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# Phonetic verbal fluency in Multilingual speakers

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**Masters in Psychological Research – Research Proposal Declaration**

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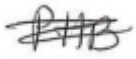
**Signed:** 

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**Abstract**

Verbal fluency is a core neuropsychological function that assess a person's ability to locate precise information under specific search criteria. This study aimed to investigate the differences in performance of multilingual individuals who report English as their first language and individuals who report other languages as their first language on a phonemic fluency test assessed by the COWAT FAS. Whilst also investigating the influence of the covariates (age, gender, years of formal education, and code switching) on the performance of these individuals. To address these aims a sample of 60 participants were recruited through purposive and snowballing sampling. The results of the study revealed a statistically non-significant difference in the performance between multilingual individuals who report English as their first language and individuals who report other languages as their first language as well as a statistically non-significant ($p > .05$) difference in performance between males and females. The Spearman rho correlation revealed a significant correlation ($p < .05$) between the age of participants and their COWAT FAS total score, while a non-significant correlation was observed between the code switching of participants and their COWAT FAS total score. Similarly, the Pearson product correlation revealed a significant positive correlation between the years of formal education of participants and the COWAT FAS total score. Overall, this study provides fresh insight into the performance of multilinguals in South Africa as well as demographic factors that influence performance on this test which creates a foundation for more studies to be conducted on this topic.

**Acknowledgment**

I would like to express my deepest gratitude to my supervisor Dr. Aline Ferreira-Correia who supported me throughout this process, your guidance, time, and effort is greatly appreciated. I would also like to thank my parents, sister (Alessandra) and friends (Onthatile and James) for all the support throughout this rollercoaster ride, your words of encouragement have led up to this memorable moment.

# 1. Introduction

Verbal fluency tasks assess an individual's capacity to locate precise information under specific search criteria (Lezak et al., 2012). These search criteria are often classified into two categories, namely, semantic fluency and phonemic fluency. In order to measure phonemic fluency, test-takers are asked to produce as many words as they can that start with a particular letter, often F, A, or S; whereas semantic fluency is evaluated through the production of semantic group exemplars (typically names of animals) (Jebhani et al., 2020; Opasso et al., 2016).

Verbal fluency tests are one of the most often utilised neuropsychological diagnostic methods due to the vulnerability of verbal fluency performance to certain cognitive impairments connected to lesions in the frontal lobe and deficits in the temporal lobe, and are therefore included in widely used batteries, or as a stand-alone test (McDowd et al., 2011).

The capacity to obtain and recover phonemic and semantic information while retaining attention during a task may be further examined by determining how many clusters are generated within a phonemic and semantic group and how many switches between clusters (Troyer et al., 1997). These categories of verbal fluency test an individual's language function such as naming ability, vocabulary, long term memory, working memory, speed of reaction, search techniques, executive function, lexical semantic access, and mental organization (Ruff et al., 1997; Vogel et al., 2009; Garcia-Moreno, 2017).

The connection between verbal fluency, executive function, and multilingual acquisition is an area of research that has gained popularity over the years. Multilingualism is widespread and growing rapidly around the world (Bhatia & Ritchie, 2014). Given that South Africa has 11 official languages, individuals who live there are more likely to be exposed to and utilise numerous languages than not (Louw & de Wet, 2007). Due to the speed at which

words can be retrieved depending on the language, the ability to speak multiple languages provides a window for studying how languages are produced (Kroll & De Groot, 2009). It is argued that the constant need to manage the various known languages that are constantly active in the brain to choose the one appropriate for each unique occurrence enhances cognitive processes, especially executive functions (Giovannoli et al., 2020). On the other hand, some researchers contend that speaking multiple languages negatively impacts language production, as seen by slower reaction times and decreased lexical access accuracy (Gollan et al., 2007; Shao et al., 2014). Hence, this study aims to investigate the differences in performance of multilingual individuals who report English as their first language (L1) and individuals report other languages as their first language (L2) on a phonemic fluency test assessed by the COWAT FAS. While also accounting for covariates such as age and gender that may have an impact on these participants' performance on this task. To address the aims of this study this paper begins with a literature review which verbal fluency, demographic factors that influence performance on a verbal fluency test and multilingualism. The subsequent chapters outline and discuss the methods, measures, procedures and results of the study.

# 2. Literature Review

## 2.1. Verbal Fluency

### 2.1.1. Conceptualisation

Verbal fluency is defined as a cognitive ability that aids memory recall (Gierach et al., 2022). In order to successfully recall information, executive control, which includes processes like self-monitoring, selective attention, internal response production, mental shifting, and inhibition, is necessary (Patterson, 2011). Verbal fluency tests assess a person's capacity to produce precise verbal information within limited search constraints (Lezak et al., 2004). There are two types of verbal fluency tests, phonemic and semantic verbal fluency (Jebhani et al., 2020; Opasso et al., 2016), the focus of this study will be on phonemic verbal fluency.

