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UNIVERSITY OF THE
WITWATERSRAND,
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# Comparison of the Psychometric Properties of the Alternative Use Test in South Africa and Venezuela

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A dissertation submitted to the Faculty of Humanities in fulfilment of the requirements for the degree of Master of Arts by Research (Dissertation) in Psychology. University of the Witwatersrand, Johannesburg, 2022

## Abstract

The Alternative Uses Test (AUT) is a measure for divergent thinking, a cognitive process associated with creativity, by assessing the fluency component of divergent thinking, which refers to the number of new and different ideas created from one stimulus (Guilford et al., 1978; Runco & Acar, 2012). The AUT lacks standardised norms (Hass, 2017; Lewis & Lovatt, 2013), which are needed to obtain accurate assessments as divergent thinking can be vulnerable to age-related changes and educational levels. This study investigated the psychometric properties of the AUT in three different samples: A Venezuelan sample of 358 participants between the ages of 20 and 85, a South African sample of 125 older adults between the ages of 65 and 89, and a South African sample of younger adults between the ages of 18 and 49. The findings of this study included internal consistency coefficients between acceptable and strong for all three samples. The present study did not find any significant associations between gender and fluency. However, it found that age had significant effects on fluency in both the Venezuelan and the South African samples. Years of education had a weak relationship with fluency in the Venezuelan sample, but it had significant effects on fluency in the South African Older Adult sample. The fluency scores were compared between the two countries by age group and found only significant differences between the groups of young adults. Lastly, normative data is provided for the Venezuelan sample, stratified by age, and for the South African Older Adults sample, stratified by educational level.

Keywords: divergent thinking, alternative uses test, sociodemographic variables, South Africa, Venezuela.

## Declaration

I, Nicole Gaffuri Soto, declare that this dissertation is my own, unaided work. It is being submitted for the degree of Master of Arts by Research (Dissertation) in Psychology at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at any other university.



_____ ____9/03/2022____

Nicole Gaffuri Soto
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Date

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## Dedication

Ad Maiorem Dei Gloriam. This dissertation is dedicated to Venerable Mother Maria Félix Torres. Thanks to her, this was possible.

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# Chapter 1: Introduction

Divergent thinking is a cognitive process closely associated with creativity (Runco & Acar, 2012). The Alternative Uses Test (AUT), which was developed by Guilford, Christensen, Merrifield, and Wilson (1978), measures this construct by taking into account the four components of the cognitive process (fluency, originality, flexibility, and elaboration). The AUT has presented strong inter-rater reliability coefficients (Blake & Palmisano, 2021; Stevenson et al., 2014) and acceptable internal consistency reliability coefficients (Silvia et al., 2008; Tanis, 2017). However, to the knowledge of the researcher, the AUT has not had any normative data published (Hass, 2017; Lewis & Lovatt, 2013) other than the ones presented in the test manual. The norms presented in this manual were done on samples of American school children and university students and are now outdated (see Guilford et al., 1978). Thus, no normative studies have been done for the AUT on Venezuelan and South African samples.

The present research used secondary data from Venezuela and South Africa. Although geographically far from each other, the two cultures share some similarities regarding socioeconomic backgrounds, educational inequalities, and high school dropout rates (Calatrava, 2020; Cockcroft et al., 2015; Jaramillo, 2018; Weybright et al., 2017). On the other hand, these two countries also have some differences, specifically in the linguistic backgrounds, as the South African population is largely multilingual (Posel & Zeller, 2015), while the Venezuelan population is generally monolingual (Library of Congress, 2005). Comparing these two countries could highlight the importance of developing country-specific norms. That is because questions that arise regarding how specific sociodemographic variables need to be controlled for, such as language practices, and educational and socioeconomic backgrounds, can be answered. Similarly, cross-country comparisons can

answer questions regarding the possibilities of using foreign norms when the countries at hand are similar in cognitive-relevant demographic variables, as is inequality.

In these samples, the demographic variables of gender, age and educational level were explored in terms of their relationships with divergent thinking, as there is some evidence of the potential effect that these variables can have on divergent thinking performance in tests like the AUT (Alcock, 2021; Kamp et al., 2015; Kapoula et al., 2016; Razumnikova, 2004; Restrepo et al., 2019; Stephens et al., 2001; Syahrin et al., 2019). Therefore, these variables need to be considered when creating normative data for this test.

This research study addressed the lack of norms for the AUT (Hass, 2017; Lewis & Lovatt, 2013) while also increasing the existing knowledge on the apparent relationships that exist between demographic variables (gender, age, and education) and divergent thinking, specifically, the fluency component of divergent thinking. The objectives of this study were to evaluate the internal consistency reliability of the AUT in a Venezuelan sample and two South African samples: one sample of younger adults and the other of older adults. It aimed to observe whether the demographic variables had any relationship or effect on the fluency scores of the AUT in Venezuela and South Africa and to compare the fluency scores between the two countries by age group. This study also aimed to create normative data for the fluency scores of the AUT from a Venezuelan and a South African sample.

This dissertation is divided into seven chapters. Chapter two included a review of the literature to clearly understand the background of divergent thinking and the AUT by taking into account some of the variables that can affect the scores when measuring this cognitive process. The chapter specifically explored the effects of gender, age, and years of education on divergent thinking, the psychometric properties of the AUT, and potential culturally specific variables such as multilingualism, socioeconomic status and quality of education that

could create discrepancies in the tests scores. This chapter also included the rationale, main objectives, and the research questions of this study.

Chapter three described the research methods of the present study. It described the nature of the study as quantitative research. The samples from the three secondary datasets that were used for this study and the corresponding sampling methods used to gather these samples were also described in this chapter. This section of the study also explained the instruments and the procedure used to complete this research while briefly mentioning the testing procedures of the three original datasets. The ethical considerations were also clarified in this chapter before describing the data analyses that were carried out to obtain the research results.

In chapter four, the results and findings of the study were reported. First, the reliability coefficients for the AUT were reported for the three samples. This was followed by a description of the fluency variables for the three samples and the findings from the exploration of the relationships between the demographic variables (gender, age, and years of education) and the fluency variables (Part 1 Fluency, Part 2 Fluency, Total Fluency, and Total Error) with the use of correlations. After the correlations, the variables that showed significant relationships were then tested with ANOVAs and t-tests to see whether these relationships could be understood as effects that the demographic variables had on fluency. Subsequently, the fluency mean scores of the samples from the two countries were compared by age groups to assess whether any significant differences existed in the test performance between the Venezuelan and the South African samples. Lastly, regression-based norms were computed for the Venezuelan sample, as well as for the South African Older Adults sample, stratified by age and years of education, respectively.

The fifth chapter contained the discussion, where the main findings were interpreted in terms of answering the research questions of this study and presenting them against previous research to understand the significance of the results observed in this study for the existing literature.

Chapter six reviewed the limitations present in the study and gave recommendations for future research. Lastly, chapter seven concluded the dissertation and summarised the main findings.

# Chapter 2: Literature Review

The present chapter included background information about divergent thinking and its interactions with the demographic variables of gender, age, and education. It continued by describing the AUT, which is explored throughout this research study, in terms of its reliability and its lack of normative studies. Subsequently, some of the cultural variables of Venezuela and South Africa and their potential impact on divergent thinking and psychometric measures were explored while arguing for the need for culturally centred normative studies for the AUT. This was followed by the rationale of this study, its main objectives, and the research questions.

## 2.1. Divergent Thinking

Divergent thinking was initially defined and assessed as part of the evaluation of creativity and, more so, as part of the Structure of Intelligence (SOI) model described by Guilford (1959). The SOI is an outdated model of intelligence, which was later replaced by other, more relevant, modern conceptualisations of intelligence, such as Gardner's theory of multiple intelligences (Gardner, 1996) or the Cattell-Horn-Carroll theory (McGrew, 1997). Nonetheless, the SOI was most impactful for the distinctions of divergent and convergent thinking, both of which remain relevant concepts to the present day and are still a point of reference in the field of creativity.

Although both divergent and convergent thinking are involved in the process of creativity, the two are entirely different. On the one hand, convergent thinking involves narrowing down different ideas to arrive to one solution that can be regarded as the most optimal (Guilford, 1959; Jones & Estes, 2015). On the other hand, divergent thinking describes the opposite of

that process. Divergent thinking involves coming up with many different ideas or solutions from one specific problem or stimulus (Ismail et al., 2019; Schroeter et al., 2019).

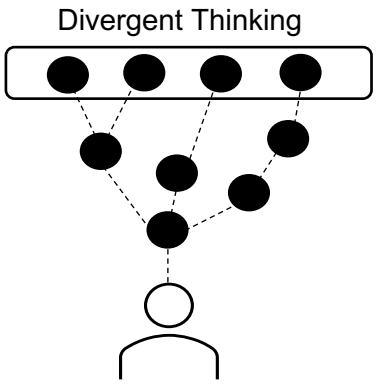
Divergent thinking can be defined as the ability or capacity to produce various solutions to a problem (Best et al., 2015; Ismail et al., 2019). Guilford (1967) argued that divergent thinking is primarily concerned with the "generation of ideas, as in solving a problem, where variety is important" (p. 8). In other words, divergent thinking is the process where novel ideas are created. It is, therefore, a cognitive process that leads to original conceptions, which, in turn, leads to creativity and creative thinking (Runco & Acar, 2012). Hence, divergent thinking is considered to be a main factor in the process of creativity but is not to be used as a synonym for creativity (Ismail et al., 2019; Vries & Lubart, 2019), although, in some cases, the two are often confused and used interchangeably (see Restrepo et al., 2019; Vidler, 1974).

The process of divergent thinking is depicted in Figure 1. Every black circle shown in Figure 1 represents an idea, and the box at the top represents the final outcome of the process. As it can be seen, there are multiple ideas or black dots on the outcome box, which branched out from a single black circle, representing the different notions that the individual can come up with from one single stimulus.

Divergent thinking is described to have four major components that lay the basis for measuring this construct (Hicks & Engle, 2019). These include fluency, flexibility, originality, and elaboration (Runco & Acar, 2012). The first component mentioned, fluency, refers to retrieving necessary information from memory to create many different ideas (Guilford, 1967; Runco & Acar, 2012). Flexibility describes the ability to elaborate different concepts by transforming the information gathered in the first component (Arefi & Jalali, 2016; Guilford, 1967; Runco & Acar, 2012). Originality consists of creating novel information (Runco & Acar, 2012), which relates to the basis of creative thinking. Lastly,

**Figure 1**

*Processes of Divergent Thinking*




*Note.* Adapted from "Diverging from the Dogma: A Call to Train Creative Thinkers in Science" by Isabel M. Schroeter, Chiara C. Forrester, Laurel M. Brigham, Erin R. Fried, Kathryn C. Grabenstein, Claire C. Karban and Molly T. McDermott, 2019, *Bulletin of the Ecological Society of America*, 100(1), p. 2.

elaboration refers to the extent to which the newly created concepts are extensively detailed (Arefi & Jalali, 2016; Guilford, 1967).

This cognitive process has been demonstrated to involve various brain regions, including a bilateral activation of the frontal lobe (Carlsson et al., 2000), specifically the superior, inferior, and middle frontal gyri (Adnan et al., 2019). Activation of the anterior cingulate cortex has also been associated with the originality component of divergent thinking, and myelination in the basal ganglia, specifically in the caudate nucleus and substantia nigra, has been associated with fluency (Zhang et al., 2021). Interestingly, these areas of the brain have also been associated with the executive functions and cognitive control (Adnan et al., 2019; Friedman & Robbins, 2022; McGough et al., 2018; Wiecki & Frank, 2013). Many studies have explored whether divergent thinking is associated with these executive functions, and while some studies have found positive results for executive

functions to play a role in divergent thinking (see Adnan et al., 2018; Bai et al., 2021; Zhao et al., 2021), others, although fewer, have shown evidence for the executive functions to hinder divergent thinking (see Vaisarova & Carlson, 2021).

These associations that divergent thinking has with the executive functions sparked curiosity on whether this cognitive process reacts to demographic variables in similar ways as these executive functions do.

### *2.1.1. Gender Differences in Divergent Thinking*

Many studies have shown either inconclusive or mixed results in gender differences in divergent thinking performance; however, it seems that most of the studies show no significant differences between men and women (Abraham, 2016; Reese et al., 2001). For instance, a study done by Reese and colleagues (2001) used the Alternative Uses Test (AUT), which is the same test explored in the present study, to measure divergent thinking in a sample of 400 adults that included young adults and older adults. This study found no significant differences in the performance of any of the four components of divergent thinking between men and women. However, for the variable of fluency, gender approximated the significance threshold (Reese et al., 2001).

Comparatively, a different study that measured divergent thinking using the Torrance Test of Creative Thinking on a sample of 228 school-aged children found that girls had significantly greater fluency scores when compared to boys. Nonetheless, the two had no significant differences in the originality scores (Kousoulas & Mega, 2009). Another study on gender differences in children showed similar results where girls outperformed boys in all areas of divergent thinking when using the Torrance Test of Creative Thinking on a sample of 165 children between the ages of 7 and 12 years (Stephens et al., 2001).

These gender differences in divergent thinking can be more prevalent in children than in older populations, as it has been argued to be the case for intelligence (Stumm & Plomin, 2015). These discrepancies between gender at young ages can be attributed to differences in brain development, as males have shown to reach the peak values of brain volume at later stages than females (Lenroot & Giedd, 2010). For example, the grey matter of the frontal lobe reaches its peak at around age 12 for boys, while girls tend to reach peak volumes as much as one year earlier than boys (Giedd et al., 1999). However, other studies have attributed these differences to societal and cultural expectations, including gender stereotypes and the amount of support, or lack thereof, that is perceived by each gender (Abraham et al., 2014; Nakano et al., 2021; Razumnikova, 2004). The present study compares divergent thinking scores between the two genders in samples from Venezuela and South Africa. As the two countries share similar gender stereotypes and expectations in terms of educational expectations, job prospectus, family responsibilities, and so forth (Mwamwenda, 2013; United Nations, 1997), it could be expected for the two samples to show similar results in the association between gender and divergent thinking.

Interestingly, research studies involving EEG scans have found that, although there seems not to be any gender-based behavioural differences regarding divergent thinking performance, there are some physical differences regarding areas of the brain involved in this cognitive process. In addition, a study using EEG scans showed different patterns of hemispheric organisation between the two genders while engaging in tasks relating to divergent thinking (Razumnikova, 2004). This raises a debate about how, despite these physiological differences, no gender-related differences in the scores of divergent thinking tests have been found. Explorations into the qualitative aspects of the answers may provide some insight into the relationship between divergent thinking and gender.

### *2.1.2. The Role of Age in Divergent Thinking*

As with any other cognitive function, divergent thinking has a developmental trajectory, evolving from childhood to adulthood, where it seems to reach a plateau (Restrepo et al., 2019). However, the process of decline remains uncertain as studies have shown mixed results (Palmiero et al., 2014). These age differences can be attributed to neuropsychological maturity and the degradation of the prefrontal lobe that is observed with ageing (Abraham, 2016; Restrepo et al., 2019).

A study in Taiwan using the New Tests of Creative Thinking, a modified Chinese version of the Torrance Tests of Creativity Thinking, compared the developmental trends of divergent thinking scores between the 1990s and the 2010s (Chang et al., 2017). The study included the responses from 1674 children and adolescents attending grades five to 11 from two datasets, one which was gathered in the 1990s and another in the 2010s (Chang et al., 2017). This study revealed similar trends in the two instances where divergent thinking performance increased with age (Chang et al., 2017). Another study compared the performance of divergent thinking measured by the AUT and the Creative Ability Test between adolescents and young adults on a sample of 98 individuals between the ages of 12 and 30 (Kleibeuker et al., 2013). The findings of this study significantly favoured the sample of young adults in terms of their originality scores. The authors of this study attributed these differences in divergent thinking to the developmental maturity of the brain, specifically of the frontal lobe, at these two life stages (Kleibeuker et al., 2013).

It has been argued that divergent thinking reaches a plateau around the age of 40, a stage where the development of this cognitive process seems to stabilise (Fusi et al., 2021; Palmiero, 2015; Restrepo et al., 2019). Moreover, a study done with a sample of 150 participants, between the ages of 20 and 80 years of age, equally divided the sample into six

age groups from young adults to old adults and measured divergent thinking using the AUT and the Creative Mental Synthesis Task (Palmiero, 2015). This study found that the younger adults (20 – 29 years) outperformed the oldest group of participants (70 – 80 years) in fluency, flexibility, and originality and demonstrated that divergent thinking reaches a peak performance around the age of 40, where it plateaued and did not seem to decrease in the later age groups (Palmiero, 2015). Similarly, another study that used the AUT to measure and compare divergent thinking performance of 24 young adults aged between 18 – 30 years, and 24 older adults aged between 64 – 87 years, did not find significant differences between the two groups (Madore et al., 2016). Studies of divergent thinking targeted only to older adults seem to be scarce. However, there is one particular study of this nature done on a South African sample of older adults (see Alcock, 2021). The study found no differences in age when comparing a group of adults between the ages of 71 and 75 years to a group of older adults between the ages of 76 – 80 years after using the AUT to measure divergent thinking (Alcock, 2021).

Contrasting studies have shown that, although divergent thinking does stabilise during middle adulthood, it starts to decline after the age of 70 in terms of fluency, as this is a cognitive process that is highly associated to the frontal lobe and can be susceptible to the deterioration of this area of the brain (Restrepo et al., 2019). For instance, a study that compared the divergent thinking between young adults (19 – 25 years) and older adults (57 – 82 years) using the Torrance Test of Creative Thinking found a decline in the visual fluency scores between the two groups (Palmiero et al., 2014). Given that the Torrance Test of Creative Thinking that was used to measure divergent thinking is time-limited, the decline in performance may be secondary to the decline in processing speeds associated with ageing (Foos & Boone, 2008; Palmiero et al., 2014; Park et al., 2001; Restrepo et al., 2019). Comparably, another study measured 60 young adults and 60 older adults on five divergent

thinking tests that were all time-limited, including Associational Fluency, Expressional Fluency, Ideational Fluency, Word Fluency, and the Test of Consequences (Foos & Boone, 2008). Each age group was randomly divided into two groups; one group took the tests with the established time limits and the other group without the time limits. The findings of this research aligned with the suggestion that slower processing speeds affect the test performance in older adults, as it showed that the group of older adults could score similarly to the group of young adults in the no-time condition (Foos & Boone, 2008).

