their LSM scores. The study recommends that more characteristics are controlled for so as to not have any confounding variables.

- **Sample Characteristics:** The study included individuals from a private and government school to increase variance in the sample. However, the sample size of the study was small, therefore, restricting the generalisability of the results for the rest of the South African early adolescence population. The researcher recommends that a larger sample be obtained for future studies.

- **Sample Characteristics:** The current sample was obtained from two schools in the Johannesburg area, with more students from the government school than the private school. Having only two schools from the same region reduces the study's ability to generalise their results. It is recommended that learners from multiple schools be used in future studies.

- **Sample Characteristics:** Internal factors such as motivation, personality traits, and disposition of the respondents may influence test performance. These factors were not tested or controlled for by the study, but it would be recommended to do so in future studies.

- **Age of Acquisition:** The study did not question the age of acquisition for each language. According to literature age of language learning may influence proficiency (Bialystok, 1997; Bialystok, & Hakuta, 1998). Therefore, because this aspect of language experience was not standardised it may influence the language results. The age of language acquisition should be included in future studies.

- **Stimulus Characteristics**: The tests were not developed for a South African population and therefore are foreign instruments to test language, divergent thinking, and working memory. The study using these tests in a South African context could impact the validity, reliability, and properties of the test. Although these tests were piloted on individuals with similar characteristics to the sample it is still recommended to assess the properties of the test prior to testing.

Research Report has been approved for MA degree in Psychology by the University.

- **Testing:** Although the AUT to test divergent thinking, was explained to each learner during testing and they were asked if they understood the instructions of the task, the respondents did poorly and found this task challenging. The test could also be considered out-dated as it was created in 1967 and has not been modified. These considerations may have influenced the study as the data was initially skewed. Therefore, other divergent thinking tasks may be easier to understand and should be considered for any future studies in divergent thinking.

- **Administration**: There were two researchers involved in the administration of the tests, one with the private school participants and one with the government school participants (as described in Procedure). Although the researchers were trained the same and decided on a standardised order of administration, there was still a margin for differences to occur. Differences may have occurred due to the following reasons: a) testing areas had to meet specific criteria but they were not identical, b) rapport between the researcher and the respondents, and c) the scoring of the tests of each school by the respective researcher. The researcher recommends that one administrator and scorer be used in future studies to control differences.

- **Setting**: Although the study controlled for certain factors such as lighting, a room with a table and chairs to try minimise distractions, the environments were not identical for the two school types. There was also limited control over distractions such as the school bell and students in the corridors. These factors could influence the results of the study. It is recommended that environments be as homogeneous as possible for the respondents at different schools in order to minimise any confounding factors.

Despite the limitations mentioned above, this study still contributes to the current literature and understanding of language experience and the cognitive constructs divergent thinking and working memory in samples of early adolescence South Africans. It also makes an important contribution to future research in this area.

Reference List

Adams, A., & Willis, C. (2001). Chapter 4: Language processing and working memory: A developmental perspective. In J.Andrade (Ed.), *Working Memory in Perspective*. New York: Psychology Press.

Akbari Chermahini, S. (2011). Neural and cognitive mechanisms of creativity (Doctoral Dissertation,) Leiden University, Leiden, Netherlands.

Alexander, N. (2013). Language in the new South African university, *In Thoughts on the New South Africa* (pp.74 – 112). Johannesburg: Jacana.

Alloway, T. P. (2014). Chapter 1: Our brain's post-it note. In T.P. Alloway & R.G. Alloway (Eds.), *Understanding working memory* (2nd Ed.) (pp. 1 – 14). London, UK: SAGE.

Anthony, K. (2012). *Exploring the relationship between the characteristics of language experience and the cognitive functions of a group of multilingual adolescents* (Honours dissertation. Retrieved from University of the Witwatersrand - WIReDSpace).

Baddeley, A. (2000). The episodic buffer: A new component of working memory? *Trends in Cognitive Sciences*, 4(11), 417-423.

Baddeley, A. (2010). Working memory. *Current Biology*, 20(4), 136-140.

Baddeley, A. D., & Hitch, G. (1974). Working memory. In G.H. Bower (Ed.), *The psychology of learning and motivation: Advances in research and theory: Volume 8* (pp. 47–89). New York: Academic Press.

Baddeley, A. Gathercole, S., & Papagno, C. (1998). The phonological loop as a language learning device. *Psychological Review*, 105(1), 158-173.

Baker, C. (1988). *Key issues in bilingualism and bilingual education.* Clevedon: Multilingual Matters Limited.

Barron, F., & Harrington, D.M. (1981). Creativity, intelligence, and personality. *Annual Review of Psychology*, 32, 439 -476.

Bialystok, E. (1997). The structure of age: In search of barriers to second language acquisition. *Second Language Research,* 13, 116–137.

Bialystok, E. (1999). Cognitive complexity and attentional control in the bilingual mind. *Child Development*, 70(3), 636-644.

Bialystok, E. (2004). *Bilingualism in development: Language, literacy and cognition.* New York, NY: Cambridge.

Bialystok, E. (2005). Consequences of bilingualism for cognitive development. In J. F. Kroll & A. M. B. De Groot A.M.B. (Eds.), *Handbook of Bilingualism: Psycholinguistic approaches* (pp. 417 – 432). New York: Oxford University Press.