Since at least the 1940s, studies on verbal fluency in healthy and clinical populations have been conducted (Patterson, 2011). The first standardised examination of verbal fluency traces back to Thurstone's written fluency test (1973), which was evidently of limited use in evaluating individuals with dominant upper extremity deficits such hemiparesis or psychomotor slowness. Given the limitation of Thurstone (1972), written verbal fluency test Borkowski, Benton and Spreen (1967) developed an oral verbal fluency test. This oral verbal fluency test addressed methodological issues from the administration of this written test to individuals with brain injuries. Given the number of words in English, these researchers determined a set of simple against relatively difficult letters, including the simple letters F, A, and S, which are still used today as a part of the Neurosensory Center Comprehensive Examination for Aphasia (Patterson, 2011). In order to validate their theories about the usefulness of word fluency evaluation, they also provided word fluency statistics for persons with and without brain injury (Borkowski et al., 1967). Word fluency tests have undergone extensive research for descriptive and normative data as well as an inclusion in formative

assessments since the original publication (Patterson, 2011). A typical example is seen with the COWAT being included in the Multilingual Aphasia Examination (Benton & Hamsher, 1996). There are presently a large number of standardised versions of verbal fluency tests using phonemic cues and these versions exist in numerous languages such as Flemish, French, Chinese, Norwegian and Spanish (Patterson, 2011). Notably these phonemic cues also exist in letters such as L, P, N, F, S, R, and V (Cardebat et al., 1990).

### 2.1.2. Verbal fluency and Demographic variables

Demographic factors such as age, gender and educational have an impact on performance on the Controlled Oral Word Association Test FAS (COWAT) (Rodríguez-Aranda & Sundet, 2006; Ross, 2003).

It has been shown that age has a significant influence on verbal fluency tasks, however, results on these effects are inconsistent. On the one hand, standardised norms on the COWAT FAS reveal an age dependent decline in performance, with younger adults performing better than older adults (Strauss et al., 2006). Tallberg et al. (2008) correlates this difference in performance between younger and older adults to a decline in information processing speed. They further assert that older adults have a lengthier reaction time prior to producing their first words and ultimately produce words at a slower rate. While other studies have been unable to identify an age-related difference (Rodríguez-Aranda & Martinussen, 2006; Steiner et al., 2008).

The association between gender and verbal fluency has contradictory evidence (Rivera et al., 2019; Weiss et al., 2006). On one hand, several studies claim that women outperform men on phonemic verbal fluency tasks (Costa et al., 2014; Scheuringer et al., 2017; Weiss et al., 2006), while other studies have been unable to confirm this disparity (Brickman et al., 2005; Cavaco et al., 2013; Khalil, 2010). This inconsistency has been explained by the fact that the

majority of studies concentrating on between-sex comparisons have not looked at variables related to verbal techniques such as switching and clustering. In phonemic fluency tests, Weiss et al. (2006) notes that women perform a higher number of switches than their male counterparts. It was revealed that to enhance verbal fluency task performance, males and females use distinct processing techniques for phonemic verbal fluency tests (Weiss et al., 2006). Males switched infrequently and created larger clusters, whereas females adopted a more successful strategy for balancing clustering and switching, which led to males having a lower overall production of words (Weiss et al., 2006).

Education has been revealed to have a significant influence on performance on verbal fluency tasks. According to a normative study conducted by Kosmidis et al. (2004), education had significantly influenced on how well participants performed on phonemic verbal fluency tests. Similarly, Ratcliff et al. (1998) explored phonemic fluency in a Hindi-speaking sample and discovered that participants' performance was influenced by their years of formal education. Casals-Coll et al. (2013) claim that individuals with higher levels of education perform better on phonemic verbal fluency tests. Furthermore, Strauss et al. (2006) argue that individuals with greater levels of education often more than 12 years of education do better on phonemic verbal fluency than those with lower levels typically fewer than 12 years of education. Nogueira et al. (2016) attributes this advantage in performance by persons with higher levels of education to increased vocabulary exposure. This illustrates how performance is impacted by stored vocabulary and cognitive abilities like articulation speed and auditory attention (Nogueira et al., 2016).

## 2.2. Multilingualism

### 2.2.1. Conceptualisation

Multilingualism or bilingualism is the ability of an individual to communicate in more than one language, and it is becoming more common around the world (Bhatia & Ritchie, 2014). These terms have become a topic of debate as they are often used interchangeably and the differences between these concepts are not always clear in research studies. For instance, a multilingual individual is defined by Li and Moyer (2008) as someone who can communicate actively in speech and writing and passively (reading and listening) in multiple languages. A similar definition is given by Cohen (2008) who asserts that multilingualism is the capacity of an individual to regularly use more than one language in their daily lives. On the other hand, Cook and Bassetti (2011) define bilingualism as an individual's ability to communicate in two or more languages. Hence, the term multilingualism will be used in this manuscript to refer to both (multilingualism and bilingualism) which is defined as individuals who communicate in two or more languages.

### 2.2.2. Multilingualism and Cognition

Multilingualism was believed to have cognitive disadvantages for much of the twentieth century (Antoniou, 2019). In fact, the 'challenge of the bilingual child' was used to describe multilingual acquisition. Studies conducted between the 1920s and the 1950s revealed that multilingual individuals performed poorly on verbal tests that assessed cognitive abilities (Goodenough, 1926; Saer, 1923; Yoshioka, 1929). This evidence led researchers to the conclusion that early exposure to multiple languages disoriented young children and resulted in cognitive deficits. However, other confounding factors, like level of bilingualism, socioeconomic status, and age, were not taken into consideration in these early studies (Alladi et al., 2013). Some of these studies failed to regard the participants' status as refugees and the

consequent interruptions to their education during war (Marian, 2018). The fact that participants were non-English speakers was also not taken into consideration as they were tested predominantly in English and some of these participants possessed very little fluency in English or were unable to speak this language (Marian, 2018). Therefore, the participants' poor performance on the test is completely expected, yet their low test results were incorrectly attributed to their bilingualism.