Therefore, research regarding divergent thinking in older adults is imperative to clarify whether other demographic variables or cognitive processes interact with divergent thinking in this population. In addition to looking at the relationship between divergent thinking and age, the present research will also study divergent thinking in terms of its relationships with gender and years of education. This can help elucidate whether other variables are at play regarding divergent thinking and ageing.

### *2.1.3. The Role of Education in Divergent Thinking*

Given the developmental nature of divergent thinking, and as is the case with other cognitive functions, this process is susceptible to educational experience and training (Bott et al., 2014; Kamp et al., 2015; Kapoula et al., 2016; Syahrin et al., 2019). For instance, a study carried out with a sample of high school students showed improved scores in divergent thinking, measured by the Verbal Instances Test, after attending meta-cognition lessons when compared to a control group that did not attend these lessons (Kamp et al., 2015). These improvements were specifically seen in the fluency and flexibility scores but not in the originality scores of the students (Kamp et al., 2015). This study hints that divergent thinking can be improved and developed with training and education. Additionally, another study analysed the originality, flexibility, and elaboration of the problem-solving of written

assignments of university students (Syahrin et al., 2019). The data for this study was gathered using a tool and guide specifically developed to explore the divergent thinking patterns shown in the student's written assignments (Syahrin et al., 2019). The study found that divergent thinking is an active cognitive process when writing scientific assignments (Syahrin et al., 2019). Thus, divergent thinking can be targeted and developed with educational experience, either by the completion of assignments that make particular use of this cognitive process or by attending lessons that can potentially impact these patterns of thinking in the students (Kamp et al., 2015; Syahrin et al., 2019).

Conversely, educational environments can also negatively impact the divergent thinking of some students, as seen in a study done on engineering students. The study measured the divergent thinking of 62 engineering students currently enrolled in their first year and 95 engineering students completing their final year of university with the Test of Creative Thinking-Drawing Production and the Watson-Glaser Critical Thinking Appraisal (Sola et al., 2017). This study discovered a significant decline in the originality, flexibility and elaboration scores of the final year students compared to the first years, which was attributed to a lack of training in creative and problem-solving abilities in the engineering curriculums (Sola et al., 2017). The educational environment's impact on divergent thinking is further corroborated by a study on high school students from Belgium and France diagnosed with dyslexia. The study compared divergent thinking scores of students from two different educational environments with the Torrance Test of Creative Thinking (Kapoula et al., 2016). The students from a Belgic high school, who get personalised classes that attend to their specific needs, showed higher divergent thinking scores than the students from a French high school that attempts to normalise the classes of the students with dyslexia and offers extra training if needed (Kapoula et al., 2016). Hence, the educational environment, and the patterns of thinking instilled by this environment, could also affect this cognitive process.

Moreover, educational experience has been known to decrease the rates at which the brain deteriorates in old age (Clouston et al., 2019; Reas et al., 2017; Vemuri et al., 2014). A research study on 2225 adults between the ages of 31 and 99 found that those participants who achieved higher levels of education across their lifespan showed less deterioration in executive functions (Reas et al., 2017). A similar study explored the cognitive performance of adults between the ages of 70 and 89 years and attained similar results favouring highly educated individuals (Vemuri et al., 2014). Another study on a similar sample of old adults found that the more educated participants showed reduced cognitive impairments associated with Alzheimer's Disease and related dementias than those with less academic achievements (Clouston et al., 2019). These studies describe the importance of educational experience when it comes to age-related deterioration and raise the question of whether the same can be seen for other cognitive processes like divergent thinking, which, as described before, is associated with the executive functions.

Interestingly, a study on a sample of older adults aged 65 to 80 explored whether educational level affected various cognitive processes, including divergent thinking (Alcock, 2021). This study used the AUT to measure the divergent thinking performance of the participants and found that higher educational levels seemed to decrease the cognitive losses related to age deterioration (Alcock, 2021). The author of this study explained that those participants with more educational experience could employ "compensatory strategies" that diminished their cognitive deterioration (Alcock, 2021, p. 226).

A gap in the literature exists regarding illiterate adults and their performance in divergent thinking tasks. In western countries, illiterate people are not a common occurrence, but in countries like South Africa and Venezuela, where school dropout rates are high (Verril, 2016; Weybright et al., 2017), illiterate individuals are more common to see. As educational

experience is an important variable that can affect divergent thinking performance (see Alcock, 2021; Kamp et al., 2015; Kapoula et al., 2016; Syahrin et al., 2019), it would be interesting to see whether illiteracy also affects divergent thinking.

The present study included participants with less education than completed high school in two of the samples, and it would be expected to see differences in the divergent thinking performance between these groups and those with university-level education. To measure these differences, as well as the role of age and gender on the process of divergent thinking, a popular measure for this construct called the Alternative Uses Tests (AUT, Guilford et al., 1978) was used in the three samples.

### 2.2. Alternative Uses Tests by J.P. Guilford

The first attempt to measure creative thinking was with the Unusual Uses Test, and after modifications, revisions, and the development of the SOI model, and thus, the classification of divergent thinking, the modern version of the Alternative Uses Test (AUT) came about (Guilford et al., 1978). The AUT is a popular measure for divergent thinking that is often used in groups of all ages (see Alcock, 2021; Guilford et al., 1978; Kleibeuker et al., 2013; Madore et al., 2016; Palmiero, 2015; Reese et al., 2001). This test consists of asking the examinee to come up with up to six different and novel uses for six everyday objects in a set amount of time (Guilford et al., 1978). The AUT is divided into two sections, each one having three items and a time limit of four minutes, bringing the total testing time to eight minutes (Guilford et al., 1978).

The method of scoring the AUT consists of comparing the responses to a set of criteria that names possible types of answers, deeming them acceptable or unacceptable (Guilford et al., 1978). For a response to be acceptable, however, it must be a possible use for the object at

hand. An example given on the scoring guide of the AUT describes that the use of "a ring for the finger" given to the object "automobile tire" cannot be an acceptable use as it is not physically possible for this object (Guilford et al., 1978). The responses are then scored accordingly; one point is awarded for an acceptable response, and no points are awarded if the response is deemed unacceptable (Guilford et al., 1978). All the acceptable responses are added up to attain the fluency score (Tanis, 2017). To attain the Flexibility score, the responses are assessed in terms of their generalised functions (Dippo & Kudrowitz, 2013); for example, "to hold a pen" and "to hold the door" are similar responses and would not count for flexibility as the two are included in the same category of "to hold". The Originality score is defined by the rarity and uniqueness of the response by counting how many times the same response was given by other participants in the sample (Dippo & Kudrowitz, 2013). Lastly, the Elaboration score refers to the detail in which the responses are given (Alhashim et al., 2020). As the examiner has to give their personal input to assess the responses at the time of scoring, the AUT has been described as a subjective measure of divergent thinking, as it has been the case for other tests that measure the same constructs, such as the Test of Consequences and the Instances Task (Silvia, 2011).

To attain accurate scores of the divergent thinking abilities of the respondents, it is essential to provide clear instructions to the examinees when applying the test and ensure that the participants have a good understanding of what is expected. This is because some researchers have come to the conclusion that instructing participants to "generate many ideas" can decrease their originality but boost their fluency. In contrast, the opposite happens when they are instructed to "generate creative ideas" (Reiter-Palmon et al., 2019, p. 146). Therefore, instructing participants to generate as many creative ideas as possible is needed to attain relevant scores of their divergent thinking performance. To account for these issues from the instructions, an additional approach to scoring the AUT can be considered, which includes the

top-two approach, where participants are asked to pick their top two most creative responses, which are then averaged to an overall score (Silvia et al., 2008).

The AUT has been described to present construct validity, discriminant validity and predictive validity (Guilford et al., 1978; Runco & Acar, 2012). In terms of reliability, the AUT has been measured in different aspects of reliability. The initial psychometric properties testing for this test, as described in the test manual, were carried out in the United States of America using samples of children, teenagers, and university students (Guilford et al., 1978). The AUT was tested for internal consistency using the Spearman-Brown formula, which showed very strong reliability estimates of .75 in adults (Guilford et al., 1978). In contrast, the test-retest reliability measured on children showed low results ranging between .53 and .63 (Guilford et al., 1978). However, it was explained by Guilford and colleagues (1978) that the low scores could be attributed to the short period of time between the first test and the retest.

Later studies have also taken on the task of exploring the reliability of the AUT. An Australian study that used the AUT on a sample of 119 adults obtained a strong inter-rater reliability of .86 (Blake & Palmisano, 2021). Similarly, a study that used the AUT to measure fluency and originality scores on a sample of 132 Dutch adolescents and adults had an even stronger inter-rater reliability score of .91 (Stevenson et al., 2014).

Other studies have also shown good reliability coefficients using tests for internal consistency, including a study on various samples of Dutch students, which obtained a reliability coefficient of .71 (Tanis, 2017). Another study on a sample of 79 American undergraduate students observed acceptable reliability coefficients of .70 and .63 for the AUT when scored by only one rater (Silvia et al., 2008). The maximal reliability of the AUT has been compared to other similar tests that measure the same construct, such as the Test of Consequences and the Instances Task (Silvia, 2011). The study concluded that, of the three

tests, the AUT scored highest in maximal reliability (Silvia, 2011). In general, it has been found that the reliability of measures of divergent thinking with subjective scoring is high when the task is short-timed (Benedek et al., 2013), which is the case for the AUT. Given the strong reliability scores obtained in the described studies and seeing that many of these studies were done using samples from western countries, the present study will explore the internal consistency reliability of the AUT in samples from South Africa and Venezuela.

In psychometrics, individual scores from psychological assessments are often analysed against a set of standardised norms, representing the measure's typical or expected performance (American Psychological Association, 2022). The normative data for this test, available in the test manual, only included American students from the fifth, sixth and ninth grades and first year of university (Guilford et al., 1978). Although the norms were obtained from large sample sizes for each age group, these norms cannot be extended to older subjects, as it was described before that divergent thinking continues to develop in adulthood (Palmiero, 2015; Restrepo et al., 2019). Therefore, normative samples need to be highly representative of the population in which the test is being applied. There are no published normative studies for the AUT to date (Hass, 2017; Lewis & Lovatt, 2013), and the norms reported on the test manual are to only be taken as frames of reference for the test and not as national norms for the American population (Guilford et al., 1978).

It is widely recognised that sociodemographic variables such as age, gender, and education, as well as other cultural variables, can affect test outcomes (Bergman & Almkvist, 2015; Duff & Ramezani, 2015; Fastenau, 1998; Pérez-Enríquez et al., 2021) hence, there is a need to create normative studies that cater for underrepresented cultures. Additionally, lacking appropriate norms could even go as far as hindering the applicability of a test in certain cultures (Burggraaff et al., 2017). Additionally, norms can be stratified to account for

different sociodemographic variables that can affect the measured construct. For instance, a normative study for a test measuring visual organisation and visual synthesis found that age and years of education affected the test performance; thus, the normative data was created while taking into account these sociodemographic differences (see Campagna & Ferreira-Correia, 2021). Due to the lack of normative studies for the AUT, the present study aims to create stratified norms for a Venezuelan and a South African sample while also considering the sociodemographic effects, hoping to motivate more studies to create culturally specific normative data for the AUT.

The AUT has been widely used around the world to measure divergent thinking, including in countries such as Chile, Indonesia, South Africa, and Spain (see Alcock, 2021; Benigno, 2016; Edery, 2016; Gonzalez & Mairal, 2004; Ismail et al., 2019; Steinsapir, 2018). This shows that this test is extensively relevant when measuring divergent thinking and creative potential across different contexts. For instance, a study explored the interaction between divergent thinking and academic performance by using the AUT on a sample of 39 high school students from Chile and concluded that, although there was no link between the two variables, divergent thinking measures such as the AUT can become relevant in different contexts (Steinsapir, 2018). Additionally, a South African study investigated and found links between divergent thinking and working memory with the AUT in a sample of 111 university students (Benigno, 2016). A study carried out in Indonesia also used the AUT on a sample of university students, this time, the study explored the divergent thinking skills of students who were undergoing preparations for a standardised test of English as a foreign language (TOEFL) and found that higher scores in divergent thinking performance were associated with higher scores on the TOEFL (Ismail et al., 2019).

These studies applied the AUT on largely different samples from different countries and contexts, illustrating the vast possibilities in which the AUT can bring in new information about divergent thinking. However, due to the lack of norms for the AUT, the interpretation of these results observed in countries from the Global South, such as are Chile, South Africa, and Indonesia (Dados & Connell, 2010), could be imprecise if they were to be compared to the norms presented in the test manual of the AUT. Normative studies catered for the cultures and countries in which they will be used can increase information given by similar studies like the ones previously described and can enhance not only the applicability of the test but also the representativeness of the score on the examinees' divergent thinking performance (Arango-Lasprilla et al., 2015; Burggraaff et al., 2017).

### 2.3. Impact of Culture on Psychometric Measures

A psychometric test can behave differently when applied in other countries as cultural biases come into play, thus, affecting the measurement tool and creating limitations in the applicability of the test and potentially affecting the test's validity (Ardila, 1995). Therefore, it has been recommended to develop country-specific normative data to improve the interpretation of test results for a more accurate representation (Arango-Lasprilla et al., 2015).

Bilingualism and multilingualism have been proven to significantly enhance many cognitive processes and executive functions, such as cognitive control and working memory (Cockcroft et al., 2019; Pot et al., 2018). Additionally, the translation of tests can affect psychometric measures. For example, the semantical structure of an item in a different language can impact how the test taker interprets the item, thus impacting their responses (Daouk-Öyry & McDowal, 2013). This could be made apparent when comparing the results of a test between countries that used the same test in different languages, as is the case in this study, and should be taken into consideration when observing the results.

In terms of divergent thinking, some evidence has shown that bilingualism and multilingualism can affect test performance when measuring this cognitive process. A study that compared groups of bilingual young adults with high and low proficiencies found links between bilingual proficiency and divergent thinking, as low-proficient bilinguals outperformed the group of high-proficient bilinguals in fluency tasks (Hommel et al., 2011). Another study on a sample of bilingual individuals found that, in terms of fluency scores, those who switch between their two spoken languages on a daily basis outperformed those bilinguals who do not tend to switch between languages on a daily basis (Storme et al., 2017). In contrast, a study on a sample of South African older adults over the age of 65 did not find significant differences between multilinguals, bilinguals, and monolinguals on divergent thinking performance (Alcock, 2021). With these mixed results, it is essential to keep in mind the potential effects of bilingualism and multilingualism when exploring divergent thinking.

South Africa enjoys a culturally rich and multilingual society with eleven official languages and many more languages that are recognised by the South African government (Kaiper, 2018). It is important to note that even though isiZulu, isiXhosa and Afrikaans are the most popular languages spoken in South Africa, most businesses and education facilities operate in English (Africa, 2016; Posel & Zeller, 2015). Thus, many South Africans are fluent in more than one language, including English, and a different language that is spoken in their household (Posel & Zeller, 2015). Comparatively, there is only one official language in Venezuela, Spanish, and only a minority of indigenous people speak other recognised dialects (Library of Congress, 2005). Even though language experience is not measured in the present study, one could argue that given this landscape and even the language policies of both countries, there are significant differences between the linguistic environment of South Africa and Venezuela, the former with a diversity that is embedded in everyday life, and the latter with a majority of monolingual experiences in and outside the home. Given the link between

divergent thinking and multilingualism already discussed, it can be expected to see higher scores in the South African samples when compared to the Venezuelan sample. However, it is important to note that this study will not control the variable for languages spoken. Nonetheless, it is still of high importance to keep these differences in mind, not only to have a complete understanding of the cultures that will be compared but also to gain insight into the psychometric variations that can exist in test performance across the different countries.

Some of the differences between South Africa and Venezuela are tied to how their cultures are intrinsically. For instance, South Africa is a multicultural country, and many of these cultures can differ greatly from one another. Furthermore, in South Africa, the black communities have a collectivistic nature while white communities have a more individualistic nature (Zyl et al., 2018), which can, in turn, create significant variability in the psychometric properties of the South African samples. In contrast, the Venezuelan culture is largely homogeneous with smaller indigenous cultures, as compared to the South African multiculturality (Library of Congress, 2005). However, this study will not be able to differentiate between the different cultures and ethnicities that coexist in South Africa when comparing the two countries as these variables were not accounted for in the datasets that the present study used. Nonetheless, these variabilities between the countries should be kept in mind at the time of comparing them, as these could potentially change the value and applicability of the test between the two countries (Burggraaff et al., 2017).

Socioeconomic status and education could also potentially affect test performance and create bias in test results. Socioeconomic status has proven to affect the development of executive functions. A study on children between the ages of 4 and 6, an important developmental period of the components of the executive functions, found significantly lower capacities on inhibitory control and working memory in children coming from lower

socioeconomic backgrounds (John et al., 2019). This raises questions on whether similar results can be seen for divergent thinking, as it is another cognitive process closely associated with the frontal lobe. Another study on bilingual and monolingual children found trends of lower verbal short-term memory performance in children from disadvantaged backgrounds in terms of their lower socioeconomic status (Meir & Armon-Lotem, 2017). Other authors attribute these poor performances on certain neuropsychological tests to the lower quality of schooling that is present in the disadvantaged backgrounds due to the poor educational systems rather than to disabilities or impaired mental capacities (Rajabi, 2009; Smith & Valarezo, 2013). Thus, creating difficulties when measuring certain constructs in countries with larger poverty rates, educational inequalities, and school dropouts. On a similar note, a study done on a sample of South African older adults found that socioeconomic status and education were associated with divergent thinking performance in old age (Alcock, 2021). The study concluded that high-quality education created a conducive environment for cognitive development that translated into decreased cognitive impairment in old age, hence affecting the divergent thinking process (Alcock, 2021). Given these results seen in older adults, it would be interesting to extend similar studies to other age groups.