Bialystok, E. (2010). Global-local and trail-making tasks by monolingual and bilingual children: beyond inhibition. *Developmental Psychology,* 46, 93–105

Bialystok, E., Craik, F. I., Green, D. W., & Gollan, T. H. (2009). Bilingual minds. *Psychology Science. Public Interest,* 10, 89–129.

Bialystok, E., Craik, F. I., Klein, R., & Viswanathan, M. (2004). Bilingualism, aging, and cognitive control: evidence from the Simon task. *Psychology of Aging*, 19, 290–303.

Bialystok, E., Craik, F. I., & Luk, G. (2008). Cognitive control and lexical access in younger and older bilinguals. *Journal of Experimental Psychology: Learning. Memory. Cognition.* 34, 859–873.

Bialystok, E., Craik, F. I. M., & Ryan, J. (2006). Executive control in a modified anti-saccade task: Effects of aging and bilingualism. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 32, 1341–1354

Bialystok, E., & Hakuta, K. (1998). Confounded age: Linguistic and cognitive factors in age differences for second language acquisition. In D. P. Birdsong (Ed.), *New perspectives on the critical period hypothesis for second language acquisition.* Hillsdale, NJ: Erlbaum.

Bialystok, E., & Viswanathan, M. (2009). Components of executive control with advantages for bilingual Children in two cultures. *Cognition*, 112, 494-500.

Blessing, L.T.M., & Amaresh Chakrabarti, A. (2009). *DRM, a design research methodology.* London: Springer.

Bonn, M., Janeke, C., & Kruger, P. (2009). Honours psychology students' perceptions of job-related skills. *New Voices in Psychology*, 5(1), 49-62.

Byrd, D. (2012). Cognitive benefits of being bilingual. *Journal of Washington Academy of Sciences*, 98(3), 19 -30.

Calvo, N., Ibáñez, A., & García, A.M. (2016). The impact of bilingualism on working memory: A null effect on the whole may not be so on the parts. *Frontier Psychology*, 7(265), 1- 4.

Cenoz, J., & Genesee, F. (Eds.). (1998). *Beyond bilingualism: Multilingualism and multilingual education*. Clevedon: Multilingual Matters.

Chin, N.B., & Wigglesworth, G. (2007). Unit A1: Describing bilingualism. In N.B.Chin & G. Wigglesworth, Bilingualism: An advanced resource book. New York, NY: Routledge.

Research Report has been approved for MA degree in Psychology by the University.

Clark, E.V. (2003). *First language acquisition*. Cambridge: Cambridge University Press.

Craik, F. & Bialystok, E. (2005). Intelligence and executive control: Evidence from aging and bilingualism. *Cortex*, 41, 222-224.

De Dreu, C.K., Nijstad, B.A., Baas, M., Wolsink, I, & Roskes, M. (2012). Working memory benefits creative insight, musical improvisation, and original ideation through maintained task-focused attention. *Personality & Social Psychology Bulletin*, 38, (5), 656-669. doi: 10.1177/0146167211435795

Engle, R.W. (2010). Role of working memory capacity in cognitive control. *Current Anthropology*, 51(S1), S17-S26.

Feng, C., Wang, H., Lu, T., Chen, T., He, H., Lu, Y., & Tu, X.M. (2014). Log-transformation and its implications for data analysis. *Shanghai Archives of Psychiatry*, 26 (2), 105-109.

Furley, P., & Memmert, D. (2015). Creativity and working memory capacity in sports: working memory capacity is not limiting factor in creative decision making amongst skilled performers. *Frontiers in Psychology*, 6 (115), 1 – 7.

Gertken, L.M., Amengual, M. & Birdsong, D. (2014). Assessing language dominance with the bilingual language Profile. In P. Leclercq, A. Edmonds, & H. Hilton. (Eds). *Measuring L2 proficiency: Perspectives from SLA* (pp. 208 -225). Bristol, UK: Multilingual Matters

Glisky, E.L. (2007). Chapter 1: Changes in cognitive function in human gging. In D.R. Riddle (Ed.), *Brain aging: models, methods, and mechanisms* (pp. 3 -20). Boca Raton, Florida: CRC Press.

Research Report has been approved for MA degree in Psychology by the University.

Gathercole, S. E., Pickering, S.J., Ambridge, B., & Wearing, H. (2004). The structure of working memory from 4 to 15 Years of Age. *Developmental Psychology*, 40(2), 177-190.

Gruber, H.E., & Bödeker, K. (2005). Chapter 6: Coping with the extraordinary: On the relation between giftedness and creativity. In H.E. Gruber & K. Bödeker (Eds.), Creativity, psychology and the history of science (pp. 365 – 422). Netherlands: Springer

Guilford, J.P. (1967). Creativity: Yesterday, today and tomorrow. *Journal of Creative Behavior,* 1(1), 3 -14.

Guilford, J.P., Christensen, P.R., Merrifield, P.R & Wilson, R.C. (1960) Alternate Uses Manuel & Sample. California: Sheridan Supply Co.

Hacksley, M., Jeffery, C., Mesthrie, R., Reddy, T., & Wildsmith-Cromarty (2007). *Towards a nuanced view of multilingualism.* South Africa: English National language body of the Pan South African Language Board.