An exception to these questionable studies, Peal and Lambert's (1962) seminal study showed that bilingualism had cognitive benefits. By properly defining bilingualism, accounting for various confounding variables such as socioeconomic status, gender, and age, and by conducting assessments in the participants' primary language, their study addressed some of the methodological problems of earlier research. They discovered that bilingual children did better than monolinguals on various verbal intelligence tests as well as nonverbal tests. The results refuted the prevailing theory at the time that bilingualism resulted in subpar cognitive development. A sizable body of research has emerged more than 50 years since that publication suggesting speaking two languages offers a "bilingual advantage" (Antoniou, 2019, p. 2). Executive function, cognitive flexibility, metalinguistic awareness, creative thinking, a delay in the development of dementia symptoms, and phonetic perception are all reportedly improved by the bilingual advantage (Antoniou et al., 2015; Bialystok et al., 2007; Lee & Kim, 2011).

There is still a debate regarding the underlying mechanisms of the bilingual advantage (De Bruin & Della Sala, 2019). Given that a bilingual person's languages are perpetually relatively active, interacting, and influencing one another, the logical assumption is that a lifetime of expertise with perpetually navigating and resolving conflict between the two languages will bring about cognitive benefits when non-linguistic processing uses the same executive control neural circuits (Bialystok, 2017). Similar transfer effects have been observed with other cognitively stimulating hobbies like playing video games, practising photography,

and learning an instrument (Park et al., 2014). As opposed to other intellectually stimulating activities, it has been suggested that managing multiple languages may have a greater impact on cognitive function (Hanna-Pladdy & MacKay, 2011). This is because language learning is one of the most difficult skills that an individual can acquire, requiring a large amount of brain activity, and individuals constantly utilise languages to transmit their thoughts throughout their lives (Antoniou et al., 2013).

Similarly, it is argued that the switching and mixing of languages by multilinguals has an impact on their cognitive function. During discourse between two multilinguals who speak the same languages it is identified that this group of individuals do not speak exclusively in only one language (Yim & Bialystok, 2012). According to Grosjean and Miller (1994), a multilingual's language progresses along a spectrum from a monolingual mode, in which a single language is used, to a multilingual mode, in which several languages are utilised during communication. These authors also highlighted that in this multilingual mode, there is a significant chance of mixing the languages known by the multilingual (Grosjean & Miller, 1994). Code switching, which is defined as the deliberate switching between many known languages or the blending of content from several known languages within a single utterance, shares traits with the multilingual mode (Muysken, 2020).

A typical example can be seen with a South African multilingual code switcher who utters a sentence like “Morning Tshepo, how are you, o robetse jwang (how did you sleep)? I had cereal for breakfast, wena o jele eng? (What did you eat for breakfast?)”. It is a colloquial speech pattern that displays a spontaneous and deliberate act by the multilingual, frequently in multilingual environments (Yim & Bialystok, 2012). Code switching, which is regarded as a communication tactic and an indicator of specific beliefs and identities, is influenced by both language and social factors (Kim, 2006). However, different multilingual speakers employ code switching to varying degrees.

The relationship between individual variability in code switching use and adaptability in performing linguistic and non-linguistic activities that demand switching across mental groups has been investigated. When performed by a multilingual proficient in all known languages, code switching is not seen as a barrier to communication or a burden for the multilingual speaker (Gardner-Chloros, 2009). This is because these individuals are cognizant of each language's fundamental structure and how it might be merged (Gardner-Chloros, 2009). According to a study conducted by Poplack (2013) on the relationship between language fluency and code switching, it was highlighted that multilinguals with higher levels of language fluency showed a preference for a more challenging form of code switching i.e., intrasentential switching. The term "intrasentential switching" refers to a linguistic change that occurs in the middle of a phrase, typically without halt, interruption, or hesitation (Rahimi & Jafari, 2011, p. 17). Code switching can therefore be seen as a more strategic form of communication than interference or a language proficiency gap.

There is significant evidence that the languages known by a multilingual person remains active even when only one language is being utilised in a monolingual setting (Grosjean, 2020; Kroll & Bialystok, 2013; Sorace & Serratrice, 2009). Cross-language effects, such as competition when distractions are provided in the non-target language, have been demonstrated in research utilizing lexical decision tasks, in which participants must determine if a stimulus item is a genuine word (Linck et al., 2008). By showing that lexical items are stimulated not just in the target language but also in non-target languages where the word has a comparable representation, this research lends support to the idea of a non-selective access to an integrated lexicon (Lemho¨ fer et al., 2004). Consequently, there is competition for resources that must be resolved at either the systemic or lexical item level (Van Assche et al., 2013). In these situations, a system is required to handle the simultaneous activation of the two languages (Abutalebi & Green, 2008). This required system is most likely found in the

executive control system. As a result of the lifelong practice with the use of multiple languages a variety of cognitive processes in the executive control system are altered such as inhibition, task switching and cognitive flexibility (Abutalebi et al., 2012; Prior & MacWhinney, 2010).