The educational system in South Africa is still seeing the effects of apartheid. Schools that were reserved for white children during the apartheid period had been developed with the highest standards and bigger budgets compared to schools that were reserved for black children (Cockcroft et al., 2015). Furthermore, to this day, the latter continue to struggle to find the resources they need to provide quality education (Cockcroft et al., 2015). Moreover, the schooling inequality gap becomes accentuated by the socio-economical inequalities, as the schools that were previously reserved for white children and that are now still seen to have a predominantly white population tend to have higher school fees than the schools with a

predominantly black population (Branson & Lam, 2010; Salisbury, 2016). Thus, maintaining the educational inequality gap embedded in the apartheid era.

The education system in Venezuela also presents inequalities rooted in the country's social and economic conditions. The educational gap is highlighted in the comparison between privately funded schools and public schools, which are funded by the government (Calatrava, 2020). Private schools in Venezuela can have a larger budget, allowing them to provide the learners with a better quality of education than public schools (Calatrava, 2020). Thus, creating educational inequalities in the Latin-American country. Perhaps inequalities in the educational system, saving the distances, are common aspects between South Africa and Venezuela, making them different from the other western countries.

The Venezuelan economic and humanitarian crisis has created difficulties that result in children dropping out of school (Jaramillo, 2018). School dropouts in Venezuela increased by 50% between 2011 and 2016, and some of the causes include malnourishment, lack of transportation and even the need to work at a young age to help their families afford food (Jaramillo, 2018; Verril, 2016). Likewise, a study in South Africa in 2017 found evidence that around 30% of learners drop out of school before Grade 12 (Weybright et al., 2017). More specifically, around 6% of learners drop out during Grade 9, which increases to 11% in Grades 10 and 11. The school dropouts in South Africa have been attributed to life events, struggling in school, or seeing no value in education (Weybright et al., 2017). Although is it challenging to take into account the quality of education of the participants of a study such as this one, one could have some insight into understanding how the variables of socioeconomic status and quality of education can play a role in the differences of the AUT scores and the divergent thinking skills when comparing these two countries.

## 2.4. Rationale

With the existence of translated versions of tests and their scoring systems, many professionals still question whether the psychometric properties of psychological and cognitive tests remain when applied in cross-cultural practice (Allen & Dana, 2004). Hence, the need arises for standardised measures of tests to be country and/or culture-specific. The AUT has been applied to measure divergent thinking in many different contexts, cultures, and languages; however, it is sometimes administered without standardised for a specific culture (Alcock, 2021). Runco and Acar (2012) mention that the reliability of tools that measure divergent thinking can differ across populations. Many studies (see Blake & Palmisano, 2021; Stevenson et al., 2014; Tanis, 2017) have tested the reliability of the AUT in different countries, but the majority of these studies are based in first-world countries such as the Netherlands and the United States of America. However, the reliability of the AUT has not been explored in samples from Venezuela or South Africa.

The normative studies for the AUT are scarce (Hass, 2017; Lewis & Lovatt, 2013), and the only normative data that can be taken as reference for scoring is based on a sample of American children, adolescents and university students (Guilford et al., 1978), which should not be used as a reference for older age groups given the associations that exist between age and divergent thinking (Kleibeuker et al., 2013; Palmiero, 2015). Thus, the present study aims to create normative data for samples from Venezuela and South Africa. Additionally, developing culturally specific norms is an important task for applying psychometric tests in foreign countries, especially in complex cultures that deviate greatly from the countries where the tests were developed (Arango-Lasprilla et al., 2015). Cultural differences can affect not only the test performance of the population of a country but also the development of some cognitive processes as cultural variables, like multilingualism, socioeconomic status, and

quality of education interact with them (Alcock, 2021; Cockcroft et al., 2019; Pot et al., 2018). Therefore, normative studies are important as they allow the exploration of the potential limitations of a test within specific contexts.

South Africa and Venezuela are significantly different in the sense that Venezuela is predominantly monolingual (Library of Congress, 2005), and South Africa is widely multilingual (Posel & Zeller, 2015). However, they also present similarities in their poverty rates, educational inequalities and their increasing rates of school dropouts (Calatrava, 2020; Cockcroft et al., 2015; Jaramillo, 2018; Weybright et al., 2017). For this reason, it is important to evaluate if there are significant differences in divergent thinking scores when measured with the use of the AUT as it could give insight to understand further the factors that could potentially influence the process of divergent thinking (Cheung et al., 2016).

Not only cultural variables but demographic variables like gender (Kousoulas & Mega, 2009; Razumnikova, 2004; Stephens et al., 2001), age (Alcock, 2021; Madore et al., 2016; Palmiero, 2015; Restrepo et al., 2019) and educational experience (Alcock, 2021; Kamp et al., 2015; Kapoula et al., 2016; Syahrin et al., 2019) can also come into play when assessing cognitive processes like divergent thinking. Hence, the relationship between these variables needs to be carefully explored and then taken into account when creating normative data. Stratifying normative data by demographic variables such as these ones helps create a more specific and representative set of norms for the country or culture to which the data is targeted.

### 2.5. Aims

This study aimed to evaluate the reliability coefficients of the AUT test in two samples from South Africa (younger adults and older adults) and one from Venezuela. Additionally, it

also sought to examine the relationships between the demographic variables and the AUT fluency scores in both samples. The present study also aimed to compare the fluency scores between the samples from Venezuela and South Africa in terms of age groups in order to understand the similarities between the two contexts. Lastly, this research study seeks to provide stratified normative data for the AUT for both samples.

### 2.6. Research Questions

What is the internal consistency reliability of the AUT when used in a Venezuelan sample? And what is internal consistency reliability of the AUT when used in south African samples of younger adults and older adults respectively?

Is there a relationship between the sociodemographic variables (age, gender, and years of education) and the fluency mean scores of the AUT in the South African and the Venezuelan samples, respectively? And are there any differences, in terms of test performance, between these relationships for each country-specific sample?

Is there a difference on the fluency scores of the AUT between the South African and Venezuelan samples matched by age?

What are the stratified normative data for the fluency scores of the AUT for both, South African and Venezuelan, samples?

# Chapter 3: Methods

## 3.1. Research Design

The design of the present quantitative study was non-experimental, as none of the variables were manipulated in any way (Swart et al., 2019), and it was cross-sectional as the variables were measured at only one point in time for each participant in all of the datasets that were used (Field, 2016).

## 3.2. Sample and Sampling

This study used three secondary datasets, one from Venezuela and two from South Africa, all of which employed the AUT as an instrument to measure the construct of divergent thinking. The samples were integrated by healthy adults with no history of psychiatric, cognitive, or neurological disorders. However, given that these are secondary datasets, the recruitment and sampling methods were different and, consequently, have different demographic characteristics. These samples and sampling techniques are described in detail in the following paragraphs and in Table 1.

### *3.2.1. Venezuelan Dataset*

**3.2.1.1. Sampling Method.** The sampling method used was non-probability, quota sampling (Campagna & Ferreira-Correia, 2021) as the original study aimed to create a sample representative of the Venezuelan population, specifically of the Capital District of the country, as described in the 2001 official census of the country (Instituto Nacional de Estadística, 2011).

**3.2.1.2. Sample Characteristics.** The Venezuelan dataset (Campagna & Ferreira-Correia, 2021) included 358 participants. The sample included more male than female adult participants over the age of 20, with years of education ranging from 0 to 23 years (see Table 1).

The complete Venezuelan sample was used for all of the data analyses except for the inter-country comparisons with the South African Sample. To make these comparisons possible, the Venezuelan sample was divided into two sub-samples by age groups. This was done by matching the variables of age and years of education to those from the South African samples in order to make them comparable. These two new sub-samples were addressed as Venezuelan Younger Adults and Venezuelan Older Adults, while the complete dataset will be addressed as Venezuelan sample. These subgroups were only utilised to compare the mean fluency score of each age group between the two countries, while the complete Venezuelan sample was used for all the remaining tests. The Venezuelan Younger Adult sample included 59 participants. There were more female participants in this subgroup from the Venezuelan sample than males. Moreover, the ages of the participants ranged between 20 and 48 (see Table 1). In order to match the characteristics of the South African Younger Adult sample for the comparison between countries, the participants with years of education under the first year of university were excluded from this subgroup (0 – 11 as per the Venezuelan schooling system). Hence, the years of education in this sample ranged between 12 and 23.

In addition, as shown in Table 1, the Venezuelan Older Adult sample included 52 participants between the ages of 65 and 85. In comparison to the younger adult subgroup, there were more male participants than females in this sample. The years of education of this subgroup ranged between 3 and 18 years. Illiterate participants, specifically those with less

than three years of education, were excluded from this subgroup in order to match the South African older adult sample in the same variable.

### *3.2.2. South African Samples*

**3.2.2.1. Sampling Methods.** The South African Younger Adults sample (Benigno, 2016; Edery, 2016) was collected with the use of non-probability, convenience sampling, as it used volunteer students from a public university in Johannesburg who were invited to participate in a research study and gave permission to use their data in future studies such as this one. On the other hand, the South African Older Adults sample (Alcock, 2021) was gathered using two non-probability sampling techniques, convenience sampling, through advertising of the study and approaching nursing homes and retirement villages, and snowball sampling as participants suggested other potential participants that met the criteria of the original study.

**3.2.2.2. Sample Characteristics.** The sample of South African Younger Adults (Benigno, 2016; Edery, 2016) included the responses from 73 students from a public university in Johannesburg. In Table 1, it is depicted that there were far more females than males in this sample. Table 1 also shows the ages of these participants, which ranged between 18 and 49, and their years of education, which ranged from 13 to 21 years.

Comparatively, the sample of South African Older Adults (Alcock, 2021) included the responses from 125 participants. In this sample, there were more males than females (see Table 1). Moreover, the original study for which this sample was gathered targeted elderly adults only; therefore, the ages of the participants in this sample ranged between 65 and 89 years of age. Furthermore, the years of education of this sample ranged between 3 years and 20 years.

**Table 1**

*Descriptive Statistics of All Samples and Subgroups*

| Variable | Statistics | South African Younger Adults (n=73) | South African Older Adults (n=125) | Venezuelan Sample (n=358) | Venezuelan Younger Adults (n=59) | Venezuelan Older Adults (n=46) |
|---|---|---|---|---|---|---|
| Age | *Mean* | 21.21 | 73.14 | 45.38 | 33.31 | 70.83 |
| | *Std Dev* | 5.29 | 6.35 | 16 | 8.08 | 4.14 |
| | *Median* | 19 | 71 | 45 | 33 | 70 |
| | *Minimum* | 18 | 65 | 20 | 20 | 65 |
| | *Maximum* | 49 | 89 | 85 | 48 | 79 |
| Gender | | | | | | |
| Males | *N (%)* | 16 (21.9%) | 44 (35.2%) | 196 (54.7%) | 28 (47.5%) | 30 (65.2%) |
| Females | *N (%)* | 57 (78.1%) | 81 (64.8%) | 162 (45.3%) | 31 (52.5%) | 16 (34.8%) |
| Years of Education | *Mean* | 14.12 | 12.8 | 9.14 | 14.58 | 9.85 |
| | *Std Dev* | 1.91 | 3.31 | 4.63 | 2.66 | 3.81 |
| | *Median* | 13 | 12 | 9 | 14 | 10.5 |
| | *Minimum* | 13 | 3 | 0 | 12 | 5 |
| | *Maximum* | 21 | 20 | 23 | 23 | 18 |
| Part 1 Fluency | *Mean* | 9.12 | 5.07 | 6.1 | 7.44 | 5.17 |
| | *Std Dev* | 4.04 | 3.88 | 3.45 | 4.11 | 3.09 |
| | *Median* | 9 | 5 | 6 | 7 | 5 |
| | *Minimum* | 1 | 0 | 0 | 0 | 0 |
| | *Maximum* | 18 | 16 | 17 | 17 | 13 |
| Part 2 Fluency | *Mean* | | 5.87 | 6.91 | 7.95 | 6 |
| | *Std Dev* | | 3.52 | 3.34 | 4.14 | 2.49 |
| | *Median* | | 6 | 7 | 8 | 6 |
| | *Minimum* | | 0 | 0 | 0 | 0 |
| | *Maximum* | | 16 | 17 | 17 | 11 |
| Total Fluency | *Mean* | | 10.94 | 13.1 | 15.39 | 11.17 |
| | *Std Dev* | | 6.9 | 6.2 | 7.72 | 4.86 |
| | *Median* | | 10 | 12 | 15 | 11 |
| | *Minimum* | | 0 | 0 | 1 | 0 |
| | *Maximum* | | 29 | 34 | 34 | 22 |
| Total Error | *Mean* | | | 7.96 | 8.47 | 8.43 |
| | *Std Dev* | | | 6.19 | 6.33 | 6.85 |
| | *Median* | | | 7 | 6 | 6.5 |
| | *Minimum* | | | 0 | 1 | 0 |
| | *Maximum* | | | 35 | 33 | 35 |

Note. The variables of Fluency Part 2 and Total Fluency were not available for the South African Younger Adults Sample, and the variable of Total Error was not available for neither of the South African samples.

## 3.3. Instruments

### *3.3.1. Demographic Questionnaires.*

All three datasets used different demographic questionnaires to gather the demographic data of the participants. Despite this, all three studies gathered information about the age, gender, and years of education of the participants.

### *3.3.2. Alternative Uses Test.*

The Alternative Uses Test (AUT) was used to measure divergent thinking (Guilford et al., 1978). This instrument asked participants to give a variety of new or unusual uses to common objects such as a brick or a toothpick in a limited amount of time, of 4 minutes per section (Akbarova, 2019; Hass, 2018). The complete test consisted of two sections, each having three common objects: a shoe, a button, and a key in part one; and a wooden pencil, an automobile tyre, and a pair of eyeglasses in part two (Guilford et al., 1978). During testing, the participants are generally asked to either write down or name up to six unusual uses for each object in a specific timeframe on the provided paper sheet (Guilford et al., 1978). Both the Venezuelan sample and the South African Older Adults sample used the complete test, which included the two sections, while the South African Younger adult sample only used the first part of the test.

The test manual states a list of potential responses for each item that are deemed either acceptable or unacceptable, based on what is a possible use for the object and its distinction from the common use of the said object. Each answer that the participant gives is scored as acceptable (1) or unacceptable (0) by following the set criteria (Guilford et al., 1978). For example, "to crush bugs" or "to tie on a car after a wedding" are acceptable responses given to a shoe and would award the participant one point; however, responses such as to "walk on" or

"to kick people with" are unacceptable and would not count for a point for the same item (Guilford et al., 1978). After the scoring of each answer is completed, the acceptable answers are added up, first by item and then by section, to attain the fluency score. Due to the nature of this study, which uses secondary datasets, only the fluency score was taken into consideration. However, as was displayed in the previous chapter, the majority of the demographic differences, specifically in terms of gender and age, have been previously perceived through the fluency scores obtained from different divergent thinking measures, including the AUT (see Foos & Boone, 2008; Kousoulas & Mega, 2009; Palmiero, 2015; Restrepo et al., 2019; Stephens et al., 2001). Additionally, demographic differences in divergent thinking relating to years of education have also been perceived using the fluency score in various studies (see Kamp et al., 2015).

The types of fluency scores that are yielded by this test include Part 1 Fluency, Part 2 Fluency and Total Fluency; additionally, Total Error can also be included by counting the unacceptable responses given by the participant. The only set of scores that were available on all three samples was Part 1 Fluency, which was included in all the analyses that were carried out. In addition to that, the South African Older Adults sample and the Venezuelan sample also included Part 2 Fluency and Total Fluency, which were included in the correlations, ANOVAs, and t-test of the Venezuelan sample, as well as the correlation and t-tests for years of education and fluency in the South African Older Adult sample, the country comparison t-test for the older adults, and the two regression-based norms. Lastly, only the Venezuelan sample included the scores for Total Error, which were used for the Venezuelan correlations, t-tests, and the Venezuelan regression-based norms.

### 3.4. Procedure

The first step to carrying out this study was to attain ethical clearance from Witwatersrand Human Research Ethics Committee (HREC) Medical, for which formal permission from the owners of the datasets was needed (see Appendices A, B, C, and D). The owners of the datasets were asked to compile, along with their signed permission letters (see Appendices E, F, G and H), the participant information sheets (see appendices I, J and K), the consent forms used for the original studies (see Appendices J, L and M), and the ethics clearance, if available (see Appendices N and O). It is important to note that, although the original Venezuelan study did get clearance from a relevant ethics committee, the researchers could not provide a copy of their ethics clearance due to it having been lost in a flood (see Appendix F).

After receiving ethics approval from HREC Medical (clearance number M210759) (see Appendix P), the researcher gained access to all three anonymised datasets in a Microsoft Excel format. After that, the datasets were cleaned and coded to be later imported into the IBM Statistical Package for the Social Sciences version 27 (SPSS 27) in order to carry out the data analyses.

The data collection process differed for all three datasets, as the responses for each were gathered with the use of different measures and instruments. The original Venezuelan study used single face-to-face sessions and structured interviews, which lasted around forty minutes, to collect demographic information about the participants, such as age, gender, and years of education (Campagna & Ferreira-Correia, 2021). The Graffar-Méndez Castellanos method was used to measure the participants' socioeconomic status. In addition, the Spanish versions of four tests were used to measure an array of neurocognitive abilities. These included the Stroop Test, measuring inhibitory control (Macleod, 1991); the Hooper Visual

Organisation Test (HVOT), which is used to measure visual organisation (Hooper, 1983); and the Consequences Test and the AUT to measure divergent thinking (Campagna & Ferreira-Correia, 2021; Christensen et al., 1953; Guilford et al., 1978).