Haarmann, H. J., O'Rourke, P. O., & Ragusa, E. (2013). *Does divergent thinking training improve language learning and performance? Literature review reveals benefits and suggests testable approaches* (TTO 1009: Technical Report Deliverable). College Park: University of Maryland Center for Advanced Study of Language, 10/04/'13.

Hakuta, K., & Diaz, R.M. (1985). The relationship between degree of bilingualism and cognitive ability: A critical discussion and some new longitudinal data. In K.E. Nelson (Ed.) *Children's Language: Volume 5.* Hillsdale, NJ: L. Erlbaum.

Herdina, P., & Jessner, U. (2002). *Towards a dynamic view of multilingualism: Perspectives of Change in Psycholinguistics*. UK: Multilingual Matters.

Hespos, S.J., Thomas, B., & Piccin, T.B. (2009). To generalize or not to generalize:

Spatial categories are influenced by physical attributes and language. *Developmental Science,* 12 (1), 88 – 95. DOI: 10.1111/j.1467-7687.2008.00749.x

Hommel, B., Colzato, L.S., Fischer, R., & Christoffels, I.K. (2011*).* Bilingualism and creativity: Benefits in convergent thinking come with losses in divergent thinking. *Frontiers in Psychology.* 2, (273). 1- 5.

Huck, S.W. (2012). *Reading statistics and research. (6th Ed.)* Boston: Pearson Prentice Hall.

Kecskes, I., & Albertazzi, L. (2007). *Cognitive aspects of bilingualism.* Netherlands: Springer.

Kemp, C. (2009). Defining multilingualism. *In L. Aronin & B. Hufeisen (Eds.), The Exploration of Multilingualism* (pp.11-26). Amsterdam, Netherlands: John Benjamins Publishing, Company.

Lambert, W.E., Havelka, J.R., & Gardner, C. (1959). Linguistic manifestations of bilingualism source. *The American Journal of Psychology,* 72, 77-82.

Leiken, M., & Tovli, E. (2014). Bilingualism and creativity in early childhood. Creativity Research Journal, 26 (4), 411-417.

Leiken, M. (2013). The Effect of bilingualism on creativity: Developmental and educational perspectives. *International Journal of Bilingualism,* 6, 1-17.

Locke, J. (2011). The development of linguistic systems: Insights from evolution. In J. Guendouzi, F. Loncke & M.J Williams (Eds.), *The handbook of psycholoinguistics and cognitive processes: Perspectives in communication disorders* (pp. 3 -30). New York, NY: Psychology Press.

Research Report has been approved for MA degree in Psychology by the University.

Marian, V., Blumenfeld, H.K., & Kaushanskaya, M. (2007). The Language Experience and Proficiency Questionnaire (LEAP-Q): Assessing language profiles in bilinguals and multilinguals. *Journal of Speech, Language, and Hearing Research*, 50, 940-967. doi: 10.1044/1092-4388(2007/067)

Marian, V. & Shook, A. (2012). *The cognitive benefits of being bilingual.* Cerebrum, 13, 1 – 12. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3583091/

Martí, F., Ortega, P., Idiazabal, I., Barrena, A., Juaristi, P., Junyent, C., Uranga, B., & Amorrortu, E. (Eds.), (2005). *Words and worlds: World lanaguages review*. Clevedon: Multilingual Matters.

Namazi, M., & Thordardottir, E. (2010). A working memory, not bilingual advantage, in controlled attention. *International Journal of Bilingual Education: Bilingualism.* 13, 597–616. doi: 10.1080/13670050.2010.488288

National Department of Basic Education (1998). National Education Policy Act No. 27 Of 1996 - Admission Policy For Ordinary Public Schools. Retrieved January 7, 2018 from https://www.education.gov.za/Resources/Policies.aspx

Nussbaum, M. (2015). Chapter 6: Basic nonparametric tests for ordinal data. In *Categorical and nonparametric data analysis: Choosing the best statistical technique*. New York, NY: Routledge.

Palmiero, M., Di Giacomo, D., & Passafiume, D., (2014). Divergent thinking and age-related changes. *Creativity Research Journal*, 26(4), 456-460.

Peal, E., & Lambert, W.E. (1962). The relation of bilingualism to intelligence. *Psychological Monographs*, 76, 1 -23.

Psychological Corporation (2009). Wechsler Individual Achievement Test –

Third Edition. San Antonio: Psychological Corporation.

Reynolds, C.R., & Fletcher-Janzen, E. (Eds.). (2007). *Encyclopedia of special education: A reference for the education of children, adolescents, and adults with disabilities and other exceptional individuals*. New Jersey: John Wileys & Sons, Inc.

Ricciardelli, L.A. (1992). Creativity and bilingualism. *Journal of Creative Behavior,* 26(4), 242-254.

Runco, M.A., & Acar, S. (2012). Divergent thinking as an indicator of creative potential. *Creativity Research Journal*, 24 (1), 66-75. doi: 10.1080/10400419.2012.652929

Sandoval, T.C., Gollan T.H., Ferreira, V.S., Salmon, D.P. (2010). What causes the bilingual disadvantage in verbal fluency: The dual-task analogy. *Bilingualism: Language and Cognition*, 13:231–252.

Schwieter, J.W. (2016). *Cognitive control and consequences of multilingualism.* Amsterdam: John Benjamins Publishing Company.