Task switching necessitates executive control, but it also parallels procedures used by multilinguals during code switching (Kheder & Kaan, 2021). Similar to code switching, task switching necessitates maintaining a set of rules and switching focus between these rules in order to ensure the successful completion of the task (Lai & O'Brien, 2020). Language processing for multilinguals resembles a continuous "switch block" in a task switching model due to the combined activation of many languages, which has an obvious connection to multilingual language use (Li & Gollan, 2022). Hence, it is proposed that if language expertise includes task switching, multilinguals who engage in more code switching will outperform other multilinguals who can successfully preserve the distinction between their known languages in speech (Yim & Bialystok, 2012).

Stemming from a similar ideology, Festman et al. (2010) grouped German-Russian multilinguals based on how much cross-language interference they displayed during a non-verbal task. In this study, participants were grouped into non-switchers and switchers. Non-switchers were regarded as participants who made minimal linguistic errors while switchers were participants who made unintended language switches (Festman et al., 2010). The results of this study revealed that in executive function tests which included problem solving and inhibition, non-switchers performed better as compared to switcher (Festman et al., 2010). The authors came to the conclusion that non-switchers had more executive control as a result of this discovery. It is crucial to note that, in this study, unintentional switching depicted cross-language interference and was linked to an insufficient control over language selection (Festman et al., 2010). As the instructions presented to participants indicated that code

switching was an error that needed to be avoided. Hence, greater executive control possessed by non-switchers allowed them to avoid this interference errors (Festman et al., 2010).

Another by study Soveri et al. (2011) evaluated multilinguals' self-reports of code switching. This study involved Finnish-Swedish multilinguals completing a self-report questionnaire about their code switching abilities, as well as tasks measuring their executive functioning, one of which assessed their verbal fluency. Unlike Festman et al. (2010) where code switching was assessed through errors, Soveri et al. (2011) assessed code switching using self-reports and it was revealed that more code switching reported by participants was linked to greater executive functioning.

Reviews and meta-analyses often regard verbal fluency as part of executive functioning (Alvarez & Emory, 2006; Snyder, 2013). However, it is not clear how verbal fluency relates to other widely studied components of executive functioning such as shifting, working memory and inhibition (Gustavson et al., 2019). The inclusion of verbal fluency as one of the executive functioning subcomponents may have some basis in its apparent face validity since it involves controlled word recall, which calls for setting goals, conducting systematic searches, and avoiding repetitions similar to those involved in other executive functions (Miyake & Friedman, 2012). Furthermore, its addition as part of executive functioning components could be linked to previous studies on frontal-lobe fluency deficits, which are comparable to other neuropsychological measures of executive functioning, implying that these two rely on related brain substrates (Alvarez & Emory, 2006; Henry et al., 2005).

There is empirical evidence that there is an overlap between verbal fluency measures and tasks that assess other aspects of executive functioning (inhibition, shifting and working memory). For example, a study conducted by Shao et al. (2014) revealed a correlation between shifting, working memory and inhibition, and a fluency latent variable. Similarly, Unsworth et al. (2011) found a positive correlation between a latent factor which consisted of phonemic and

semantic tasks and working memory, inhibition, processing speed, and vocabulary. Which indicates that there is a relationship between verbal fluency and executive functioning.

It is still unclear, however, whether the association between verbal fluency and executive functioning results from a common variation in executive functioning or whether verbal fluency tasks require shifting- or updating-specific skills, due to the strong correlations across executive functioning components (Gustavson et al., 2019). When carrying out fluency tasks common executive functioning abilities are presumably engaged in ensuring that instructions are adhered to, prompts are effectively utilised to carry out lexical search and interference is avoided from related words (Whiteside et al., 2016). However, Miyake and Friedman (2012) assert that some of these processes may rely on controlled recall from long term memory (a capability that is unique to updating). Likewise, Troyer and Moscovitch (2006), asserted that shifting-specific capabilities, which necessitates the deliberate switching between subcategories, may enhance performance on fluency tasks. Hence, it is claimed that fluency reflects a synthesis of specific and general executive functioning processes (Kraan et al., 2013).

Most studies on the bilingual advantage have focused on aspects of executive functioning (Bialystok, 2015). The phrase executive function, also known as executive control or cognitive control, is defined by Miyake and Friedman (2012) as a collection of general-purpose control mechanisms that are related to the prefrontal cortex of the brain and regulate one's thoughts and behaviours. It has been heavily debated in the past whether executive functioning is a single construct or a collection of unique mechanisms (Welsh et al., 2006). In their seminal work, Miyake et al. (2000) used a latent variable method to determine whether the three components of executive functioning—inhibition, attention and working memory—are distinct entities or represent an unified underpinning skill. The findings of this latent

variable approach revealed that while these three executive functioning aspects may be distinguished, they are not entirely independent (Miyake et al., 2000).