The South African Younger Adults data was collected using single face-to-face sessions of 90 minutes (Benigno, 2016; Edery, 2016). Participants completed a demographics questionnaire in these sessions along with three tests to measure their working memory, creativity, and divergent thinking. These included the Automated Working Memory Assessment (AWMA) to measure their working memory (Alloway et al., 2008), the Torrance Test of Creativity (TTCT) to measure creativity (Torrance, 1972), and the AUT to measure divergent thinking (Benigno, 2016; Edery, 2016; Guilford et al., 1978).

Lastly, the South African Older Adults data was collected in a single face-to-face session, which included the following instruments: demographics questionnaire, Living Standards Measure (LSM) developed by the South African Advertising Research Foundation (SAARF) (Haput, 2017), a shortened version of the Lawton Instrumental Activities of Daily Living (IADL Lawton & Brody, 1969), Remote Associates Test (Mednick, 1968), Verbal Fluency Test (Benton & Hamsher, 1976), Montreal Cognitive Assessment (Nasreddine et al., 2005), Language Experience and Proficiency test (Marian et al., 2007), Victoria Stroop Test (Spreen & Strauss, 1998), Raven's Standard Progressive Matrices (Raven, 1989), Design Fluency Test (Jones-Gotman & Milner, 1977) and the AUT (Alcock, 2021; Guilford et al., 1978).

All the data was collected before the Covid-19 pandemic, and therefore, no safety protocols had to take place for any of the face-to-face sessions.

### 3.5. Ethical Considerations

As this research study used secondary data, it posed no risk to any of the participants. Although the original studies did obtain ethics approval, these studies intended to obtain the data to develop test norms, investigate the psychometric properties of specific tools and answer questions related to several cognitive constructs, they did not originally intend to investigate the psychometric properties of the AUT and compare different contexts as the present study does. Therefore, before conducting this study, the researcher sought ethical approval from the University of the Witwatersrand Human Research Ethics Committee (HREC (Medical) and attained the clearance number M210759 (see Appendix P) in order to gain permission to use the data for this specific purpose.

All three studies provided the participants with information sheets (see appendices I, J and K), and formal consent was obtained before participation (see appendices I, L and M). Participation was voluntary, and all the information obtained was anonymised and kept confidentially. Furthermore, the datasets remained secured in password-protected files on a computer protected by password, and only the researcher and supervisors were able to access the datasets.

### 3.6. Data Analysis

The first step of the data analysis process was to code, clean and export the data into the IBM Statistical Package for the Social Science version 27 (IBM SPSS 27). Then, descriptive statistics were carried out for all the samples and subgroups in terms of their demographic variables, as well as the fluency scores (Part 1 Fluency, Part 2 Fluency and Total Fluency) and Total Error scores, in order to have a general understanding of the data and to check for the assumptions of normality.

To test the strength of the internal consistency reliability of the AUT, the McDonald's Omega was carried out for all three samples.

The next step was to explore the influence of the demographic variables on the fluency scores with the use of correlations. However, before running the correlations, summaries of the fluency variables from all samples were stated, followed by clarifying the assumptions of normality for all the sociodemographic variables and fluency variables from the three different samples. Subsequently, the assumptions of linearity and homogeneity of variance were tested with the use of scatter dots. As these assumptions were not met for the majority of the variables in any of the sample groups, various nonparametric Spearman's Rho correlations were carried out to assess the relationships of the sociodemographic variables and Part 1, Part 2, Total Fluency and Total Error, in the case of the Venezuelan sample; and for Part 1 Fluency in the two South African samples simultaneously. Additionally, as the only variables that showed linearity and homogeneity of variance were years of education with Part 1, Part 2 and Total Fluency in the South African Older Adult sample, a Pearson's correlation was run to explore the relationship between these variables. From the results of these correlations, further testing was done using Factorial ANOVAs, Independent Samples t-tests and nonparametric Welch's t-tests in order to test the effect of the sociodemographic variables on the fluency variables in the three samples.

To explore how the two countries could be compared to one another in terms of their fluency scores, two independent samples t-tests were carried out, one to compare the younger adults' groups and the other to compare the older adults' groups. The two samples of younger adults were only compared using the scores for Part 1 Fluency, while the samples of older adults were compared at all the three levels of the fluency scores (Fluency Part 1, Fluency

Part 2 and Total Fluency). However, Part 2 Fluency and Total Fluency did not have equal variances; therefore, the Welch t-test was used for these two variables.

The last step in the data analysis process involved creating norms for the Venezuelan and South African Older Adults samples using regression-based norms. The norms for the Venezuelan sample were stratified by age, as years of education did not have a significant effect on fluency. Regrettably, due to the nature of the South African Younger Adults dataset that was available for this study, the younger sample was not taken into account for the regression-based norms; therefore, the South African norms were only computed for the South African Older Adult sample and were only stratified by years of education. The process of creating regression-based norms included calculating the predicted scores for the participants using a multiple regression; the residuals were also calculated and standardised using the standard deviation of the residuals. Lastly, the percentile of the standardised residuals was calculated using the empirical cumulative distribution (Elst et al., 2011; Oosterhuis et al., 2015).

# Chapter 4: Results

This chapter was divided into five sections, following each of the data analyses that were carried out. The first section included the McDonald's omega test of reliability for the Venezuelan sample and the two South African samples. The second section included a description of the fluency scores trends and the normality of the variables in the samples before it moved on to the correlations, t-tests, and the ANOVAs between fluency and the demographic variables of gender, age, and years of education for the samples of each country, to explore the relationships and the effects that could exist between the variables. Next, the inter-country mean difference comparisons by age groups were presented in the third section. The last section of this chapter presented the regression-based norms that were computed for the samples.

## 4.1. Internal Consistency Reliability

This section addresses the first research question regarding the internal consistency of the AUT in the Venezuelan and the South African samples. The reliability of the AUT was measured with the use of McDonald's Omega (ω) method for measuring internal consistency instead of using the more commonly used method, Cronbach's alpha (α). The McDonald's ω was chosen as the ideal reliability measure for this study as it has been argued to be more precise for measuring errors in multi-items measurement scales (Crutzen & Peters, 2017; Hayes & Coutts, 2021). The ω coefficient can be interpreted as acceptable if it falls between .65 and .80 and strong if it is greater than .80 (Kalkbrenner, 2021).

The six-item version of the AUT, organised in Part 1 and Part 2, had an overall acceptable McDonald's Omega coefficient of ω = .80 for the Venezuelan sample. In addition, the internal consistencies of Part 1 and Part 2 of the test were measured separately on the

same sample. Part 1 showed a strong reliability coefficient of ω = .86, and Part 2 had an acceptable coefficient of ω = .66. This appeared to demonstrate that Part 1 of the AUT had fewer measurement errors than Part 2 of the same test when applied to a Venezuelan sample. Additionally, these results show that Part 1 delivers more reliable results when compared to the complete, 6-item version of this test.

Comparatively, when measured on the South African Older Adults sample, the whole, six-item version of the AUT shows a strong reliability coefficient of ω = .86. However, similar to the Venezuelan sample, Part 1 of the AUT also showed a strong reliability coefficient of ω = .83, while Part 2 showed an acceptable reliability coefficient of ω = .72. While Part 2 seemed not to be completely free of measurement errors in this sample, the full six-item version of the AUT had the highest strength of internal consistency reliability. Therefore, applying both parts of the tests in this sample gave more reliable results for measuring divergent thinking than only applying one half of the test.

On the other hand, the South African Younger Adult sample, which was only tested on the first part of the test, showed similar results to the other two samples in Part 1 of the AUT, with a strong internal consistency coefficient of ω = .82. This may illustrate that Part 1 of the AUT was a strong enough measurement for divergent thinking. However, one should not forget that, although Part 2 has trends to show less than strong reliability coefficients, the two parts of the test together may indicate more accurate results as it did for the South African Older Adults sample.

### 4.2. Sociodemographic Variables and their Relationships with Fluency

The second research question of this study asked whether there was a relationship between the sociodemographic variables (gender, age, and years of education) and the fluency

variables from the AUT. However, before carrying out the correlations and further tests, the fluency variables are to be described, and the assumption of normality should be addressed.

### *4.2.1. Fluency Variables of the Three Samples*

As indicated in Chapter 3, the AUT scores for fluency were divided into three. Due to the nature of the AUT, the maximum score possible for Total Fluency was 36, but none of the participants in any of the samples reached the maximum score (see Table 1). In addition, Part 1 Fluency and Part 2 Fluency each had a maximum possible score of 18. This maximum score was only reached for Part 1 Fluency by at least one participant in the South African Younger Adults sample, while the highest score attained in Part 2 Fluency was 17, reached by at least one participant from the Venezuelan sample, more specifically, from the Venezuelan younger adult group (see Table 1). In addition, the Total Errors variable, which contained the total number of unacceptable answers given in the two parts of the AUT, also had a maximum score of 36, which meant that all the responses given were unacceptable. This variable was only calculated in the Venezuelan sample, where at least one participant scored zero unacceptable answers, and at least one participant scored 35 unacceptable answers.

### *4.2.2. Assumption of Normality for the Sociodemographic Variables and the Fluency Variables*

Before running the correlations and further hypotheses tests, the assumption of normality for all variables and samples needed to be addressed. The Central Limit Theorem (CLT) was used to assume normality for all samples, as the three had sample sizes larger than 30, which is considered to be the threshold for using the CLT (Kwak & Kim, 2017).

### *4.2.3. Correlations Between Variables*

Although the assumption of normality was met for all variables in the Venezuelan sample, the assumptions of linearity and homogeneity of variance for a Pearson's correlation were not assumed for the sociodemographic variables and the variables of fluency (Part 1 Fluency, Part 2 Fluency, Total Fluency and Total Error), as measured using Scatter/Dot graphs. Therefore, the relationships between these were measured using the nonparametric, Spearman's rho correlation.

Table 2 shows the Spearman's rho correlation between the sociodemographic variables and fluency variables in the Venezuelan sample. The variable of gender, as it is a dichotomous and categorical variable, was included in the Spearman's correlation; however, there were no significant correlations between gender and any of the fluency variables in this sample, as shown in Table 2. Age had significant relationships will all three fluency scores: a negative and weak relationship with Part 1 Fluency, $r_s = -.15$, $p < .001$; a negative, weak relationship with Part 2 Fluency, $r_s = -.22$, $p < .001$; and a negative, weak relationship with Total Fluency, $r_s = -.20$, $p < .001$. Although all three of these relationships were weak, these results show that there might be a small deterioration in divergent thinking as age increases.

Comparatively, years of education also demonstrated significant relationships with fluency at the three levels. However, these three correlations were small in their size, $r_s = .13$, $p < .05$, for Part 1 Fluency; $r_s = .11$, $p < .05$, for Part 2 Fluency; and $r_s = .13$, $p < .05$, for Total Fluency (see Table 2). Although weak, these positive relationships showed that as years of education increase, the fluency score also increases. These findings, along with the relationships found with the variable of age, raised the question of whether age and years of education interact simultaneously with the fluency scores.

**Table 2**

*Spearman's Rho Correlations in the Venezuelan Sample*

| | Gender | Age | Years of Education |
|---|---|---|---|
| **Part 1 Fluency** | .103 | -.149** | .126* |
| **Part 2 Fluency** | .092 | -.217** | .105* |
| **Total Fluency** | .101 | -.200** | .126* |
| **Total Error** | -.064 | .115* | .073 |

* $p < 0.05$ (2-tailed).
** $p < 0.01$ (2-tailed).

In addition, Table 2 showed that the variable of total error only had one significant but weak relationship with age, $r_s = .12$, $p < .05$. This shows matching results to those mentioned above, and although this relationship is small, it hints that as age increases, there tend to be more incorrect answers.

Then, the correlations for the two South African samples were carried out. For these correlations, the two South African samples were run together in order to explore the relationship between age and Part 1 Fluency. As mentioned above, the assumption of normality was met for all the variables of all samples. However, after assessing the assumptions of homogeneity of variance and linearity with Scatter/Dot graphs for these samples, it was found that none of the sociodemographic variables showed neither linearity nor homoscedasticity with Part 1 Fluency. Therefore, a Spearman's rho correlation was carried out to examine the association between the sociodemographic variables of gender, age, and years of education on Part 1 Fluency for the two South African samples simultaneously.

The spearman's rho indicated that, in the South African samples, gender and years of education had significant relationships with Part 1 Fluency. More specifically, there was a moderate relationship between age and Part 1 Fluency, $r_s = .36$, $p < .001$, and another

moderate relationship between years of education and Part 1 Fluency, $r_s = .44$, $p < .001$, in the south African samples.

Further testing on the South African Older Adult sample found an interesting result, showing that years of education had significant relationships with fluency at all three levels on a Pearson's correlation. Only in this sample did years of education have a linear and homogeneous variance with Part 1, Part 2, and Total Fluency. Thus, a Pearson's correlation was run to explore the associations between these variables. Interestingly, years of education had a significant correlation that was medium in size with Part 1 Fluency, $r_s = .48$, $p < .001$; while it had two strong and significant correlations with Part 2 Fluency, $r_s = .52$, $p < .001$; and Total Fluency, $r_s = .53$, $p < .001$. These indicate that even in old age, years of education can potentially interact with the fluency scores of participants.

Given the significant but weak correlations that were obtained from the correlations, it was decided to check whether these relationships could be explained as an 'effect' that age and years of education had on fluency and if the correlations observed above could imply a significant difference in performance when dividing the sample using these variables, allowing to make a better choice for stratifying the data for the regression-based norms. Hence, it was decided to carry out further testing to explore the effect of these relationships that seem to exist between these two sociodemographic and the fluency variables. This was done using Factorial Between Groups ANOVAs and Welch's t-Tests. To carry out these tests, the variables of age and years of education were grouped. The same groups of Younger Adults and Older Adults were used for the variable of age. The variable of years of education was split into two groups, those with high school completed or less and those with university-level education. These differed between the Venezuelan and South African samples according to the schooling systems of the two countries. However, it is important to note that the South

African Younger Adults sample comprised of university students and the minimum years of education in this sample was 13 years. Thus, those students that had not been in university for more than one full year were allocated to the lower group. The years of education groups are as follows: 0 – 11 years, and ≥ 12 years for the Venezuelan sample; and 3 – 13 years, and > 13 years for the South African samples.

The first Factorial Between Groups ANOVA was carried out to investigate the effects of age and years of education on Part 1 Fluency in the Venezuelan sample, following the normal distribution assumed for all variables and a non-significant Levene's Test that allowed to assume equal variances. This ANOVA, shown in Table 3 and Table 4, revealed that the variable of age had a significant effect on Part 1 Fluency, $F(3, 354) = 6.95$, $p < .05$, but with a small effect size, $\eta_p^2 = .02$ (see Table 3), as the mean difference of scores in Part 1 Fluency between the younger and older adults in the Venezuelan sample was of 1.49, with higher scores seen in the group of younger adults (see Table 4). However, as shown in Table 3, years of education and the two variables simultaneously (Age x Years of Education) did not appear to have any significant effects on Part 1 Fluency.

**Table 3**

*Factorial ANOVA – Effects of Age and Years of Education on Part 1 Fluency in the Venezuelan Sample*

| *Variables* | *Sum of Squares* | *F* (3, 354) | $\eta_p^2$ | *p* |
|---|---|---|---|---|
| Age | 81.37 | 6.95 | .019 | .009 |
| Years of Education | 0.51 | 0.04 | .000 | .835 |
| Age x Years of Education | 17.61 | 1.5 | .004 | .221 |

**Table 4**

*Factorial ANOVA – Pairwise Comparisons of Age and Years of Education on Part 1 Fluency in the Venezuelan Sample*

| *Pairwise Comparisons* | *Mean Difference* | *Std. Error* | *95% CI for Error* | |
|---|---|---|---|---|
| | | | *Lower* | *Upper* |
| Young Adults vs. Older Adults | 1.49 | 0.57 | 0.38 | 2.61 |
| ≥12 years of education vs. 0 – 11 years of education | 0.12 | 0.57 | -1 | 1.23 |
| Younger Adults with ≥12 years of education vs. Older Adults with ≥12 years of education | 2.19 | 0.96 | 0.31 | 4.07 |
| Younger Adults with 0 – 11 years of education vs. Older Adults with 0 – 11 years of education | 0.79 | 0.61 | -0.4 | 2 |

Moreover, as the Levene's test for homoscedasticity failed to assume equal variances for Part 2 Fluency and Total Fluency, the Welch's t-Test was run to explore the effects of the sociodemographic variables on these two. On the one hand, age had an effect on Part 2 Fluency, as the younger adults from the Venezuelan sample generally scored 1.26 points higher than their older adult counterparts $t(87.97) = 3.18$, with a small effect size, $d = .38$ (see Table 5). Years of education did not appear to have a significant effect on Part 2 Fluency, and as shown in Table 6, the mean difference between the two groups was less than half a point. On the other hand, in terms of Total Fluency, age also had a significant effect. This time, the Venezuelan younger adults scored 2.46 points higher than the older adults from the Venezuelan sample, $t(86.12) = 3.3$, $p = .001$, but it also had a small effect size, $d = .4$ (see Table 5). Similar to Part 2 Fluency, years of education did not have a significant effect on Total Fluency, with the mean difference between the two groups not reaching one full point (see Table 6).