Shi, B., Wang, L., Yang., J., Zhang., & Xu, L. (2017). Relationship between divergent thinking and intelligence: An empirical study of the Threshold Hypothesis with Chinese Children. *Frontier Psychology*, 8 (253), 1 – 9. doi: 10.3389/fpsyg.2017.00254

Shuttleworth Edwards, A. (2013). The WISC-IV Test Performance in the South African Context. In S. Laher., & K. Cockcroft. Psychological Assessment in South Africa: Research and Applications.

Shuttleworth-Edwards, A., & Van der Merwe, A.S. *(2015).* WAIS-III and WISC-IV South African Cross-Cultural Normative Data Stratified for Quality of Education. In F.R. Ferraro (Ed). *Minority and Cross-Cultural Aspects of Neuropsychological*

Assessment: Enduring and Emerging Trends (pp.72 -96). New York: Taylor & Francis. Pg 72 – 96

Southard, E. (2014). Examining the relationships among working memory, creativity, and intelligence. (Master Thesis) Retrieved from UNF Theses and Dissertations. Paper 548.(http://digitalcommons.unf.edu/etd/548).

Takeuchi H., Taki Y., Hashizume H., Sassa Y., Nagase T., Nouchi R., & Kawashima, R. (2011). Failing to deactivate: the association between brain activity during a working memory task and creativity. *Neuroimage,* 55, 681–687.

Takeuchi, Taki, Hashizume, Sassa, Nagase, Nouchi, & Kawashima, (2011)

Vandervert, L. R., Schimpf, P. H., & Hesheng, L. (2007). How working memory and the cerebellum collaborate to produce creativity and innovation. *Creativity Research Journal*,19(1), 1-18. doi:10.1080/10400410701277043

Vartanian, O., Jobidon, M.E., Bouak, F., Nakashima,A., Smith, I., Lam, Q., & Cheung, B. (2003). Working memory training is associated with lower prefrontal cortex activation in a divergent thinking tasks. *Neuroscience,* 236, 186 – 194.

Webb, V.N. (2002). *Language in South Africa: The role of language in national transformation, reconstruction and development.* Amsterdam: John Benjamins Publishing Company.

Webb, M.E., Little, D.R., Cropper, S.J., & Roze,K. (2017). The contributions of convergent thinking, divergent thinking, and schizotypy to solving insight and non-insight problems. Thinking & Reasoning, 23 (3), 245-238.

Wechsler, D. (2014). *Wechsler Intelligence Scale for Children* – Fifth Edition.

USA: Pearson.

Wen, Z., & Mota, M.B. (Eds.). (2015). *Working memory in second language acquisition and processing.* Canada: Multilingual Matters.

Wiley, J. & Jarosz, A.F. (2012). Working memory capacity, attentional focus, and problem solving. Current Directions in Psychological Science, 21(4), 258 – 262.

Research Report has been approved for MA degree in Psychology by the University.

Appendix 1: Demographic Questionnaire

Demographic Questionnaire

CODE | | | | |

Demographic Questionnaire

Child's Full Name: _____

Gender: | M | | F | Date of Birth: | D | D | | M | M | | Y | Y | Y | Y |

Home Language: _____ School Language:_____

Current Grade:_____

Did your child ever fail a grade at school? If so, which one?_____

Did your child attend pre-primary school? _____

Living Amenities & Caregiving:

Educational and occupational status of parents or primary caregivers:

Mother: Level of Education		**Father: Level of Education**	
No schooling		No schooling	
Less than primary school completed		Less than primary school completed	
Primary school completed		Primary school completed	
Secondary school not completed		Secondary school not completed	
Secondary school completed		Secondary school completed	
Tertiary education completed		Tertiary education completed	
Other		Other	
Current occupation:		Current occupation:	

Marital status of primary caregivers:

Married	
Living together as husband and wife	
Widow/widower	
Divorced/separated	
Never married	

Number of caregivers in the household (please tick):

0	
1	
2	
>2	

Living Standards Measure:

Please answer the following questions according to your child's circumstances while growing up.

Question	Answer	
1. I have the following in my household:		
TV set	TRUE	FALSE
Video game console (e.g.. Xbox or Play Station)	TRUE	FALSE
DVD player	TRUE	FALSE
M-Net/DStv subscription	TRUE	FALSE
Hi-fi/music centre	TRUE	FALSE
Computer / Laptop	TRUE	FALSE
Vacuum cleaner/floor polisher	TRUE	FALSE
Dishwashing machine	TRUE	FALSE
Washing machine	TRUE	FALSE
Tumble dryer	TRUE	FALSE
Home telephone (excluding a cell)	TRUE	FALSE
Deep freezer	TRUE	FALSE
Fridge/freezer (combination)	TRUE	FALSE
Microwave oven	TRUE	FALSE
Built-in kitchen sink	TRUE	FALSE
Home security service	TRUE	FALSE
3 or more cell phones in household	TRUE	FALSE
2 cell phones in household	TRUE	FALSE
Home theatre system	TRUE	FALSE
2. I have the following amenities in my home or on the plot:		
Tap water in house/on plot	TRUE	FALSE
Hot running water from a geyser	TRUE	FALSE
Flush toilet in/outside house	TRUE	FALSE
3. There is a motor vehicle in our household	TRUE	FALSE
4. I am a city dweller	TRUE	FALSE
5. I live in a house, cluster or town house	TRUE	FALSE
6. I live in a rural area outside Gauteng	TRUE	FALSE
7. There are no radios, or only one radio (excluding car radios) in my household	TRUE	FALSE
8. There is no domestic workers or household helpers in household (both live-in & part time)	TRUE	FALSE