Managing and transitioning between two or more languages on a regular basis can help multilinguals' executive functioning (Adesope et al., 2010). Due to the need to concurrently attend to the language they are speaking in while inhibiting their other known language, researchers have hypothesised that multilinguals may have greater inhibitory control (Green, 1998). Additionally, it has been asserted that this technique can enhance the task-switching and attentional control of multilinguals (Wiseheart et al., 2016). Task switching necessitates the ability to focus attention on a single task in the context of two possible responses, in order to formulate the correct task-specific answer (Wiseheart et al., 2016). The ability of a multilingual to shift attention between two tasks is therefore seen as a component of executive control (Alzahabi & Becker, 2013).

It has also been noted that multilingualism improves working memory (Yang, 2017). This is linked to the constant maintenance of mental representations related to discourse, planning and reasoning (Daubert & Ramani, 2019). As well as the retention of information in the mind which is required to simultaneously activate both languages (Kroll et al., 2012). Evidence supporting this theory indicates that bilinguals use prefrontal brain regions connected to executive function when carrying out tasks that call for monitoring attention to a target language and switching between languages (Coderre et al., 2016).

Bilingual advantage in executive functioning has been supported by some studies (Adesope et al., 2010; Yang, 2017). In both, a Stroop task (interference suppression) and a Simon task, researchers discovered that bilinguals have greater inhibitory control (stimulus–response conflict) (Nayak et al., 2020). According to Adesope et al (2010) meta-analysis of 63 studies, there is significant evidence that multilinguals perform better than monolinguals in the working memory and attentional control areas of executive functioning. Given the aim of this

study to assess the performance of multilinguals on a phonemic verbal fluency test (COWAT FAS) the subsequent chapter discusses verbal fluency and multilingualism.

## 2.3. Verbal fluency and Multilingualism

The verbal fluency task, which requires participants to generate as many distinct words as they can within a specific duration while adhering to specific criteria (such as semantic or category, letter or phonemic), has been used by researchers to shed light on the differences between monolinguals and multilinguals on their executive control and linguistic abilities (Paap et al., 2017). Performance in the semantic fluency condition is similar to how we use language every day. For example, semantic fluency tasks require participants to recall phrases of wardrobes items that fall under the category of apparel. As a result, in the condition of semantic fluency, individuals can revisit the existing connections in their mental lexicon associated with a notion while coming up with new words (Friesen et al., 2015).

Nevertheless, since it requires the creation of words that begin with a letter or phoneme, which is not usually done in daily life, the letter fluency requirement is more challenging. To perform successfully in the letter fluency condition, strategies must be developed and related phonological networks' activation must be inhibited (Luo et al., 2010). Under the conditions of letter and semantic fluency, the relative involvement of the executive and linguistic components are altered (Shao et al., 2014). While language abilities are more important for semantic fluency, executive control mechanisms are of great importance for letter fluency (Sandoval et al., 2010).

It is argued that multilinguals outperform monolinguals on letter fluency as compared to category fluency. For instance, in a study conducted by Luo et al. (2010), multilinguals outperformed monolinguals on letter fluency when they are grouped based on their vocabulary size, which suggests that multilinguals have greater executive control. Paap et al. (2017) failed to replicate these findings. According to Paap et al. (2017), it is insufficient to use improved

performance on letter fluency compared to category fluency as a measure of effective executive control. Notably, there was no discernible difference between performance on letter fluency tests and semantic fluency tasks when examining the link between verbal fluency performance in monolinguals and independent measures of executive control (Shao et al., 2014). Given the paucity of empirical data and reproducibility challenges, it is uncertain if multilinguals and monolinguals perform differently on semantic and letter fluency tests, and whether these variances are mediated by particular traits of executive control abilities.

Although studies have revealed that multilinguals and monolinguals both exhibit comparable levels of phonetic fluency (Bialystok et al., 2008; Friesen et al., 2015). On semantic fluency, multilinguals have often performed lower (Luo et al., 2010). Gollan et al. (2002) and Rosselli et al. (2000) offer a number of justifications for the distinctions between letter and category fluency. They assert that cross-language interference occurs when many items compete with one another in each language, lengthening the time required to retrieve a specific item in a particular language. Rosselli et al. (2000) specifically draw attention to the fact that while phonetic fluency is not restricted to concrete words, some semantic fluency categories, such as animals, only include the recall of concrete words (such as lion). They also propose that concrete words may share more representational components between the two languages than non-concrete words (Gollan et al., 2002; Rosselli et al., 2000). As a result, semantic fluency may be more affected by cross-language interference than phonetic fluency.

In some studies, on L1 attrition with long-term immigrants, verbal fluency measurements were utilised (Schmid & Jarvis, 2014). It was discovered that immigrants' L1 fluency ratings were significantly lower in their new (L2-dominant) environment than those of L1 speakers in their home countries. Additionally, Linck et al. (2009) discovered impacts of short stays abroad on L1 fluency. According to their findings, Spanish students who had spent three months abroad had lower L1 fluency and higher L2 fluency than students who had studied

at home (Linck et al., 2009). In other words, the performance of multilinguals can be impacted by their language proficiency and the context in which they are being assessed in. Given this premise, and although semantic fluency will not be assessed in this study, the investigation of phonetic fluency in multilingual contexts may shed light on this particular tension described.