**Table 5**

*Welch's t-Tests – Effects of Age in the Venezuelan sample*

| *Statistics* | | *Part 2 Fluency* | *Total Fluency* |
|---|---|---|---|
| Younger Adult | *M* | 7.09 | 13.37 |
| | *SD* | 3.44 | 6.35 |
| Older Adults | *M* | 5.83 | 10.9 |
| | *SD* | 2.49 | 4.7 |
| *t* | | 3.18 | 3.3 |
| *df* | | 87.97 | 86.12 |
| *p* | | .002 | .001 |
| Mean Difference | | 1.26 | 2.46 |
| Std. Error Difference | | .4 | .75 |
| 95% CI of the Difference | *Lower* | 0.47 | 0.98 |
| | *Upper* | 2.05 | 3.95 |
| Cohen's *d* | | .38 | .4 |

**Table 6**

*Welch's t-Tests – Effects of Years of Education in the Venezuelan sample*

| *Statistics* | | *Part 2 Fluency* | *Total Fluency* |
|---|---|---|---|
| ≥ 12 years of education | *M* | 7.12 | 13.65 |
| | *SD* | 3.90 | 7.15 |
| 0 – 11 years of education | *M* | 6.82 | 12.74 |
| | *SD* | 3.09 | 5.76 |
| *t* | | 0.69 | 1.15 |
| *df* | | 158.47 | 160.35 |
| *p* | | .491 | .250 |
| Mean Difference | | 0.30 | 0.91 |
| Std. Error Difference | | .43 | .79 |
| 95% CI of the Difference | *Lower* | -0.55 | -0.65 |
| | *Upper* | 1.14 | 2.47 |
| Cohen's *d* | | .09 | .147 |

Although the correlations in the South African samples were moderate in size, it was also decided to check their effects on Part 1 Fluency. Thus, a second Factorial Between Groups ANOVA was carried out to explore the effects of age and years of education on Part 1 Fluency in the South African samples. As stated above, the assumption of normality was met

for all variables, and a Levene's test confirmed that equal variances could be assumed. In Table 7, it was demonstrated that age had a significant effect on Part 1 Fluency for the South African samples, $F(3, 194) = 50.18$, $p < .001$, with a large effect size, $\eta_p^2 = .21$. Table 8 showed a mean difference of 4.05 points, favouring the younger adults. Further, years of education also appeared to have an effect on Part 1 Fluency in the South African samples, $F(3, 194) = 13.06$, $p < .001$, with a medium effect size, $\eta_p^2 = .06$ (see Table 7). The group with higher levels of education obtained a mean score that was 2.07 points higher than the group with lower levels of education (see Table 8). Age and years of education did not co-interact to have a significant effect on Fluency Part 1 in the South African samples.

Similarly, it was also decided to check whether the correlations that years of education had with Part 1 Fluency, Part 2 Fluency and Total Fluency in the South African Older Adult sample could also be translated as an effect. Therefore, various Independent Samples t-tests were carried out after checking the assumptions. Table 9 showed that years of education did have an effect on the three fluency variables in this sample. The educated group outscored the not educated group by 3.43 points in Part 1 Fluency, $t(123) = 5.52$, $p < .001$, with a large effect size, $d = .99$; this difference was of 3.15 points in Part 2 Fluency, $t(123) = 5.63$, $p < .001$ with a large effect size, $d = 1.01$; and of 6.61 points in Total Fluency, $t(123) = 6.09$, $p < .001$, also with a large effect size, $d = 1.09$.

**Table 7**

*Factorial ANOVA – Effects of Age and Years of Education on Part 1 Fluency in the South African Samples*

| *Variables* | *Sum of Squares* | *F(3, 194)* | $\eta_p^2$ | *p* |
|---|---|---|---|---|
| Age | 704.785 | 50.18 | .21 | .000 |
| Years of Education | 183.38 | 13.06 | .06 | .000 |
| Age x Years of Education | 46.22 | 3.29 | .02 | .071 |

**Table 8**

*Factorial ANOVA – Pairwise Comparisons of Age and Years of Education on Part 1 Fluency in the South African Samples*

| *Pairwise Comparisons* | *Mean Difference* | *Std. Error* | *95% CI for Error* | |
|---|---|---|---|---|
| | | | *Lower* | *Upper* |
| Young Adults vs. Older Adults | 4.05 | 0.57 | 2.92 | 5.18 |
| >13 years of education vs. 0 – 13 years of education | 2.07 | 0.57 | 0.94 | 3.2 |
| Younger Adults with >13 years of education vs. Older Adults with >13 years of education | 3.01 | 0.9 | 1.24 | 4.79 |
| Younger Adults with 0 – 13 years of education vs. Older Adults with 0 – 13 years of education | 5.09 | 0.7 | 3.7 | 6.48 |

**Table 9**

*Independent Samples t-tests – Effects of Years of Education in the South African Older Adults sample.*

| *Statistics* | | *Part 1 Fluency* | *Part 2 Fluency* | *Total Fluency* |
|---|---|---|---|---|
| > 13 years | *M* | 6.79 | 7.45 | 4.27 |
| | *SD* | 3.79 | 3.24 | 6.59 |
| 3 – 13 years | *M* | 3.37 | 4.30 | 7.67 |
| | *SD* | 3.11 | 3.01 | 5.51 |
| *t* | | 5.52 | 5.63 | 6.09 |
| *df* | | 123 | 123 | 123 |
| *p* | | .000 | .000 | .000 |
| Mean Difference | | 3.43 | 3.15 | 6.61 |
| Std. Error Difference | | 0.62 | 0.56 | 1.09 |
| 95% CI of the Difference | *Lower* | 2.20 | 2.04 | 4.46 |
| | *Upper* | 4.65 | 4.26 | 8.76 |
| Cohen's *d* | | .99 | 1.01 | 1.09 |

### 4.3. Country Comparisons

The third question of this study focused on whether there was a difference between the fluency scores in the two countries by age group. To answer this question, an independent samples t-test was run first to compare the Part 1 Fluency score of younger adults from Venezuela and South Africa. As previously described, the assumption of normality was met for all variables. In addition, the Levene's test for homogeneity of variance was non-significant, indicating that equal variances could be assumed. As shown in Table 10, the t-test was statistically significant, as the South African sample of younger adults reported a mean score for Fluency Part 1 of 1.68 points higher, 95% CI [.24, 3.03], than the Venezuelan group of younger adults, $t(130) = 2.36$, $p < .05$, two-tailed, with a small effect size, $d = .41$.

**Table 10**

*Independent Samples t-Test and Welch's t-Test – Compared Means Between Countries by Age Groups*

| *Statistics* | | *Part 1 Fluency in Younger Adults* | *Part 1 Fluency in Older Adults* | *Part 2 Fluency in Older Adults* | *Total Fluency in Older Adults* |
|---|---|---|---|---|---|
| South African Sample | *M* | 9.12 | 5.07 | 5.87 | 10.94 |
| | *SD* | 4.04 | 3.88 | 3.52 | 6.90 |
| Venezuelan Sample | *M* | 7.44 | 5.17 | 6.00 | 11.17 |
| | *SD* | 4.11 | 3.09 | 2.49 | 4.86 |
| t | | 2.36 | -0.18 | -0.27 | -0.24 |
| df | | 130 | 100.25 | 113.33 | 113.63 |
| p | | .02 | .859 | .79 | .81 |
| Mean Difference | | 1.68 | -0.10 | -0.13 | -0.23 |
| Std. Error | | .71 | .52 | .48 | .95 |
| 95% CI of the Difference | *Lower* | 0.24 | -1.24 | -1.09 | -2.10 |
| | *Upper* | 3.09 | 1.03 | .83 | 1.64 |
| Cohen's d | | .41 | -.03 | -.04 | -.04 |

Then, the fluency mean scores were compared between the two older adult samples at three different levels: Part 1 Fluency, Part 2 Fluency and Total Fluency. Assumption testing indicated that equal variances were not assumed for any of the three fluency variables. Therefore, the tests were interpreted using the Welch's t-test, illustrated in Table 10. As it was depicted, these three tests were non-significant (see Table 10), showing that there were no significant differences in the test performance of older adults on the AUT across South Africa and Venezuela.

### 4.5. Regression-Based Norms

The last question of this research study enquired about potential normative data for the Venezuelan and South African samples. To answer this question, various regression-based norms were conducted to create stratified norms. As shown by the previous tests, gender and years of education did not have significant relationships or effects on the Fluency variables in the Venezuelan sample; therefore, only the sociodemographic variable of age could be considered for the regression-based norms for this sample.

The first step to performing these norms was to use a standard multiple regression, also known as simultaneous multiple regression, to calculate the predicted scores of the participants. The assumptions for the simultaneous multiple regressions in the Venezuelan sample were evaluated before proceeding with the analysis. The assumption of normality was met as indicated above. With the use of boxplots, the univariate outliers were adjusted to 1 unit higher than the largest non-outlier in order to lessen their impact on the analysis only when needed. In addition, the residuals met the assumptions of normality, linearity, and homogeneity of variance after inspecting the normal probability plot of standardised residuals and the scatterplot of standardised residuals against standardised predicted values. Moreover, the multivariate outliers were not of concern, as indicated by the maximum Mahalanobis

distance, which did not exceed the critical value for $\chi^2$ value for $df = 1$ at $\alpha = .001$ of 10.83. Lastly, multicollinearity was not a concern as only one variable was taken into account for these regression analyses.

The first standardized multiple regression, done for the Venezuelan sample, showed that age accounted for a significant 3% of the variability of the Part 1 Fluency score, $R^2 = .029$, adjusted $R^2 = .026$, $F(1, 356) = 10.53$. In addition, age also accounted for a significant 5% of the variability of Part 2 Fluency score, $R^2 = .051$, adjusted $R^2 = .048$, $F(1, 356) = 19.13$. Similarly, in the case of Total Fluency, the same sociodemographic variable accounted for a significant 5% of variability, $R^2 = .047$, adjusted $R^2 = .044$, $F(1, 356) = 17.49$. Further, age also accounted for significant variability of Total Error; however, it is only 2% of variability, $R^2 = .016$, adjusted $R^2 = .014$, $F(1, 356) = 5.90$, $p < .05$. The unstandardized (B) and standardized (β) regression coefficients for all fluency scores from the Venezuelan sample were reported in Table 11.

After the percentile of the standardised residuals were calculated using the empirical cumulative distribution function, a normative table, stratified by age, for the Venezuelan sample was laid out at the 5th, 25th, 75th, 95th and 99th percentiles for Part 1 Fluency, Part 2 Fluency, Total Fluency and Total Error of the AUT (see Table 12).

**Table 11**

*Standardized Multiple Regression models summary – Age and all Fluency Scores of the Venezuelan Sample.*

| *Variables* | *B [95% CI]* | *β* | *t* | *p* |
|---|---|---|---|---|
| Part 1 Fluency | -0.04 [-0.06, -0.01] | -0.17 | -3.25 | .001 |
| Part 2 Fluency | -0.05 [-0.07, -0.03] | -0.23 | -4.37 | .000 |
| Total Fluency | -0.08 [-0.12; -0.04] | -0.22 | -4.18 | .000 |
| Total Error | -0.05 [0.01; 0.09] | 0.13 | 2.43 | .016 |

**Table 12**

*Venezuelan Norms for the AUT – Stratified by age.*

| *Variables* | *Percentiles* | *20-35 (n=112)* | *36-50 (n=107)* | *51-65 (n=29)* | *66-85 (n=47)* |
|---|---|---|---|---|---|
| Part 1 Fluency Score | *5th* | 2 | 1 | 1 | 1 |
| | *25th* | 4 | 4 | 4 | 3 |
| | *75th* | 9 | 9 | 8 | 7 |
| | *95th* | 14 | 13 | 11 | 11 |
| | *99th* | 17 | 15 | 15 | 13 |
| Part 2 Fluency Score | *5th* | 3 | 2 | 2 | 2 |
| | *25th* | 6 | 4 | 4 | 3 |
| | *75th* | 10 | 9 | 9 | 8 |
| | *95th* | 15 | 14 | 12 | 9 |
| | *99th* | 15 | 15 | 16 | 11 |
| Total Fluency Score | *5th* | 6 | 3 | 5 | 4 |
| | *25th* | 10 | 8 | 8 | 7 |
| | *75th* | 18 | 16 | 16 | 13 |
| | *95th* | 27 | 25 | 21 | 19 |
| | *99th* | 32 | 28 | 31 | 22 |
| Total Error Score | *5th* | 18 | 32 | 27 | 35 |
| | *25th* | 13 | 23 | 20 | 23 |
| | *75th* | 9 | 13 | 10 | 12 |
| | *95th* | 3 | 3 | 4 | 4 |
| | *99th* | 1 | 1 | 1 | 2 |

As the South African Younger Adult sample was comprised of university students, a highly educated sample where the vast majority of the participants were under 25 years of age, the regression-based norms for South Africa were computed only for the South African Older Adult sample. Thus, it was only stratified by years of education since only one age group was taken into account. Additionally, the grouping for years of education was corrected according to the schooling system of South Africa, 3 – 12 years, and ³ 13 years.

In terms of the assumptions needed to conduct a multiple regression, normality was assumed for all variables, as previously described, and the univariate outliers that were

present in the variables were adjusted to 1 unit higher than the largest non-outlier to decrease any negative effect that could have hindered the analysis. Additionally, all the assumptions needed from the residuals were met, including normality, linearity, and homogeneity of variance. Moreover, multivariate outliers were not a concern, as well as multicollinearity. With this in order, the multiple regression analysis could proceed.

Years of education was found to be related to a statistically significant 23% variance in Part 1 Fluency, $R^2$ = .23, adjusted $R^2$ = .220, $F(1, 123) = 36.04$; and a statistically significant 27% variance in Part 2 Fluency, $R^2$ = .27, adjusted $R^2$ = .26, $F(1, 123) = 44.64$; and lastly a statistically significant 28% of variance in Total Fluency, $R^2$ = .28, adjusted $R^2$ = .28, $F(1, 123) = 48.21$. In addition, the regression coefficients for the South African Older Adults sample were presented in Table 13.

Subsequently, the percentiles of the standardised residuals were calculated with the empirical cumulative distribution function. Then the normative table of the AUT for the South African Older Adults was computed with the stratification by years of education (see Table 14).

**Table 13**

*Standardized Multiple Regression models summary – Years of Education and all Fluency Scores of the South African Older Adults Sample.*

| *Variables* | *B [95% CI]* | *β* | *t* | *p* |
|---|---|---|---|---|
| Part 1 Fluency | 0.56 [0.37, 0.34] | 0.48 | 6 | .000 |
| Part 2 Fluency | 0.55 [0.38, 0.71] | 0.52 | 6.68 | .000 |
| Total Fluency | 1.11 [0.79, 1.42] | 0.531 | 6.94 | .000 |

**Table 14**

*South African Norms for the AUT for Older Adults (<65) – Stratified by Years of Education.*

| *Variables* | *Percentiles* | *0 – 12 (n=63)* | *≥ 13 (n=62)* |
|---|---|---|---|
| Part 1 Fluency Score | *5th* | 0 | 1 |
| | *25th* | 1 | 4 |
| | *75th* | 5 | 9 |
| | *95th* | 9 | 13 |
| | *99th* | 14 | 15 |
| Part 2 Fluency Score | *5th* | 0 | 3 |
| | *25th* | 2 | 5 |
| | *75th* | 7 | 9 |
| | *95th* | 10 | 13 |
| | *99th* | 11 | 15 |
| Total Fluency Score | *5th* | 0 | 4 |
| | *25th* | 3 | 10 |
| | *75th* | 10 | 18 |
| | *95th* | 18 | 26 |
| | *99th* | 22 | 29 |

### 4.6. Summary

To summarise, this chapter presented many different data analyses, including parametric and nonparametric correlations, ANOVAs, and t-tests, to look at which variables had significant relationships and effects on the fluency scores of divergent thinking in order to carry out the regression-based norms. The norms that were created for two of the three samples included in this study were also presented in this chapter.

# Chapter 5: Discussion

This chapter focuses on answering and discussing the four research questions of this study. First, the internal consistency reliability was discussed for both the Venezuelan and the South African samples. Then, the relationships between the sociodemographic variables on fluency were discussed for both contexts (Venezuela and South Africa) while looking for parallels in the literature to better understand these correlations. Afterwards, the comparisons between Venezuela and South Africa were discussed while aiming to understand the possible cultural reasons for their differences and similarities. Lastly, the norms for Venezuela and South Africa were discussed in terms of their importance and their role in future testing and assessment.

## 5.1. Reliability of the AUT Across Different Contexts

The first aim of the study was to explore the internal consistency of the AUT in these samples. The reliability of this test is most commonly explored in terms of its inter-rater reliability by comparing the scores given by at least two different scorers (see Blake & Palmisano, 2021; Cousijn et al., 2014; George & Wiley, 2018; Rahmani et al., 2020; Stevenson et al., 2014). However, this type of reliability was not considered in the present research as this study used secondary datasets, and the researcher only had access to the scores.

To explore the internal consistency reliability of the AUT in the three samples included in this research study, the McDonald's ω was employed. Overall, the AUT was shown to have acceptable and strong internal reliability scores across the two countries and age groups tested for the present study. More specifically, the internal consistency coefficients for the Venezuelan sample ranged between .66 and .86, and for the two South African

samples, they ranged between .72 and .86. These results are comparable to the internal consistency coefficient of other studies, such as a coefficient of .71 found in a Dutch study (Tanis, 2017) and coefficients between .63 and .70 found in an American study (Silvia et al., 2008). The results from the present study showed a higher upper bound than those shown by the other two studies. This can be attributed to the different test that was used to measure internal consistency, as the present study used McDonald's ω, a relatively newer and more specific measure for internal consistency (Crutzen & Peters, 2017; Hayes & Coutts, 2021).

As this test consisted of two parts, the reliability coefficient was calculated for both parts as well as for the complete test as a unit in those samples that allowed it, namely the Venezuelan sample and the South African Older Adults Sample, while the South African Younger Adults sample only provided results for the first part of the test. The first part of the AUT referred to as Part 1 Fluency in this research study, showed a strong reliability coefficient in the three samples, meaning that, across these two countries, the first part of the test appears to have very little measurement error (Kalkbrenner, 2021). In contrast, Part 2 Fluency had a lower omega coefficient in both the Venezuelan and South African Older Adults samples, deeming the second part of the test only as acceptable rather than strong. This is interesting to see as both Part 1, and Part 2 of the test are very similar due to the nature of the test. However, this lower score in internal consistency reliability could be attributed to external factors, such as fatigue, or other biases, including scoring conditions, that could affect these results (Benedek et al., 2013; Ercan et al., 2007).