Appendix 2: Selective Questions of the Language Experience and Proficiency Questionnaire (LEAP-Q)

CODE: _____

1. Please list all the languages you speak in the order of which you feel is most dominate (from the ones you speak better to those you do not know very well)
   1. Language 1 _____
   2. Language 2 _____
   3. Language 3 _____
   4. Language 4 _____
   5. Language 5 _____

2. Now from all the languages you listed above, which one did you learn first, second, third, etc.? (Order of acquisition)
   1. Language learned 1st _____
   2. Language learned 2nd _____
   3. Language learned 3rd _____
   4. Language learned 4th _____
   5. Language learned 5th _____

3. If you have to speak with someone that speaks all the same languages that you know, in which language would you speak with that person?

   _____

4. Please rate the level of proficiency (ability) on speaking, understanding and reading the languages you know on a scale of 0 (I don't know) to 10 (Extremely well).

Speaking each language:

1. Language: _____ Rate:

0	1	2	3	4	5	6	7	8	9	10

2. Language: _____ Rate:

0	1	2	3	4	5	6	7	8	9	10

3. Language: _____ Rate:

0	1	2	3	4	5	6	7	8	9	10

4. Language: _____ Rate:

0	1	2	3	4	5	6	7	8	9	10

5. Language: _____ Rate:

Research Report has been approved for MA degree in Psychology by the University.

Understanding of each language:

1. Language: _____ Rate: 0 1 2 3 4 5 6 7 8 9 10
2. Language: _____ Rate: 0 1 2 3 4 5 6 7 8 9 10
3. Language: _____ Rate: 0 1 2 3 4 5 6 7 8 9 10
4. Language: _____ Rate: 0 1 2 3 4 5 6 7 8 9 10
5. Language: _____ Rate: 0 1 2 3 4 5 6 7 8 9 10

Reading in each language:

1. Language: _____ Rate: 0 1 2 3 4 5 6 7 8 9 10
2. Language: _____ Rate: 0 1 2 3 4 5 6 7 8 9 10
3. Language: _____ Rate:
4. Language: _____ Rate: 0 1 2 3 4 5 6 7 8 9 10
5. Language: _____ Rate:

Research Report has been approved for MA degree in Psychology by the University.

Appendix 3: Letter to the Principle

PSYCHOLOGY
THE SCHOOL OF HUMAN AND COMMUNITY DEVELOPMENT (SHCD)

Private Bag 3, Wits, 2050 · Tel: 011 717 4541 · Fax: 011 717 4559 · E-mail: psych.SHCD@wits.ac.za

Letter seeking access and consent for school research

Dear Principal,

Good day. My name is Kirstin Anthony and I am currently completing my Master of Psychology by Coursework and Research Report at the University of the Witwatersrand. For the purpose of my studies, I am required to undertake research. My research is entitled; **Exploring the relationship between divergent thinking and working memory in linguistically diverse early adolescents.** This project falls within a bigger research study that also seeks to explore the relationship between these variables and language experience (such as monolingualism, bilingualism and multilingualism) in which Jaime Abrahams (Masters Student in the field of Education Psychology) is part of the team and is also under the supervision of Mrs. Aline Ferreira-Correia.

I will be conducting a short cognitive evaluation of school students in the 7th to 9th grades (12 – 14 years). Standardized assessments will be used to measure working memory (ability to mentally hold and process information) and divergent thinking (ability to think about many ideas related to one concept). This evaluation involves tests such as the Alternate Uses Test and the Digit Span, Picture Span and the Letter-Number Sequencing subtests from the Wechsler Intelligence Scale for Children-Fifth Edition (WISC-V) as well as language questionnaires. There will also be a demographic and which will be completed by the parents/guardians. As Academic Achievement is one of the core variables of my study, access to academic records in the form of the learners' school reports will be required as we are looking specifically at results obtained in English and Mathematics. The entire assessment takes approximately 30 to 40 minutes for each participant.

I am requesting permission to invite all the potential participants in grades 7 to 9 from your school by sending the information sheet, consent form and demographic questionnaire attached to all parents/guardians. All the letters and envelopes will be provided. Consent to participate will be requested from the parents or legal guardians. Information letters, consent forms and assent forms have been prepared for these purposes and have been attached for your perusal.

I am contacting you in order to respectfully request your permission to conduct data collection in your School. This permission and the help I require involves:

1- Getting in touch with the 7th to 9th grades teachers in order to organise with them the best moment for the student that has been granted consent to be invited to participate and be assessed.

Research Report has been approved for MA degree in Psychology by the University.

2- Having a quiet and well-lit space in the school premises, with a desk and two chairs, in which I can conduct the assessments

Data collection will take place in May and June 2017 and I would like to organise whenever is most convenient for the school community during this time.