## 3. Rationale

Verbal fluency is a core neuropsychological function (Sass et al., 2013). Literature indicates that performance on verbal fluency tasks are influenced by demographic variables such as age, gender and years of formal education (Rodríguez-Aranda & Sundet, 2006). There are discrepancies in the performance on the COWAT FAS linked to age (Olabarrietta-Landa et al., 2015), gender (Loonstra et al., 2001) and multilingualism (Rodríguez-Aranda & Sundet, 2006; Ross, 2003) while literature relating to years of education (Hankee et al., 2013) is more consistent.

A specific area of debate is how knowing and the use of two or more languages has an impact on verbal fluency and performance of verbal fluency tasks. For instance, there is a contention regarding whether multilinguals perform better or worse than monolinguals on verbal fluency tasks (bilingual advantage vs bilingual disadvantage) (Hilchey & Klein, 2011; Ivanova & Costa, 2008; Portocarrero et al., 2007). Gaining an understanding about this not only has theoretical implications as it contributes to the current debate, but it also has practical implications as it helps clinicians in their work.

South Africa is a multilingual nation with 11 official languages, but assessment is often not available in all these languages and tests are frequently administered in English (Bethlehem et al., 2003; Louw & de Wet 2007). Thus, it is imperative to know how the linguistic background of young adults is associated with performance on verbal fluency tasks, in

particular phonemic verbal fluency tasks (Foxcroft, 2003), as literature suggests that those are the most affected when one is multilingual (Kroll & Bialystok, 2013).

Hence, this study aimed to contribute to this highly debated field by investigating the difference in performance of individuals with different linguistic backgrounds on phonemic verbal fluency which was assessed using the COWAT FAS. Whilst also investigating the influence of the covariates (age, gender, years of formal education, and code switching) on the performance of these individuals.

# 4. Methods

## 4.1. Research aims and Questions

The goal of this study was to investigate the differences in performance of multilingual individuals who report English as their first language and individuals report other languages as their first language on a phonemic fluency test assessed by the COWAT FAS. While also accounting for covariates that may have an impact on these participants' performance on this task. The following research questions were developed to achieve this goal:

- Is there a statistically significant difference between young multilinguals who report English as their first language and young multilinguals who other languages as their first language on phonemic verbal fluency assessed with the COWAT FAS?
- Is there a correlation between code switching assessed by the number of languages used on a daily basis by participants and the total score on the COWAT FAS?
- Is there a correlation between the age of participants and the total score on the COWAT FAS?

- Is there a statistically significant difference between performance of males and females on the COWAT FAS?
- Is there a correlation between the years of formal education of participants and the total score on the COWAT FAS?
- Is there a statistically significant difference between participants who attended a public school and participant who attended a private school on the COWAT FAS?

## 4.2. Research design

This study is grounded within the quantitative research design, which involves quantifying and analysing phenomena to obtain numerical results (Apuke, 2017). Given that this study aimed to investigate the differences in performance of young individuals who report English as their first language and young individuals who report other languages as their first language on the COWAT FAS, the quantitative research method was most appropriate as it allowed for data to be collected numerically and for this data to be analysed using statistical techniques such as statistics (Aliaga & Gunderson, 2002).

Furthermore, this study was a cross-sectional study as the participants' responses were observed at a single point in time (Rindfleisch et al., 2008). A non-experimental research design was used, which involves the lack of manipulation of variables (Salkind, 2010). Additionally, this study was *ex post facto*, also known as after-the-fact research. This is a type of research whereby the examination of a phenomenon begins after the occurrence of the fact without the intervention of the researcher (Sharma, 2019).

### 4.3. Sample and sampling

All participants were healthy adults with no reported history of neurological, psychiatric, or motor metabolic illness. Overall, this study consisted of a total of 60 participants, subdivided in two groups, namely, one who reported speaking English as first language (n=12) and another who reported a language different from English as their first language (n=48). The sample demographic characteristics are summarised in Table 1, where it can be observed that 18 participants were male and 42 of them were female. The mean age of these participants was 26.23 and their age ranged between 18 and 40 years. Furthermore, a total of 12 participants had reported English as a first language (L1) and 48 of them reported other languages as their first language (L2).

The data utilised in this study were derived from two different sources (primary and secondary data sources). Participants obtained through the primary data source consisted majorly of first year and second year university students. Whereas the secondary data was obtained from the COWAT FAS data collected by Ferreira-Correia (2019). The sample of the study consisted of clinical and healthy control.

Overall, the participants of this study included individuals who reported English as their first language and individuals who reported other languages as their first language. Individuals who took part in this study were between the ages of 18 and 40 years, they also possessed years of formal education between 12 and 14 years. These participants were recruited through the use of purposive sampling (Cresswell & Plano Clark, 2011) and through referrals from other participants (snowball sampling) (Sharma, 2017). A total of 66 participants were recruited in this study, however, due to some participants years of formal education exceeding the required range (12 to 14 years) and a participant failing to answer over 80% of the questions a total of 6 participants were excluded from the study, leaving the sample with a total of 60 participants.