Additionally, the reliability coefficients for the complete tests, referred to as Total Fluency in this study, differed between the two countries. While it demonstrated a strong coefficient in the South African Older Adults sample, which was even higher than the coefficient for Part 1 Fluency in the same sample; the internal reliability coefficient of Total

Fluency in the Venezuelan was of .80, which many authors describe as the cut-off point between what is considered acceptable and what is considered strong in terms of reliability coefficients (Catalán, 2019; Feißt et al., 2019; Kalkbrenner, 2021; Silvia et al., 2008).

For the South African Older Adults sample, this meant that the complete, six-item version of the AUT gave a better result altogether than only measuring participants with a three-item version of the test, be it Part 1 or Part 2 of the test. On the other hand, in terms of the Venezuelan sample, although the complete six-item version of the test could be considered a reliable measure (Catalán, 2019; Silvia et al., 2008), it appeared that Part 1 of the test had less room for measurement errors than the complete version of the AUT in this specific sample.

## 5.2. Associations between the Sociodemographic Variables and Fluency

The second aim of the study was to determine the relationships and effects between the sociodemographic variables and fluency in the Venezuelan and the South African samples. These sociodemographic variables included gender, age, and years of education, all of which are discussed below.

### *5.2.1. Associations between Age and Fluency*

Age had significant correlations with the fluency variables in both contexts. The Spearman correlations showed small significant relationships between age and all the fluency variables (Part 1 Fluency, Part 2 Fluency, Total Fluency and Total Error) in the Venezuelan sample. At the same time, there was a moderate relationship between age and Part 1 Fluency in the South African sample. The remaining fluency variables could not be calculated as the South African Younger Adult sample only included scores for Part 1 of the test.

As the literature stated, it was expected to find differences by age in the performance of divergent thinking, in this case, in their fluency scores. The literature presented many studies that have found variances between different age groups in the components of divergent thinking (see Palmiero, 2015; Reese et al., 2001; Restrepo et al., 2019). Similarly, the present study first found significant but weak correlations between age and fluency in the Venezuelan sample. To ensure the significance of the relationship, the researcher decided to further explore this relationship by comparing means with the use of an ANOVA and Welch's t-tests. These tests demonstrated that the effect that age had on fluency was statistically significant. In terms of the relationship between these variables in the South African samples, the correlation showed that a moderate relationship exists between the two, which was then confirmed as an effect that age had on fluency with the use of an ANOVA.

The present study has similar findings to those in a study done in Italy, which also compared the AUT scores between younger and older adults and found similar effects of age on the dimensions of divergent thinking (Palmiero, 2015). In the Italian study, young adults between the ages of 20 and 39 outperformed the groups of older adults between the ages of 60 – 80 in some dimensions of divergent thinking (Palmiero, 2015). In terms of age differences in fluency, the study by Palmiero (2015) only found differences between the youngest age group (20 -29) and the oldest age group (70 – 80); and found no differences between the age groups that included participants of 40 years and older in any of the dimensions of divergent thinking (Palmiero, 2015). Comparatively, the present study also found trends of higher scores in the groups of younger adults when compared to the older adults in both the Venezuelan and the South African contexts, thus, confirming Palmiero's (2015) findings regarding the differences between younger adults and older adults.

Given that the test is time-limited, it is possible that the decline in processing speeds linked to age may partially explain these differences. For instance, Foos and Boone (2008) measured divergent thinking with five different timed tests in young adults and older adults, where half of the individuals from each group took the test within the standard time limit, and the other half were given unlimited time to complete the tasks. The results from Foos and Boone's study suggested that the time limits negatively affected the performance of the older adults, as they tended to take more time to provide the answers. This study provided evidence that the declining processing speeds seen in older adults can affect any cognitive operation (Park et al., 2001). Although this could have been the case in the present study, more studies on the impact of the time limit of divergent thinking tests should be conducted to consider the processing speeds when measuring divergent thinking with tasks that use a time limit, such as the AUT.

#### *5.2.2. Associations between Years of Education and Fluency*

The variable of years of education showed conflicting results in terms of its relationship with fluency in the present study. On the one hand, years of education had small but significant relationships with Part 1, Part 2, and Total Fluency in the Venezuelan sample, which were not seen as statistically significant effects on the ANOVA and the Welch's t-tests. Thus, it was concluded that, in the Venezuelan sample, years of education did not have a sufficient correlation with fluency for it to be used for the stratification of norms.

The findings observed in the Venezuelan sample contradicted most of the previous studies discussed in the literature, some of which described various studies that saw positive the effects of educational experience on divergent thinking performance (see Kamp et al., 2015; Syahrin et al., 2019; Zach & Ophir, 2020) and others which described better divergent thinking abilities in old age (Alcock, 2021; see Clouston et al., 2019; Reas et al., 2017;

Vemuri et al., 2014). These unexpected findings could be attributed to other factors, such as socioeconomic status and other personal experiences like the number of languages spoken, which were not accounted for in the present study. Hence, further research with Venezuelan samples could be beneficial for this Latin-American country to create a better understanding of these findings.

The grouping for years of education was done differently for the two samples. The Venezuelan sample was grouped as per the Venezuelan schooling system, where the group with lesser education ranged between zero years and 11 years, which equals to high school completed. This was done differently for the South African samples as the sample of Younger Adults only included participants with at least some university education. It was decided to group those participants with less than a full year of university education with those that only had high school completed or less. Therefore, as per the schooling system of South Africa, those participants who reported 13 years of education, which equals to the first year of university, were included in the group with less years of education. Due to this, it was expected to see lower differences between the groups of years of education in the South African samples. Nonetheless, the correlations between these variables were stronger in the case of the South African samples.

It was interesting to see the strong effect of years of education on fluency scores from the South African Older Adults sample and the large mean differences between the two groups. Years of education had a moderate relationship with Part 1 Fluency when tested on the two South African samples, and it had moderate relationships with all three fluency variables (Part 1, Part 2 and Total Fluency) in the South African Older Adult sample. All these moderate relationships were translated into effects after further exploration with the use of the ANOVA and the t-tests. These findings illustrated how educational experience could

lessen the deterioration of divergent thinking as a cognitive process, contributing to the cognitive reserve theory (Alcock, 2021; Stern, 2002). The results complemented the theory described in the literature review that stated the positive effects that education could have on decreasing the deterioration of various cognitive processes (Alcock, 2021; see Clouston et al., 2019; Reas et al., 2017; Vemuri et al., 2014). Hence, confirming that the findings of similar studies on processes such as the baseline cognitive performance (Vemuri et al., 2014) and on the executive functions (Reas et al., 2017) can be extended to divergent thinking.

### *5.2.3. Associations between Gender and Fluency*

As it was brought forward in the literature review, gender has shown inconclusive results regarding its interaction with divergent thinking (Abraham, 2016). The results from this study, in terms of the correlations between gender and fluency, were insignificant, therefore, stating that gender did not have any relationship to the divergent thinking variable in either Venezuela or South Africa. The present study, as it found no significant relationships between the two variables, locates itself on the side of the existing literature which argues that there is no difference between men and women when it comes to divergent thinking abilities (see Abraham, 2016; Reese et al., 2001; Said-Metwaly et al., 2021). At the same time, it further confirms these notions, specifically for the construct of fluency in divergent thinking. Studies on the other side of the debate, which have found gender differences in divergent thinking performance using the Torrance Test of Creative Thinking as a measure for this construct, are mostly based on samples that only include children and adolescents (Kousoulas & Mega, 2009; Stephens et al., 2001). Although there will remain to be an ongoing debate on whether or not there are significant differences in the divergent thinking abilities between males and females, a conclusion that can be drawn is that the AUT did not present any gender biases for the three samples used for this research study.

Additionally, although some studies have found physical differences between men and women in terms of brain activity when engaging with divergent thinking (Abraham et al., 2014; Razumnikova, 2004), it appears that the behavioural ability does not change between the two genders regardless of the areas of the brain that are activated.

### 5.3. Inter-country Comparisons of the Fluency Scores

The third aim was to investigate how the samples from the two countries compare to one another in terms of age groups. It was decided to compare them by age groups instead of collectively, as the Venezuelan sample had a wide range of ages (50 – 64) that were not included in any none South African samples. Therefore, the sub-samples of Venezuelan Young Adults and Venezuelan Older Adults were organised to make these comparisons as fair as possible.

Only a significant difference was observed between the Venezuelan and the South African younger adults in Part 1 Fluency, the only variable that could be compared for this age group. In comparison, no significant differences were observed for the samples of older adults in any of the fluency variables (Part 1, Part 2, and Total). These mixed results were quite interesting as these could hint at both similarities and differences between these countries in relation to divergent thinking.

As the samples were comparable in terms of age and years of education, one could say that the South African sample had better divergent thinking abilities in terms of the younger adults. However, it could also be possible that other variables could come to play. For instance, experiential bias, which refers to how some personal and social experiences could impact a test score (Runco & Acar, 2010), could have come into play. That is because the sample of South African Younger adults was solely comprised of university students; and

thus, had first-hand experience with test-taking, which could have been advantageous to this group as the participants in this sample were more likely to be accustomed to taking tests than those from the Venezuelan sample, who came from different backgrounds and with different experiences in terms of education and test-taking. Additionally, the mode in which the test was administered in the two samples could have also impacted these results (Cook, 2013). The Venezuelan sample had to say aloud the different uses for each object of the AUT, while the South African Younger Adult sample wrote down their answers. The Venezuelan participants could have been disadvantaged in terms of giving repeated answers or losing time while remembering the answers that were already given.

Other factors that can be involved in the difference in performance on the AUT in young adults include the differences in language experience that exists between the two countries, as it is common for South Africans to be bilingual and multilingual (Posel & Zeller, 2015), while Venezuelans are largely monolingual (Library of Congress, 2005). Previous research on this matter has shown evidence for increased performance in some dimensions of divergent thinking in bilingual individuals who regularly switch languages (Storme et al., 2017), which is a common practice in South Africa. Nonetheless, mixed results have been reported in terms of the impact of bilingualism and multilingualism on divergent thinking (see Alcock, 2021; Anthony, 2018; Hommel et al., 2011; Storme et al., 2017), which could explain the difference in results observed between the young adults and the older adults in the present study.

Other cultural factors that could explain the difference in performance in the younger adults could include socioeconomic status and quality of education, which have shown evidence to affect the divergent thinking performance in previous studies (see Dai et al., 2012; Rodet, 2021). As part of its sampling method, the Venezuelan sample was to be as

representative as possible of the population, and it was achieved using quota sampling. It included people from many different socioeconomic statuses, which, in turn, involved different qualities of education. It is possible that the South African sample was not as representative in terms of these two factors, making the two samples not as comparable.

However, as these factors were not considered for the present study, one could not claim that these aspects played a role in the test performance. Hence, more research comparing countries in the global south should be encouraged to create a better and more complete understanding of the cultural factors that can potentially affect psychological constructs in these countries.

### 5.4. AUT Norms for Venezuela and South Africa

The last objective of the present research study was to create normative data for South Africa and Venezuela. It was possible to create norms for the AUT for the Venezuelan sample, stratified by age groups from 20 – 85 years, and for the South African Older Adults sample (65 – 89 years), stratified by years of education. For the South African correlations, ANOVA, and t-tests that measured the effect of these variables with the fluency scores, the grouping for years of education was accommodated due to the highly educated sample available for the South African Younger Adults sample. This was corrected for the regression-based norms of the South African Older Adult sample to follow the South African school system; the education groups for the stratification of the South African norms were 3 – 12 years, and ≥13 years.

At the time that this research study took place, there seemed not to be any norms published for the AUT (Hass, 2017; Lewis & Lovatt, 2013) and the only normative data available seemed to be the ones provided in the test manual, which were produced in the

1960s and with samples of students between the 5th grade and university level (Guilford et al., 1978). Moreover, the test manual of the AUT states that the norms provided were only to be taken as "basic frames of reference" and not as "national norms" (Guilford et al., 1978, p. 18). Compared to the existing norms, the norms presented in this study considered older adults, a group that is often overlooked; additionally, in terms of the South African norms, the variable of years of education was also considered as an additional factor for more accurate descriptions. Although the goal of the normative data presented in the current study was not to be taken as "national norms" either, the researcher hoped that these could inspire future normative studies for the AUT, with similar stratifications of age and years of education or other variables that were not explored in this research.

# Chapter 6: Limitations of the Study and Recommendations for Future Research

This chapter enlists and clarifies the limitations that were present in this research study and, subsequently, puts forwards various suggestions for future researchers to take into account when conducting similar research to the present study or research in the same field of divergent thinking using the AUT as a cognitive measure.

## 6.1. Limitations

The present study was limited from reaching its full potential in different areas. In terms of sample characteristics, there was a gap of 15 years between the South African Younger Adults sample and the South African Older Adults sample, which could have affected the findings regarding the relationship between age and fluency. Additionally, the participants from the South African Younger Adults sample were highly educated, as this sample comprised of university students; thus, the effects of education on fluency could not be tested for this age group in South Africa. For the same reason of high levels of education in the sample South African Younger Adults samples, it was not very representative and, therefore, norms could not be computed for this South African age group. The same sample presented another limitation, as it only included scores for the first part of the AUT and not for the second part. This brought difficulties for drawing conclusions about this sample, as compared to the South African Older Adults sample, which also included Part 2 Fluency and Total Fluency, and the Venezuelan sample, which included these two and Total Errors.

Another limitation of this study came from the use of secondary datasets. The researcher only had limited access to these datasets and did not have access to information about the participants' socioeconomic status and the number of languages spoken. This is why these two variables were not accounted for in the data analyses. However, not all the datasets

had gathered information about these variables, and if the researcher had had access to the complete datasets, comparisons across the three samples could still not have been possible. In addition, the use of secondary datasets presented another limitation in terms of the scores available from the AUT as the researcher of this study only had access to the fluency score. Thus, the researcher could not include the originality, flexibility, and elaboration scores in the research study.

Lastly, this study did not account for measurement invariance testing nor for differential item functioning; therefore, the norms given in this research should be taken with caution.

### 6.2. Recommendations

The most important recommendation is to create more psychometric studies for the AUT, using representative samples for the populations of interest, using participants from different age groups, backgrounds and with different life experiences. It can be beneficial to study the interactions between divergent thinking and other variables not included in the present study, such as multilingualism, socioeconomic status, and quality of education, to create more specific knowledge for this cognitive process and take those into account for the normative studies.

It is also recommended to make use of the complete, six-item version of the AUT to obtain more specific results, as well as using all the four scores that measure the different components of divergent thinking (fluency, originality, flexibility, and elaboration) to attain a more comprehensive knowledge of how this construct can potentially interact with the demographic variables. Additionally, including the Total Error results in future analyses can be beneficial to explore the potential answers that this variable may hold.

# Chapter 7: Conclusion

In summary, divergent thinking is a cognitive process through which a person can generate many different ideas that branch out from one stimulus (Guilford, 1967; Ismail et al., 2019; Schroeter et al., 2019). This cognitive process is commonly associated with problem-solving and creative thinking (Guilford, 1967; Ismail et al., 2019) and is comprised of four factors: fluency, originality, elaboration, and flexibility (Runco & Acar, 2012). Demographic variables have been known to be associated with divergent thinking, including gender, age, and level of education (Alcock, 2021; Kamp et al., 2015; Kapoula et al., 2016; Razumnikova, 2004; Restrepo et al., 2019; Stephens et al., 2001; Syahrin et al., 2019). All three of these variables were explored in this research study by looking at how they have interacted in past research studies and how they interact with the fluency scores in the present research.

The AUT was developed by Guilford, Christensen, Merrifield, and Wilson (1978) to assess divergent thinking. This test was modified from the unusual uses test after Guilford and his colleagues developed the SOI (Guilford et al., 1978), a model of intelligence that became outdated after the development of other, more relevant models of intelligence. However, the AUT remained relevant in the field of divergent thinking, and it continues to be commonly used across nations to assess this cognitive process (see Alcock, 2021; Benigno, 2016; Edery, 2016; Gonzalez & Mairal, 2004; Ismail et al., 2019; Steinsapir, 2018). Nonetheless, there have not been any normative studies published for the AUT (Hass, 2017; Lewis & Lovatt, 2013), which are essential for more accurate interpretations of scores across nations and age groups.

The findings of this study concluded that the AUT is a reliable measure to assess the construct of divergent thinking in samples from South Africa and Venezuela as the internal consistency coefficients range between acceptable and strong. Further, this study concluded

that the variable of age had significant relationships with and effects on fluency in both Venezuela and South Africa; thus, this variable was accounted for at the time of creating the normative data. On the other hand, years of education had a weak correlation to fluency in the Venezuelan sample, but it did not have an effect on fluency in the same sample. However, the same demographic variable had strong correlations to fluency in the South African samples, specifically in the Older Adults sample, which were also seen as significant effects. Therefore, the variable of years of education was considered for the stratification of norms for the South African Older Adults sample but not for the Venezuelan sample. It was concluded that gender did not have any associations with the fluency scores. The normative data presented in this study should serve as an incentive for future researchers to create similar studies for the AUT while also taking into account more culturally specific variables to create more accurate norms.

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# Appendix A

Formal Permission Letter to Stephanie Alcock, owner of dataset used for the South African Older Adults Sample.

University of the Witwatersrand,
School of Human and Community Development,
Department of Psychology.

Stephanie Alcock
716976@students.wits.ac.za

23 March 2021

Dear Stephanie Alcock,
Re: Permission to access and use database for research purposes

My name is Nicole Gaffuri Soto. I am a student in the MA in Psychology by Research Programme in the School of Human and Community Development at the University of the Witwatersrand. For the purpose of my study, I am required to undertake research. Specifically, I am conducting research on divergent thinking titled "Comparison of the Psychometric Properties of the Alternative Use Test in South Africa and Venezuela". Which will specifically look at how different psychometric factors such as construct validity, reliability, and norms of the Alternative Use Test (AUT) can be compared to samples from developing countries, namely South Africa and Venezuela. Additionally, this study also seeks to investigate how some sociodemographic variables such as age, gender, and years of education, could potentially affect the results of the AUT.

I request permission to get access to the database that was used for the project "Development of a Theoretical Model of Creative Cognition in the Elderly". Specifically, the data regarding the Alternative Use Test along with the participants' demographics data including age, gender, and years of education.