This research will adhere to all the Ethical Principles and protocols endorsed by the University of the Witwatersrand's Human Research Ethics Committee (HREC Non-Medical). This involves no-harm, voluntary participation, confidentiality, and right to withdraw at any stage during the data collection. Although there are no individual benefits to participating in the study, the information gained will however contribute to the broader understanding of academic achievement in the South African context.

The report resulting from this research will be available in the library of the University of the Witwatersrand, which offers access to material on the world-wide web. The findings will also potentially be published in scientific journals. I will send a digital copy of the results of the study to you by June 2018.

If you do grant me permission to conduct research at your institution, would you please be so kind as to complete the attached consent form. You may either email the letter to me or I can collect it directly from you. My details as well as my supervisors' details appear below should you need any further information.

I look forward to hearing from you.

Yours sincerely

Kirstin Anthony

Cell: 083 676 3850

Email: kirst_10@yahoo.com

Aline Ferreira-Correia

Tel: (011) 011 717 4527

Email: Aline.FerreiraCorreia@wits.ac.za

Appendix 4: Parent/Guardian Information Sheet

PSYCHOLOGY
THE SCHOOL OF HUMAN AND COMMUNITY DEVELOPMENT (SHCD)

Private Bag 3, Wits, 2050 · Tel: 011 717 4541 · Fax: 011 717 4559 · E-mail: psych.SHCD@wits.ac.za

Parent/Legal Guardian Information Sheet

Dear Parent/Guardian

My name is Kirstin Anthony; I am completing my Master of Psychology by Coursework and Research Report at the University of the Witwatersrand. For the purpose of my studies, I am required to undertake research. I would like to invite your child to participate in my research.

My research aims to examine the interactions between the following:

- Divergent thinking (a component of creativity)
- Working Memory (ability to mentally hold and process information)
- Language acquisition and proficiency (information about the number of languages each participant knows and uses)
- Academic Performance (Specifically looking at English and Mathematics)

It is important to note that this research is part of a bigger study including co – researcher Jaime Abrahams (Masters Student in the field of Education Psychology). The larger study also involves investigating the relationship between divergent thinking and working memory, as well as language and academic performance. The results obtained from this research will be shared with Jaime Abrahams. This research and the larger study are under the supervision of clinical psychologist Mrs. Aline Ferreira-Correia.

Specifically, I am looking for voluntary participants between the ages of 12 and 14, with no history of neurological illnesses or head injuries. I have gained permission from the School's Principal in order to conduct the study at their school.

This research aims to make a significant contribution to the understanding of how speaking one or more languages have an impact on particular cognitive functions (such as working memory and divergent thinking), and how this can potentially contribute to the academic performance of children in the 7th to 9th grades. There is very limited research regarding these important variables in the South African context. The findings may be of particular interest to psychologists and educators.

If you agree to allow your child to participate, he/she will be invited to meet with me for an assessment session that involves different types of activities, from answering questions, remembering information and solving different types of cognitive problems. The tests of this protocol tools are frequently used by psychologists all over the world when conducting psychological research. This process will take approximately 30 to 40 minutes. This testing

Research Report has been approved for MA degree in Psychology by the University.

will take place at your child's school in a time that does not affect academic or sport attendance. As Academic Achievement is one of the core variables of my study, access to your child's academic records in the form of the learners' school reports from the current year, will be required as we are looking specifically at results obtained in English and Mathematics.

Your child will not receive any compensation, monetary or otherwise, for participating in the study and no negative consequences for withdrawing. I would therefore like to stress that your child's participation in this research is entirely voluntary and may withdraw from it at any point.

Your child's identity as a participant will be only known to me, my fellow researcher and our supervisor. The test protocols will be stored in a locked file cabinet (at my supervisors' office) and the results stored in a password protected computer. Only we and our supervisor will have access to these files. To protect confidentiality, the name or other personal identification data will not be used. Instead, an identification number will be used in each protocol. The school and teahers will not have access to any of the results obtained during testing. These results will not affect you child's acadmic results.

If you agree to allow your child participate in the study it is required that you complete the attached consent form and the demographic questionnaire on behalf of your child. The consent form, demographic questionnaire and school reports will be kept separately from the rest of the data for the purpose of confidentiality.

The report resulting from this research will be available in the library of the University of the Witwatersrand, which offers access to material on the world-wide web. The findings will also potentially be published in scientific journals. If you wish to have access to the results, you may request so by contacting me. The results are expected to be ready by June 2018.

Should any matters require further clarification please do not hesitate to call me at 0605286356, or email me at kirst_10@yahoo.com.

You may also contact my research supervisor, Ms. Aline Ferreira-Correia telephonically at 011 717 4527 or via email at Aline.FerreiraCorreia@wits.ac.za.