**Table 1: Sample Characteristics**

| Variable | *n* | % | *Mean* | *SD* | Minimum | Maximum |
|---|---|---|---|---|---|---|
| Age | 60 | - | 24.50 | 7.32 | 18 | 40 |
| Gender | 60 | - | - | - | - | - |
| Female | 18 | 30 | - | - | - | - |
| Male | 42 | 70 | - | - | - | - |
| | | - | 1.80 | 0.40 | - | - |
| English as first language | 12 | 20 | - | | - | - |
| English as second language | 48 | 80 | - | | - | - |
| Code Switching (number of languages used on a daily basis | - | - | 2.47 | 0.87 | - | - |
| 1 | 6 | 10 | - | - | 1 | 5 |
| 2 | 28 | 46.7 | - | - | - | - |
| 3 | 19 | 31.7 | - | - | - | - |
| 4 | 6 | 10 | - | - | - | - |
| 5 | 1 | 1.7 | - | - | - | - |

## 5. Measures

### 5.1. Demographic Questionnaire

Each participant was presented with a demographic questionnaire (Ferreira-Correia, 2019) (Appendix 1). This questionnaire obtained demographic information about the

participants such as their age, gender, years of formal education, the type of institution they received their primary and secondary education (public or private), and an exploration of language experience, which included questions related to their home language, languages known in order of dominance and languages used on a daily basis.

### 5.2. The Controlled Oral-Word Association Test FAS (COWAT)

The COWAT, also known as the "FAS," is a popular neuropsychological measure of verbal fluency that is made up of three word conditions (Whiteside et al., 2016). Within a one-minute time limit per letter, the test-taker must produce as many words as possible that begin with the specified letter (F, A, or S) (Lezak et al., 2004). During this task, the examinee is also asked not to use proper nouns, numbers, or words with different suffixes (Olabarrieta-Landa et al., 2017).

The COWAT FAS has a simple scoring system. Each word is written by the examiner as it is spoken by the test-taker (Lezak et al., 2004). The summation of different and correct words produced by the test-taker for all three-letter sets determines their overall score (Lezak et al., 2004). Inadmissible words such as repeated words, slangs or proper names are counted as errors.

The FAS version of the COWAT has an inter-rater reliability of 0.9, high test-retest reliability, and strong correlations between letter sets ranging from 0.85 to 0.94, the COWAT has excellent psychometric properties within samples in the United States (Ross et al., 2006; Troyer, 2000). Thus far, there appear to have been no empirical efforts to produce letter sets adequate for the multicultural and multilingual South African context. Neuropsychologists typically employ the FAS letter set with patients who speak English whereas with patients who speak Afrikaans the most commonly administer the MAS letter set. This is because the letter F

is rarely used in Afrikaans sentences and can be easily misunderstood with the letter V (Baufeldt, 2009). Given that the sample under investigation received their formal education in English, the FAS letter set was administered.

## 6. Procedure

This study began by requesting ethical approval from the Human Research Ethics Committee (Non-Medical) of the University of Witwatersrand in order to request for permission from Ferreira-Correia (2019) (Appendix 2) to access her database.

To allow for the recruitment of students at the University of Witwatersrand permission was requested from the registrar (Appendix 3). Permission was requested for an email invitation to be sent out from the registrar's office to students who meet this study's criteria.

Information about the study was provided in writing to all participants and discussed with them verbally. The Participant Information Sheet (Appendix 4) provided full disclosure on the research aims and procedures. After this, those who were willing to participate were required to give formal consent (Appendix 5).

Twenty-four participants followed the procedure outlined in Ferreira-Correia (2019) while 36 participants followed a similar procedure, in which participants were administered a demographic questionnaire and the COWAT FAS and not the other tests administered in Ferreira-Correia (2019).

Sixteen participants attended the face-to-face administration while 20 participants opted for the alternative online administration. Individuals who agreed to participate in this study face-to-face, were invited to Umthombo building (U220), the office of this study's supervisor where the questionnaire and the COWAT FAS task was administered. Appropriate testing conditions were adhered to as the questionnaires were administered in a well-lit room, with

chairs, good ventilation, and low noise levels. Studies which were administered online took place between the 25th of July to the 25th of August 2022 while in-person studies were administered on the 28th of July 2022.

Furthermore, as an alternative due to COVID-19 related protocols, this study offered the possibility for online participation. Although this involved a slight variation on the administration standards, it was incorporated to accommodate those preferred not to attend contact sessions. Once informed consent had been obtained from the participants, a meeting was arranged and booked using Google Meeting. The administration procedure of the demographic questionnaire and the COWAT was the same used for the face-to-face administration, described above.

All potential participants were invited to participate in this study through social media platforms, emails, word of mouth, and referrals. Individuals who agreed to participate in this study were initially sent via email the participant information sheet and consent form.

### 6.1. Ethical Considerations

Ethical approval was received for this study from the Human Research Ethics Committee (Non-medical) of the University of Witwatersrand protocol number MASPR/22/01 (Appendix 6). Likewise, Ferreira-Correia (2019) received ethical approval from the Human Research Ethics Committee (Medical) of the University of Witwatersrand protocol number M140872 (Appendix 7).

This study upheld the principle of autonomy by ensuring that participation was voluntary, and that informed consent was acquired before participation. Hence, participants were given the participant information sheet (Appendix 4) as well as a consent form (Appendix 5) before participating in the study. Furthermore, these documents indicated unequivocally that

participation in the study was fully voluntary and were informed of their freedom to withdraw from the study at any moment or to refuse to answer any question without penalty.

To ensure participant confidentiality and anonymity, the data obtained were analysed in groups, hence it was impossible to single out participants data. Each participant was also given a research identity number, and only the researcher had access to the identity number and the signed consent forms of participants was separated from their data.