If you agree to give us permission to access and use the data for purpose of this study, I will need a letter giving us formal permission (with your organisation's letterhead, signature, and date) and access to an anonymised Excel file containing the data from the variables noted above. The data will be kept secure and strictly confidential in a password protected file, in a password protected computer. Only my supervisor and I, the researcher, will have access to the data. I will delete the data files from my computer after the completion and publication of the study.

The research report 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, and as one of the authors, you will be able to contribute to the paper we submit to the journals.

Please let me know if you require any further information. I look forward to your response as soon as is convenient.

Yours sincerely,

Nicole Gaffuri Soto
+27 63 334 8716
2373382@students.wits.ac.za

Dr Aline Ferreira Correia
+27 11 717 4527
Aline.FerreiraCorreia@wits.ac.za
Senior Lecturer/Research Supervisor
Psychology Department
University of the Witwatersrand

# Appendix B

Formal Permission Letter to Ilva Campagna Osorio, Principal Investigator of the dataset used for the Venezuelan Sample.

University of the Witwatersrand,
School of Human and Community Development,
Department of Psychology.

Ilva Campagna Osorio
+58 416 621 03 81
ilvacampagna@hotmail.com

23 March 2021

Dear Ilva Campagna Osorio,
Re: Permission to access and use database for research purposes

My name is Nicole Gaffuri Soto. I am a student in the MA in Psychology by Research Programme in the School of Human and Community Development at the University of the Witwatersrand. For the purpose of my study, I am required to undertake research. Specifically, I am conducting research on divergent thinking titled "Comparison of the Psychometric Properties of the Alternative Use Test in South Africa and Venezuela". Which will specifically look at how different psychometric factors such as construct validity, reliability, and norms of the Alternative Use Test (AUT) can be compared to samples from developing countries, namely South Africa and Venezuela. Additionally, this study also seeks to investigate how some sociodemographic variables such as age, gender, and years of education, could potentially affect the results of the AUT.

I request permission to get access to the Standardization II database that was used for the "Neuropsychological Assessment of the Venezuelan Population" project. Specifically, the data regarding the Alternative Use Test along with the participants' demographics data including age, gender, years of education and socioeconomic status.

If you agree to give us permission to access and use the data for purpose of this study, I will need a letter giving us formal permission (with your organisation's letterhead, signature, and date) and access to an anonymised Excel file containing the data from the variables noted above. The data will be kept secure and strictly confidential in a password protected file, in a password protected computer. Only my supervisor and I, the researcher, will have access to the data. I will delete the data files from my computer after the completion and publication of the study.

The research report 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, and as one of the authors, you will be able to contribute to the paper we submit to the journals.

Please let me know if you require any further information. I look forward to your response as soon as is convenient.

Yours sincerely,

Nicole Gaffuri Soto
+27 63 334 8716
2373382@students.wits.ac.za

Dr Aline Ferreira Correia
+27 11 717 4527
Aline.FerreiraCorreia@wits.ac.za
Senior Lecturer/Research Supervisor
Psychology Department
University of the Witwatersrand

# Appendix C

Formal Permission Letter to Katherine Vergara, co-owner of dataset used for the Venezuelan Sample.

University of the Witwatersrand,
School of Human and Community Development,
Department of Psychology.

Katherine Vergara
neuropsicologiahuc@gmail.com

23 March 2021

Dear Katherine Vergara,
Re: Permission to access and use database for research purposes

My name is Nicole Gaffuri Soto. I am a student in the MA in Psychology by Research Programme in the School of Human and Community Development at the University of the Witwatersrand. For the purpose of my study, I am required to undertake research. Specifically, I am conducting research on divergent thinking titled "Comparison of the Psychometric Properties of the Alternative Use Test in South Africa and Venezuela". Which will specifically look at how different psychometric factors such as construct validity, reliability, and norms of the Alternative Use Test (AUT) can be compared to samples from developing countries, namely South Africa and Venezuela. Additionally, this study also seeks to investigate how some sociodemographic variables such as age, gender, and years of education, could potentially affect the results of the AUT.

I request permission to get access to the Standardization II database that was used for the "Neuropsychological Assessment of the Venezuelan Population" project. Specifically, the data regarding the Alternative Use Test along with the participants' demographics data including age, gender, years of education and socioeconomic status.

If you agree to give us permission to access and use the data for purpose of this study, I will need a letter giving us formal permission (with your organisation's letterhead, signature, and date) and access to an anonymised Excel file containing the data from the variables noted above. The data will be kept secure and strictly confidential in a password protected file, in a password protected computer. Only my supervisor and I, the researcher, will have access to the data. I will delete the data files from my computer after the completion and publication of the study.

The research report 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, and as one of the authors, you will be able to contribute to the paper we submit to the journals.

Please let me know if you require any further information. I look forward to your response as soon as is convenient.

Yours sincerely,

Nicole Gaffuri Soto
+27 63 334 8716
2373382@students.wits.ac.za

Dr Aline Ferreira Correia
+27 11 717 4527
Aline.FerreiraCorreia@wits.ac.za
Senior Lecturer/Research Supervisor
Psychology Department
University of the Witwatersrand

# Appendix D

Formal Permission Letter to Kate Cockcroft, owner of dataset used for the South African Younger Adults Sample.




University of the Witwatersrand,
School of Human and Community Development,
Department of Psychology.

Prof. Kate Cockcroft
+27 11 717 4511
Kate.Cockcroft@wits.ac.za
Department of Psychology
School of Human and Community Development
University of the Witwatersrand

7 May 2021

Dear Prof. Kate Cockcroft,
Re: Permission to access and use database for research purposes

My name is Nicole Gaffuri Soto. I am a student in the MA in Psychology by Research Programme in the School of Human and Community Development at the University of the Witwatersrand. For the purpose of my study, I am required to undertake research. Specifically, I am conducting research on divergent thinking titled "Comparison of the Psychometric Properties of the Alternative Use Test in South Africa and Venezuela". Which will specifically look at how different psychometric factors such as construct validity, reliability, and norms of the Alternative Use Test (AUT) can be compared to samples from developing countries, namely South Africa and Venezuela. Additionally, this study also seeks to investigate how some sociodemographic variables such as age, gender, and years of education, could potentially affect the results of the AUT.

I request permission to get access to the database that was used for the projects "Verbal working memory and verbal creativity" and "Verbal working memory and verbal creativity". Specifically, the data regarding the Alternative Use Test along with the participants' demographics data including age, gender, and years of education.

If you agree to give us permission to access and use the data for purpose of this study, I will need a letter giving us formal permission (with your organisation's letterhead, signature, and date) and access to an anonymised Excel file containing the data from the variables noted above. The data will be kept secure and strictly confidential in a password protected file, in a password protected

computer. Only my supervisor and I, the researcher, will have access to the data. I will delete the data files from my computer after the completion and publication of the study.

The research report 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, and as one of the authors, you will be able to contribute to the paper we submit to the journals.

Please let me know if you require any further information. I look forward to your response as soon as is convenient.

Yours sincerely,

Nicole Gaffuri Soto
+27 63 334 8716
2373382@students.wits.ac.za

Dr Aline Ferreira Correia
+27 11 717 4527
Aline.FerreiraCorreia@wits.ac.za
Senior Lecturer/Research Supervisor
Psychology Department
University of the Witwatersrand

# Appendix E

Signed Permission Letter from Stephanie Alcock, owner of the dataset for the South African Older Adults Sample.

1

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

University of the Witwatersrand,
School of Human and Community Development,
Department of Psychology.

Nicole Gaffuri Soto
+27 63 334 8716
2373382@students.wits.ac.za

Dr Aline Ferreira Correia
+27 11 717 4527
Aline.FerreiraCorreia@wits.ac.za
Senior Lecturer/Research Supervisor
Psychology Department
University of the Witwatersrand

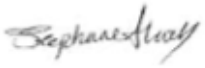
23 Mach 2021

Dear Nicole Gaffuri Soto and Dr Aline Ferreira Correia,
Re: Permission to access and use database for research purposes

I, Stephanie Alcock, give permission to Nicole Gaffuri Soto to access and use the anonymised participants' demographics data, and the data regarding the Alternative Use Test from the "Development of a Theoretical Model of Creative Cognition in the Elderly" project. This permission is explicitly granted for the dissertation project "Comparison of the Psychometric Properties of the Alternative Use Test in South Africa and Venezuela".

The dataset does not have any identifying information of the participants and therefore, the student will only have access to an anonymised file. Furthermore, the data set was collected after being approved by the University of the Witwatersrand's Human Research Ethics Committee (HREC Non-Medical).

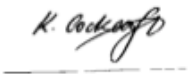
Yours sincerely,



Stephanie Alcock
716976@students.wits.ac.za



Dr Aline Ferreira Correia
+27 11 717 4527
Aline.FerreiraCorreia@wits.ac.za
Senior Lecturer/Research Supervisor
Psychology Department
University of the Witwatersrand



Prof. Kate Cockcroft
+27 11 717 4511
Kate.Cockcroft@wits.ac.za
Department of Psychology
School of Human and Community Development
University of the Witwatersrand

# Appendix F

Signed Permission Letter from Ilva Campagna Osorio, principal investigator of the dataset used for the Venezuelan Sample.

Universidad Central de Venezuela
Hospital Universitario de Caracas
Servicio de Neurología

Nicole Gaffuri Soto
+27 63 334 8716
2373382@students.wits.ac.za

Dr Aline Ferreira Correia
+27 11 717 4527
Aline.FerreiraCorreia@wits.ac.za
Senior Lecturer/Research Supervisor
Psychology Department
University of the Witwatersrand

23 Mach 2021

Dear Nicole Gaffuri Soto and Dr Aline Ferreira Correia,
Re: Permission to access and use database for research purposes

I, Ilva Campagna Osorio (Principal Investigator), give permission to Nicole Gaffuri Soto (MA student) and Aline Ferreira Correia (research supervisor) to access and use the anonymised participants' demographics data, and the data regarding the Alternative Use Test from the Standardization II database, which was collected for the "Neuropsychological Assessment of the Venezuelan Population" project. This permission is explicitly granted for the dissertation project "Comparison of the Psychometric Properties of the Alternative Use Test in South Africa and Venezuela".

The dataset does not have identifying information of the participants and therefore, the student will only have access to an anonymised file. Furthermore, the study was approved by the Ethics Committee of the University Hospital of Caracas (Hospital Universitario de Caracas). Unfortunately, I am not able to provide a copy of our ethics clearance, as our records were destroyed after our office flooded. In addition to this letter you may find a copy of the information sheet and consent form used for the purpose of this study.

Yours sincerely,



Lic. Ilva Campagna Osorio
Principal Investigator

# Appendix G

Signed Permission Letter from Katherine Vergara, co-owner of the dataset used for the Venezuelan Sample.

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Universidad Central de Venezuela
Hospital Universitario de Caracas
Servicio de Neurología

Nicole Gaffuri Soto
+27 63 334 8716
2373382@students.wits.ac.za

Dr Aline Ferreira Correia
+27 11 717 4527
Aline.FerreiraCorreia@wits.ac.za
Senior Lecturer/Research Supervisor
Psychology Department
University of the Witwatersrand

23 Mach 2021

Dear Nicole Gaffuri Soto and Dr Aline Ferreira Correia,
Re: Permission to access and use database for research purposes

I, Katherine Vergara, give permission to Nicole Gaffuri Soto (MA student) and Aline Ferreira Correia (supervisor) to access and use the anonymised participants' demographics data, and the data regarding the Alternative Use Test from the Standardization II database, which was collected for the "Neuropsychological Assessment of the Venezuelan Population" project. This permission is explicitly granted for the dissertation project "Comparison of the Psychometric Properties of the Alternative Use Test in South Africa and Venezuela".

The dataset does not have identifying information of the participants and therefore, the student will only have access to an anonymised file. Furthermore, the study was approved by the Ethics Committee of the University Hospital of Caracas (Hospital Universitario de Caracas). Unfortunately, I am not able to provide a copy of our ethics clearance, as our records were destroyed after our office flooded.

Yours sincerely,

Lic. Katherine Vergara Pérez
Esp. Neuropsicología Clínica
C.I. 14.362.992 FPV 5415

_____
Lic Katherine Vergara
Principal Neuropsychologist
Sección de Neuropsicología
Hospital Universitario de Caracas, Venezuela

## Appendix H

Signed Permission Letter from Prof. Kate Cockcroft, owner of the dataset used for the South

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

University of the Witwatersrand,
School of Human and Community Development,
Department of Psychology.

Nicole Gaffuri Soto
2373382@students.wits.ac.za

Dr Aline Ferreira Correia
+27 11 717 4527
Aline.FerreiraCorreia@wits.ac.za
Senior Lecturer/Research Supervisor
Psychology Department
University of the Witwatersrand

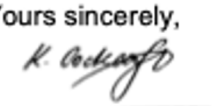
23 Mach 2021

Dear Nicole Gaffuri Soto and Dr Aline Ferreira Correia,
Re: Permission to access and use database for research purposes

I, Kate Cockcroft, give permission to Nicole Gaffuri Soto to access and use the anonymised participants' demographics data, and the data regarding the Alternative Use Test from projects "Verbal working memory and verbal creativity" and "Verbal working memory and verbal creativity". This permission is explicitly granted for the dissertation project "Comparison of the Psychometric Properties of the Alternative Use Test in South Africa and Venezuela".

The dataset does not have any identifying information of the participants and therefore, the student will only have access to an anonymised file. Furthermore, the data set was collected after being approved by the University of the Witwatersrand's Human Research Ethics Committee (HREC Non-Medical).

Yours sincerely,



Prof. Kate Cockcroft
+27 11 717 4511
Kate.Cockcroft@wits.ac.za
Department of Psychology
School of Human and Community Development

African Younger Adults Sample.

# Appendix I

Participant Information Sheet used for the South African Older Adults Sample

THE SCHOOL OF HUMAN AND COMMUNITY DEVELOPMENT
(SHCD)

**Information Sheet**

Good day. My name is Stephanie Alcock and I am currently a PhD student in Psychology within the School of Human and Community Development, at the University of the Witwatersrand. I have contacted you because you are an individual above the age of 65 who is capable of independent living. I would therefore like to invite you to take part in this study.

**Title of Study**: Modelling the Theoretical Relationships between Creativity, Fluid Intelligence, Executive Control, and the Multilingual Experience in the Elderly.

**Purpose of the Study:** This study aims to develop an integrated theoretical model of creativity. By focusing on an elderly sample, I wish to assess the effects of age on the cognitive functions underlying creativity and how particular activities, such as the multilingual experience, potentially influences creative thinking.

**What Participation Entails:** You will be required to complete a consent form, a demographic questionnaire and several cognitive tests, which involves answering questions, creative thinking tasks and problem solving. Any personal details provided in these documents and any data collected will remain confidential as they will only be available to the researchers and their supervisors. It will take approximately 60-90 minutes to complete all the tests, including a 10 to 15 minute break halfway.

**Risks and Benefits of the Study:** Please be aware that if you participate you will be offered R150.00 to cover any travel or refreshment expenses. I would like to stress that you are not obliged to participate in this study and may withdraw from it at any point without a given reason. You have the option to not answer any particular question and there will be no negative consequences if you should do so. Please note that if you are not invited to proceed with your participation it is because you do not meet the study's demographic and screening criteria, which is in no way diagnostic but rather a consequence of the sample design. All data collected and information of those who have been excluded or withdraw voluntarily will in default be disregarded and destroyed.

Participation is not anticipated to have risks in any manner. However, you may feel distressed or frustrated when taking the cognitive tests as they involve time constraints and may be perceived as difficult. Should you feel distressed because of this study, you may receive free counselling by contacting the South African Depression and Anxiety Group: 011 262 6396 or Mrs Aline Ferreira-Correia: 011 717 4527, who is a registered clinical psychologist with the Health Professions Council of South Africa (HPCSA).

**Research Outcomes:** The results from this study will be used to compile a research report, which will be available and accessible in the library of the University of the Witwatersrand and the world-wide web. Should you be interested in obtaining these results, you are more than welcome to contact me. It is anticipated for these results to be ready in December 2020.

**Concerns and Enquiries:** Should you have any concerns, complaints, enquiries or require further information about this study please do not hesitate to contact me or either of my supervisors by using the contact details provided below.


| **Researcher** | **Supervisor** | **Co-supervisor** |
|---|---|---|
| Stephanie Alcock | Kate Cockcroft | Aline Ferreira-Correia |
| Phone Number: 076 975 8467 | Phone Number: (011) 717 4511 | Phone Number: (011) 717 4527 |
| Email: 716976@students.wits.ac.za | Email: Kate.Cockcroft@wits.ac.za | Email: Aline.FerreiraCorreia@wits.ac.za. |


## Appendix J

Participant Information Sheet and Informed Consent Form used for the Venezuelan Sample

## Consentimiento Informado

En el Hospital Universitario de Caracas, Servicio de Neurología, Sección de Neuropsicología se está realizando el proyecto de investigación titulado **"Estandarización de Pruebas Neuropsicológicas en Población del Área Metropolitana de Caracas"** con el objeto de conocer las puntuaciones normales de sujetos sanos en pruebas que miden el funcionamiento cognitivo.

**Investigador Principal: Esp. Ilva Campagna**

**Nombre del Sujeto**:_____

Ud. ha sido convocado a participar en un estudio relacionado con la valoración de las funciones cognitivas en personas sanas del área metropolitana de Caracas, que nos permitirá obtener los valores normativos para poder valorar los resultados en las pruebas neuropsicológicas de los pacientes con quejas cognitivas.

En este consentimiento se le informa por qué se está realizando este estudio y qué se le hará si decide participar en el mismo.