Thank you and Kind Regards,





Kirstin Anthony

Cell: 083 676 3850

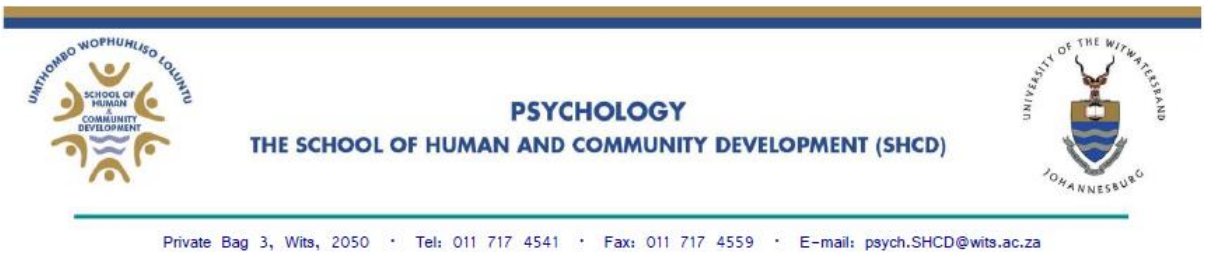
Email: kirst_10@yahoo.com

Aline Ferreira-Correia

Tel: (011) 011 717 4527

Email: Aline.FerreiraCorreia@wits.ac.za

Appendix 5: Consent Form



Consent Form

Dear Kirstin Anthony

I, Mother/Father/Legal Guardian of _____

give consent for my child to participate in this study.

I understand:

- The aims and procedures of the research are provided in the information sheet.
- There is no risk or harm that could come to my child from participating in this study.
- Participation is completely voluntary
- My child may choose to withdraw from the study at any time, for any reason, with no negative consequences.
- My child's identity and results will be confidential and the information will be kept in a password secure file in a password secure computer and the protocols of the tests will be kept in a locked cabinet, both only accessible to the researchers and the supervisor.
- No rewards will be offered or provided for my child's participation.
- I have received the contact details of the researcher (Kirstin Anthony) and the supervisor (Mrs Aline Ferreira Correia)
- The research will be conducted at my child's school, for approximately 30 minutes, during a period that would not involve missing class or extra mural activities.
- If I consent to my child participating I will complete the Demographic Questionaire on my childs behalf.

- I can request a summary of the results on June 2018 to the researcher via email.

By allowing my child to participate I state that my child:

- Has not repeated any grade
- Has not been diagnosed with any form of learning disability
- Has no visual or hearing impairments
- Is proficient in English
- Has no history of epilepsy, meningitis, or has suffered a head injury.
- Is not on chronic medication
- Has no behavioural difficulties

Signed: _____

Date:_____

Appendix 6: Respondents Information Sheet

PSYCHOLOGY
THE SCHOOL OF HUMAN AND COMMUNITY DEVELOPMENT (SHCD)

Private Bag 3, Wits, 2050 · Tel: 011 717 4541 · Fax: 011 717 4559 · E-mail: psych.SHCD@wits.ac.za

Participant Information Sheet

Dear Student,

My name is Kirstin Anthony and I am completing my Master of Psychology by Coursework and Research report at the University of the Witwatersrand. For me to complete my studies I need to do research about how speaking one or more languages can change the way you solve problems in your mind and use your creativity, and how those can have an impact on your marks. Because I am looking at your school results I will need to access your current school year report, as I will be looking at your English and Mathematics marks.

I have contacted your parent/guardian and he/she has given me permission to invite you to participate in this research. It will take 30 to 40 minutes and I will ask you to remember information, think about new ideas and solve a few problems in your mind. Participating in the research will not interfere with any of your academic lessons or extra mural activities. Your answers are confidential, which means that no one will have access to them, and they will not be shared with the school and your teachers. These results will not affect your school academic results. Instead of using your name in your answers, we will use a number.

If you are willing to take part in the study please write your name or sign attached assent form. . You will not receive any reward for participating. If you decide not to participate you can let me know at any stage and we will stop with no negative consequences.

If you have any questions after the assessment you may ask your parent/guardian to contact me at, 0836763850, or email me at kirst_10@yahoo.com.

You may also contact my research supervisor, Mrs. Aline Ferreira Correia telephonically at (011) 717 4527 or via email at Aline.FerreiraCorreia@wits.ac.za.

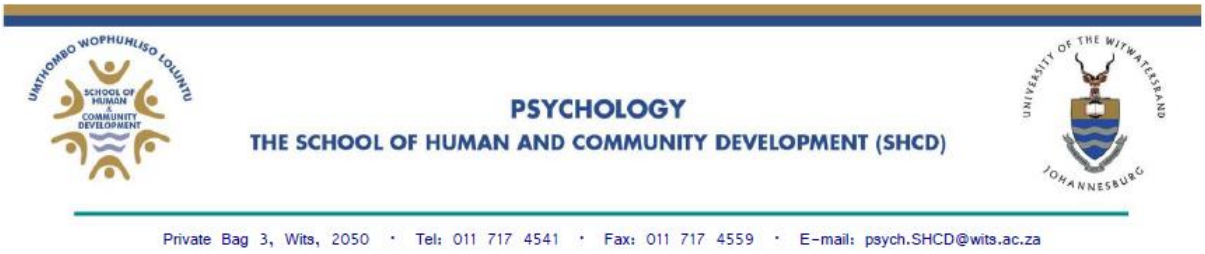
Thank you and regards,

Kirstin Anthony

Aline Ferreira-Correia

Research Report has been approved for MA degree in Psychology by the University.

Appendix 7: Assent Form



Participant Assent Form

I, _____ understand:

- I have been invited to participate in this study.
- Kirstin Anthony has explained what the study is about.
- That there are no rewards that will be given if I say yes.
- That there are no negative consequences if I choose not to participate.
- I can stop the activities at any time that I want.
- That my name will not be used in any materials or reports as the information will be confidential and anonymous.
- I can ask questions at any time.