**Propósitos del estudio.**

El objetivo de esta investigación es establecer los valores normales de los sujetos sanos de la población del área metropolitana de Caracas en una serie de pruebas neuropsicológicas, para utilizar estas tablas como medida comparativa con las cuales valorar los resultados de los pacientes que ameriten una evaluación con fines diagnósticos por presentar problemas cognitivos. Obtener los resultados de una muestra de sujetos sanos de diferentes edades y niveles educativos nos indica cuáles son las puntuaciones esperadas en pacientes con las mismas características sociodemográficas. Sin medidas estándares con las que comparar las puntuaciones de un paciente en una prueba neuropsicológica determinada, el resultado carece de valor. Las pruebas neuropsicológicas son de gran utilidad como herramienta diagnóstica en diferentes enfermedades, especialmente las neurológicas, psiquiátricas y sistémicas.

**Sus derechos**: Es importante saber que:

1) Su participación es completamente voluntaria y anónima; ninguna persona extraña al estudio conocerá los resultados de su evaluación.

2) Ud. puede decidir si participar o no, o retirarse de la investigación sin perjuicio para Ud.

3) La aplicación de las pruebas tendrá una duración aproximada de cuarenta y cinco minutos a una hora, consiste en responder o realizar tareas sencillas verbales o escritas, y no implican ningún riesgo a su integridad física y/o mental.

4) De Ud. requerirlo, podrá recibir los resultados de las pruebas administradas.

**Procedimientos**:

Si Ud. califica para el estudio y está de acuerdo en participar, su participación en el mismo dura poco tiempo aproximadamente una hora. Se le pide lo siguiente:

Estar dispuesto a recibir una llamada de verificación por parte de los supervisores del evaluador, quienes constatarán los resultados de la evaluación.

**Beneficios:**

Ud. se puede beneficiar con su participación porque:

1) Tendrá una evaluación neuropsicológica integral que le servirá como nivel de funcionamiento base para evaluaciones neuropsicológicas posteriores que pueda requerir.

2) El costo de este estudio será gratuito.

3) Por último, Ud. participará y contribuirá al crecimiento de la neuropsicología en el país, lo que redundará en beneficios para los pacientes con enfermedades neurológicas o psiquiátricas.

**Confidencialidad**: Su historia clínica será confidencial y se identificará en el estudio con un número y solo los investigadores sabrán a que nombre corresponde. Su nombre no será usado en ninguna publicación o reporte.

**Retiro del estudio**:

Ud. puede retirarse de este estudio voluntariamente cuando lo desee. Si el evaluador que lo está atendiendo considera que su participación a lo largo de este estudio no es favorable para Ud. también puede decidir que debe abandonarlo.

**Uso de los resultados**:

Si Ud. autoriza que los investigadores hagan un seguimiento de su funcionamiento cognitivo a lo largo del tiempo, o tras enfermedades potencialmente deteriorantes de las habilidades mentales, favor indique:

(Por favor marque abajo para indicar si Ud. puede o no ser contactado en el futuro)

____Puedo ser contactado de nuevo para información.

____No puedo ser contactado de nuevo para información.

Iniciales del voluntario:_____ Fecha:_____

Si Ud. está de acuerdo en ser contactado de nuevo, aún después puede cambiar de opinión en proveer información en el futuro.

**Preguntas:** Ud. es libre de preguntar sobre este estudio y sus derechos en este proyecto de investigación. Cualquier otra pregunta puede dirigirse a:

Esp. Ilva Campagna – Hospital Universitario de Caracas – Telf: 6067430-04166210381

**El propósito y procedimientos de este proyecto me han sido explicados y los he comprendido bien, he sido informado acerca de todos las incomodidades, riesgos y beneficios que pueden resultar y los he comprendido. Yo estoy de acuerdo en participar como individuo en este proyecto. Yo estoy enterado de que puedo suspender mi participación en cualquier momento.**

Firma del Paciente:_____ Fecha:_____

Firma del Testigo:_____ Fecha_____

**DECLARACIÓN DEL INVESTIGADOR:**

Yo le he explicado a la persona arriba nombrada la naturaleza y objetivos de los procedimientos arriba descritos y los riesgos previstos, las incomodidades y los beneficios que pueden resultar. Le he preguntado si tenía alguna pregunta sobre los procedimientos y he

contestado esas preguntas con mi mayor capacidad. He considerado y rechazado procedimientos alternativos de respuesta a las preguntas sobre esta investigación.

Firma:_____ Fecha:_____

# Appendix K

Participant Information Sheet used for the South African Young Adults Sample




School of Human and Community Development

*Private Bag 3, Wits 2050,*

*Johannesburg,*

*South Africa*

**TEL:** 011 717 4500 **FAX:** 011 717 4559

Dear Participant

**Participant Information Sheet**

**"The Relationship between Working Memory and Creativity"**

Our names are Alessia Benigno, Chad Edery and Naledi Mokoena, and we are conducting a research project under the supervision of Professor Kate Cockcroft within the Department of Psychology at the University of the Witwatersrand. This research project contributes towards an Honours degree in Psychology. The aim of this particular study is to determine whether or not a relationship exists between working memory and creativity in individuals.

The 'normal' functioning of working memory is essential given the amount of information processing required in lecture settings as well as life in general. The present study will specifically focus on the relationship between working memory and creativity as a key learning component. The data generated from this study will provide further insight into the underlying relationship and mechanisms of both working memory and creativity. In addition to this, the data generated in this study will also provide

valuable information with regard to the effectiveness of the Automated Working Memory Assessment (AWMA), Torrance Tests of Creative Thinking (TTCT) and the Alternate Uses Task (AUT) as screening tools for working memory and creativity in the South African population.

We would like to invite you to participate in the study. Participation will involve the completion of four assessments/questionnaires. The first of these is the assessment of working memory components using the Automated Working Memory Assessment (AWMA). The second assessment is that of the Torrance Test of Creative Thinking (TTCT). The third assessment is the completion of the Alternate Uses Task (AUT), and the final assessment is a biographical questionnaire. The AWMA is a computerised assessment which is administered by the researchers. The TTCT and AUT are completed by participants and are scored by the researchers. Finally, the biographical questionnaires are completed by participants and are used for statistical purposes.

As a whole, all tests take on average one hour to one hour and fifteen minutes to complete, with the AWMA taking up about 45 minutes of the time. The biographical questionnaire should take up to a maximum of 15 minutes to complete. Assessment of participants will take place at a time that has been negotiated with the participant. The assessment will be conducted at the University of the Witwatersrand in a quiet environment so as to ensure optimum administration of the assessments. The results of this study (as previously mentioned) will be used to answer the question of whether or not there is an existing relationship between working memory and creativity.

No findings that are able to identify any participants will be published; only those findings of the combined results of all participants will be used. The data collected from the participant will be stored in a secured locked cupboard and a password protected computer that is kept in a locked office. Additionally, the data will contain no personal or identifying information. The only individuals that will have access to the data will be the supervisor (Professor Kate Cockcroft), and the researchers (Alessia, Chad and Naledi). Any potentially identifying information (such as that would be used for course credit or any other student numbers should they appear) will be destroyed upon data capture.

Participation in this study is completely voluntary and you are under no obligation to consent to participate. If you choose or decline to participate, your relationship with the school will not be affected. If you agree to participate, you may withdraw at any time without prejudice.

The collected data may be used for other purposes (such as further study) but will remain confidential and unidentifiable to any single participant. In addition to this, no individual participant will be identifiable through the publication of any findings that result from further use of this collected data.

If the participant finds any aspect of the assessment uncomfortable or troubling, they may go to the Clinic in the Emthonjeni Centre on the University of the Witwatersrand East campus for a Psycho-Educational Assessment.

In terms of feedback from the study, a small paragraph will be published on the SAKAI site (or may be e-mailed to the participant if they so wish) which will detail the results, as the study is longitudinal in nature and is thus ongoing. Should you find that after the completion of the assessments that you would like to discuss anything relevant to the study or have any questions about the contents of the questionnaires/assessments, please do not hesitate to contact us.

| If you would like to contact the **researchers** about any aspect of this study, please contact the following: | If you have a **complaint** concerning the manner in which this research is being conducted, please contact: |
|---|---|
| **Chief Investigator:**<br>Professor Kate Cockcroft<br>Tel: 011 717 4511<br>Email: kate.cockcroft@wits.ac.za<br><br>**Researchers:**<br>Alessia Benigno<br>Email: 710577@students.wits.ac.za | **Human Ethics Officer**<br>Human Research Ethics Committee (HREC)<br>Tel: 011 717 1234 |

| | |
|---|---|
| Chad Edery<br><br>Email: chad.edery@gmail.com<br><br>Naledi Mokoena<br><br>Email: 507304@students.wits.ac.za | |

Kind regards,

Alessia Benigno, Chad Edery, and Naledi Mokoena

# Appendix L

Informed Consent Form used for the South African Older Adults Sample

THE SCHOOL OF HUMAN AND COMMUNITY DEVELOPMENT
(SHCD)

**Informed Consent Form**

I confirm that I am an adult above the age of 65 who is capable of independent living. I have read and understand the information provided in the information sheet in relation to the research entitled: *Modelling the Theoretical Relationship between Creativity, Fluid Intelligence, Executive Control and the Multilingual Experience in the Elderly*. I have adequately been informed about the research procedures, what participation entails and have been given sufficient time to consider whether or not to participant in this study. I also understand that:

- My participation is completely voluntary.
- I may withdraw from the research at any time with no negative consequences for me
- My results and identity will be kept anonymous 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 researcher and the supervisor.
- My participation will be treated with confidentiality
- No rewards or compensation will be offered or provided for my participation
- No risks are associated with participation
- I have been given a number for free counselling services if I experience any distress that may be elicited by this study
- I have received the contact details of the researcher Miss Stephanie Alcock and her supervisor Professor Kate Cockcroft and co-supervisor Mrs Aline Ferreira-Correia.

**Declaration by Participant**

I hereby consent to take part in this study

Participant's name: _____

Signature: _____ Date: _____

**Declaration by Researcher**

I confirm that I have explained the research to the participant and have answered any questions about it.

Researcher's name: _____

Signature: _____ Date: _____

## Appendix M

Informed Consent Form used for the South African Young Adults Sample

I,_____, consent to participate in this study and am aware of what participation in the study entails.

Furthermore, I DO/ DO NOT (please circle the appropriate response) give permission for my data to become archival and thus be used in future studies at the University of the Witwatersrand.

Signature_____

Date_____

Student Number | | | | | | | | | | |

## Appendix N

Ethics Clearance from HREC (Medical) for the South African Older Adults Sample

UNIVERSITY OF THE WITWATERSRAND JOHANNESBURG

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

**Office of the Deputy Vice-Chancellor (Research & Post Graduate Affairs)**

**TO:** Miles S Alcock and AF Correia
School of Human and Community Development
Department of Psychology
University

E-mail: 716976@students.wits.ac.za

**CC:** Supervisor: Professor K Cockcroft <Kate.Cockcroft@wits.ac.za>
and <HREC-Medical.ResearchOffice@wits.ac.za>

**FROM:** Iain Burns
Human Research Ethics Committee (Medical)
Tel: 011 717 1252

E-mail: Iain.Burns@wits.ac.za

**DATE:** 03/10/2018

**REF:** *R14/49*

**PROTOCOL NO:** **M180726** *(This is your ethics application study reference number. Please quote this reference number in all correspondence relating to this study)*

**PROJECT TITLE:** *Modelling the theoretical relationship between creativity, fluid intelligence, executive control and the multilingual experience in the elderly*

Please find attached the Clearance Certificate for the above project. I hope it goes well and that an article in a recognized publication comes out of it. This will reflect well on your professional standing and contribute to the Government funding of the University.

MSWorks2000/Iain0007/Clearscan.wps

UNIVERSITY OF THE WITWATERSRAND JOHANNESBURG

R14/49 Miles S Alcock and AF Correia

## HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
## CLEARANCE CERTIFICATE NO. M180726

| | |
|---|---|
| **NAME: (Principal Investigator)** | Miles S Alcock and AF Correia |
| **DEPARTMENT:** | School of Human and Community Development<br>Department of Psychology<br>University |
| **PROJECT TITLE:** | Modelling the theoretical relationship between creativity, fluid intelligence, executive control and the multilingual experience in the elderly |
| **DATE CONSIDERED:** | 27/07/2018 |
| **DECISION:** | Approved unconditionally |
| **CONDITIONS:** | |
| **SUPERVISOR:** | Professor K Cockcroft |
| **APPROVED BY:** | Dr CB Penny, Chairperson, HREC (Medical) |
| **DATE OF APPROVAL:** | 03/10/2018 |

**This clearance certificate is valid for 5 years from date of approval. Extension may be applied for.**

**DECLARATION OF INVESTIGATORS**

To be completed in duplicate and **ONE COPY** returned to the Research Office Secretary on 3rd floor, Phillip V Tobias Building, Parktown, University of the Witwatersrand, Johannesburg.

I/We fully understand the conditions under which I am/we are authorised to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated from the research protocol as approved, I/we undertake to resubmit to the Committee. I agree to submit a yearly progress report. When a funder requires annual re-certification, the application date will be one year after the date of the meeting when the study was initially reviewed. In this case, the study was initially reviewed in July and will therefore reports and re-certification will be due early in the month of July each year. Unreported changes to the application may invalidate the clearance given by the HREC (Medical).

Principal Investigator Signature

05/10/2018
Date

**PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES**

## Appendix O

Ethics Clearance Certificates for the South African Young Adults Sample

HUMAN RESEARCH ETHICS COMMITTEE (SCHOOL OF HUMAN & COMMUNITY DEVELOPMENT

CLEARANCE CERTIFICATE PROTOCOL NUMBER: HONS/16/001 IH

PROJECT TITLE: Working Memory and Verbal Creativity

INVESTIGATORS Benigno Alessia

DEPARTMENT Psychology

DATE CONSIDERED 23/02/16

DECISION OF COMMITTEE* Approved

This ethical clearance is valid for 2 years and may be renewed upon application

DATE: 23 February 2016 CHAIRPERSON _____
(Professor. A Thatcher)

cc Supervisor: Prof. K Cockcroft
Psychology

DECLARATION OF INVESTIGATOR (S)

To be completed in duplicate and one copy returned to the Secretary, Room 100015, 10th floor, Senate House, University.

I/we fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure be contemplated from the research procedure, as approved, I/we undertake to submit a revised protocol to the Committee.

This ethical clearance will expire on 31 December 2018

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG
HUMAN RESEARCH ETHICS COMMITTEE (SCHOOL OF HUMAN & COMMUNITY DEVELOPMENT
CLEARANCE CERTIFICATE PROTOCOL NUMBER: HONS/16/001 IH
PROJECT TITLE: Working Memory and Verbal Creativity
INVESTIGATORS Edery Chad

DEPARTMENT Psychology

DATE CONSIDERED 23/02/16

DECISION OF COMMITTEE* Approved

This ethical clearance is valid for 2 years and may be renewed upon application

DATE: 23 February 2016 CHAIRPERSON _____
(Professor. A Thatcher)

cc Supervisor: Prof. K Cockcroft
Psychology

DECLARATION OF INVESTIGATOR (S)

To be completed in duplicate and one copy returned to the Secretary, Room 100015, 10th floor, Senate House, University.

I/we fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure be contemplated from the research procedure, as approved, I/we undertake to submit a revised protocol to the Committee.

This ethical clearance will expire on 31 December 2018

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

# Appendix P

Ethics Clearance from HREC (Medical) for the Current Study

| UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG | HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL) |
|---|---|

**Office of the Deputy Vice-Chancellor (Research and Innovation)**

**TO:** Ms N Gaffuri Soto
School of Human and Community Development
Department of Psychology
University

E-mail: 2373382@students.wits.ac.za

**CC:** Supervisor: Dr A Ferreira Correia
Aline.FerreiraCorreia@wits.ac.za
and <HREC-Medical Research Office@wits.ac.za>

**FROM:** Mr Iain Burns
Human Research Ethics Committee (Medical)
Tel: 011 717 1252

E-mail: Iain.Burns@wits.ac.za

**DATE:** 2021/08/24

**REF:** R14/49

**PROTOCOL NO:** **M210759** (This is your ethics application reference number. Please quote it in all enquiries, oral or written, relating to this study.)

**PROJECT TITLE:** *Comparison of psychmetric properties of the Alternative Uses Test in South Africa and Venezuela*

Please find attached the Clearance Certificate for the above project. I hope it goes well and that an article in a recognized publication comes out of it. This will reflect well on your professional standing and contribute to Government funding of the University.

MSWork32000/Iain0007/Clearscan.wps

UNIVERSITY OF THE WITWATERSRAND JOHANNESBURG

R49 Ms N Gaffuri Soto

# HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
## CLEARANCE CERTIFICATE NO. M210759

| | |
|---|---|
| **NAME:** (Principal Investigator) | Ms N Gaffuri Soto |
| **DEPARTMENT:** | School of Human and Community Development<br>Department of Psychology<br>University |
| **PROJECT TITLE:** | *Comparison of psychmetric properties of the Alternative Uses Test in South Africa and Venezuela* |
| **DATE CONSIDERED:** | Ads hoc |
| **DECISION:** | Approved unconditionally |
| **CONDITIONS:** | Sub-study under M180726 |
| **NOTE:** | If contact information regarding student study participants is required, please contact the Registrar's office - <Nicoleen.Potgieter@wits.ac.za> |
| **SUPERVISOR:** | Dr A Ferreira Correia |
| **APPROVED BY:** | Dr CB Penny, Chairperson, HREC (Medical) |
| **DATE OF APPROVAL:** | 2021/08/24 |

**This Clearance Certificate is valid for 5 years from the date of approval. An extension may be applied for.**

---

**DECLARATION OF INVESTIGATORS**

To be completed in duplicate and **ONE COPY** returned to the Research Office secretariat on the 3rd floor, Phillip Tobias Building, Parktown, University of the Witwatersrand, Johannesburg.

I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated from the research protocol as approved, I/we undertake to submit details to the Committee. **I agree to submit a yearly progress report**. When a funder requires annual re-certification, the application date will be one year after the date when the study was initially reviewed. In this case, the study was initially reviewed in **2021/07/01** and therefore reports and re-certification will be due in the month of **2021/07/01** each year. Unreported changes to the study may invalidate the clearance given by the HREC (Medical).

Signature of Principal Investigator

27/08/2021
Date