Would you like to participate? Please tick one of the boxes below.

☐ Yes, I am willing to participate in the study

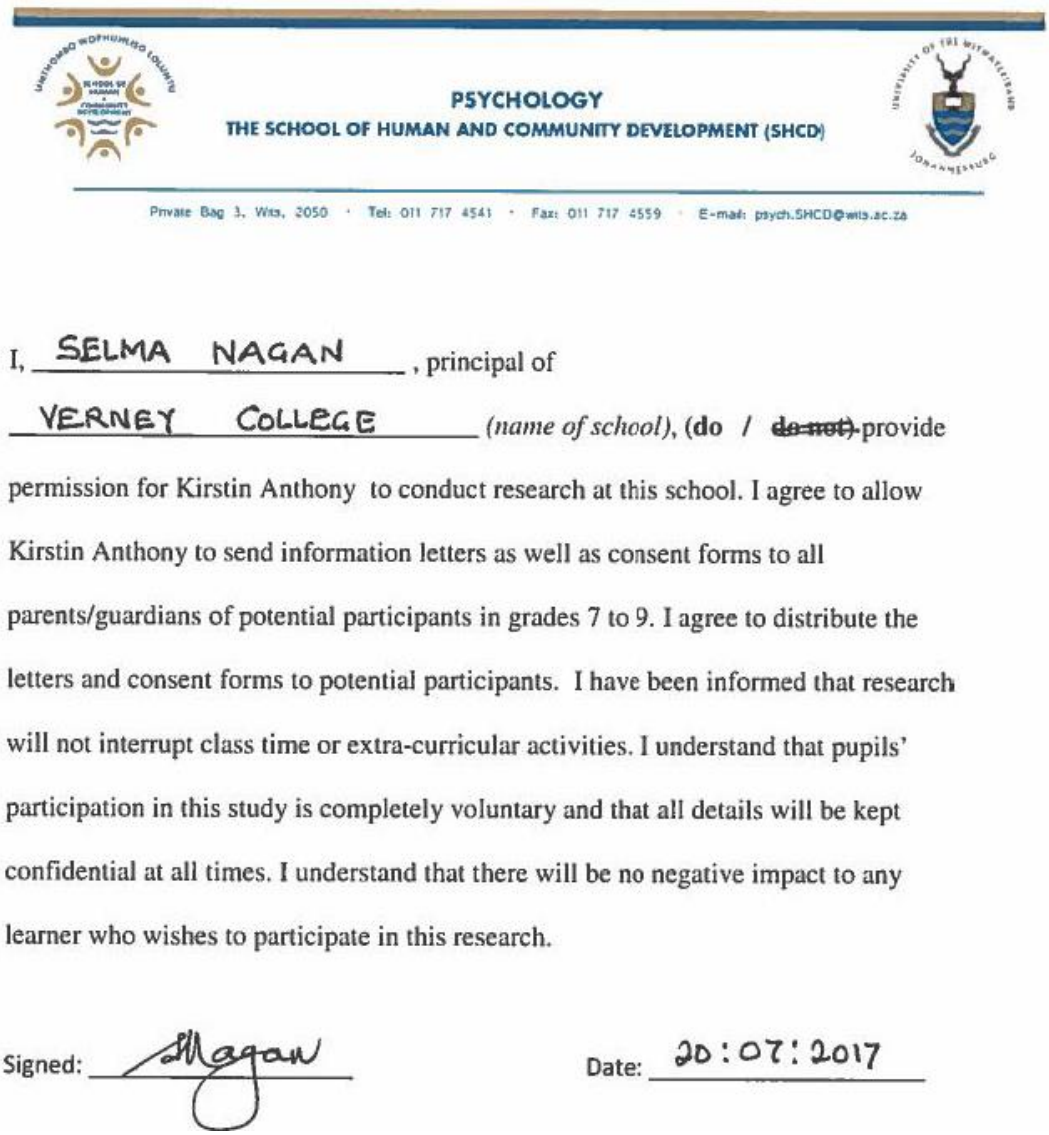
☐ No, I am not willing to participate in the study

(Signing the form will indicate that you will participate in the study)

_____ _____

Name/Signature Date

Appendix 8: Permission from Private School Principle



PSYCHOLOGY
THE SCHOOL OF HUMAN AND COMMUNITY DEVELOPMENT (SHCD)

Private Bag 3, Wits, 2050 · Tel: 011 717 4541 · Fax: 011 717 4559 · E-mail: psych.SHCD@wits.ac.za

I, SELMA NAGAN, principal of

VERNEY COLLEGE *(name of school)*, (**do** / ~~**do not**~~) provide permission for Kirstin Anthony to conduct research at this school. I agree to allow Kirstin Anthony to send information letters as well as consent forms to all parents/guardians of potential participants in grades 7 to 9. I agree to distribute the letters and consent forms to potential participants. I have been informed that research will not interrupt class time or extra-curricular activities. I understand that pupils' participation in this study is completely voluntary and that all details will be kept confidential at all times. I understand that there will be no negative impact to any learner who wishes to participate in this research.

Signed: Nagan Date: 20:07:2017

Research Report has been approved for MA degree in Psychology by the University.

Appendix 9: Ethics Certificate

Research Report has been approved for MA degree in Psychology by the University.