To further ensure anonymity which is in alignment with the Protection of Personal Information Act (POPI Act) participants were not asked for personal identifying information that was not of direct importance to this study.

To ensure the safety and security of participants' data, information provided by participants was stored safely using passwords for data collected online while for data collected physically, the information was locked in a safe confined room. Third parties were not allowed access to the information provided by participants as only the researcher and the supervisor of this study had access to the raw data. Only variables that had been indicated as important to this study were examined.

Participants were given the opportunity to gain information about the findings, and conclusions of the study. For this reason, the contact details of the researcher and the supervisor were provided in the participant information sheet. Furthermore, participants were invited to contact the researcher if they had any questions about the study. They were also informed that the results of this study can be found in the University of Witwatersrand's online library which offers access to materials on the world-wide web.

## 7. Data analysis

All data analyses were conducted using the Statistical Package for the Social Sciences (SPSS), version 26 (IBM Corp, 2019). A descriptive analysis including the mean, standard deviation was conducted on the demographic data (age, gender and number of languages used on a daily basis) of the participants. The summed scores of the COWAT FAS measures of phonemic fluency were examined with descriptive statistics (mean, median, mode) and boxplots. A p value of $< 0.05$ was considered statistically significant for this research.

To answer the first, fourth and fifth research questions, namely exploring whether a statistically significant difference exists between multilinguals who report English as their first language and multilinguals who report other languages as their first language, to explore whether a statistically significant difference exists between performance of males and females and to explore whether there will be a statistically significant difference in performance between participants who attended a public school and participants who attended a private school on phonemic verbal fluency assessed with the COWAT FAS an Independent samples T-test was conducted. The independent samples T-test was conducted on the summed scores of the phonemic fluency task assessed by the COWAT FAS (i.e., on each letter, and total correct responses). An independent T-test is a type of inferential statistic used to determine if there is a significant difference between the means of the dependent variable (phonemic fluency assessed by COWAT FAS) of the two independent groups (multilinguals individuals who report English as their first language and multilinguals who report other languages as their first language, males and females and participants who attended a public school and participants who attended a private school) (Allen et al., 2014). The independent samples T-test determined if there was a significant difference in the continuous dependent variable, namely: the mean total score of the phonemic fluency task assessed by COWAT FAS, and the two independent

groups (e.g multilinguals who report English as their first language and multilinguals who report other languages as their first language).

To conduct the independent samples T-test, the following assumptions were met: the scale of measurement of the dependent variable was either be interval or ratio data. Individuals who participated in this study had participated once and they had no influence over the participation of other individuals (independence). The scores were approximately normally distributed (normality). Homogeneity of Variance, each group of scores had approximately the same degree of variation (Allen et al., 2014).

To answer the second and third research question, namely investigating whether code switching (the number of languages used on a daily basis), the age of the participants correlates with their performance on the COWAT FAS of participants correlates with total score on the COWAT FAS a Spearman rho correlation was conducted. This non-parametric statistical test is an alternative to the Pearson's Product Moment Correlation. It assesses the relationship between two ranked variables while also accounting for the direction and strength of this relationship (Allen et al., 2014). This statistical test is often carried out when the assumptions of normality or linearity are not met. Given that the assumption of normality was not met in this study, the Spearman correlation coefficient was conducted to assess the correlation between the code switching and age of participants and their total score on the COWAT FAS.

To answer the fifth research question, namely investigating whether years of formal education of the participants correlates with their performance on the COWAT FAS of participants correlates with total score on the COWAT FAS Pearson's Product Moment Correlation (r) was conducted. This statistical test was utilised as it allowed to assess the relationship between two continuous variables while also accounting for the direction and strength of this relationship (Allen et al., 2014). Given that the following assumptions were met this test was conducted; the scale of measurement of the variable were either be interval or

ratio data. Individuals who participated in this study only participated once and they had no influence over the participation of other individuals (independence). The scores were approximately normally distributed (normality). And homoscedasticity, at all points along the linear relationship, the error variance was considered to be the same. In other words, the variability of one variable across consistent across all values of the other (Allen et al., 2014).

# 8. Results

## 8.1. Descriptive Findings

The study consisted of a total of 60 participants, of which 20% (n=12) of the total sample reported English as their first language, making them a part of the English L1 group. Whereas 80% (n=48) of the total sample reported other languages as their first language, making them a part of the English L2 group. This indicates that the majority of participants are multilinguals and do not identify English as their first language.

In the English L1 group, participants had a mean age of 26.25 (SD 6.27), minimum age of 18 years and a maximum age of 35 years. This group of participants constituted of 33% males (n=4) and 66.7% females (n=8) indicating that there were more females than males within this group. With regards to the years of formal education of participants, similar distributions were observed as 41.7% (n= 5) had 12 years of formal education and 41.7% (n= 5) participants had 14 years of formal education.

Similarly, regarding the type of school attended by participants, 66.7% (n = 8) attended a public school indicating that the majority of participants attended a public school. In terms of the code switching of participants assessed through the number of languages used on a daily basis, this group of participants had a minimum of 1 language being used on a daily basis being and a maximum of 3 languages being used on a daily basis.

In the English L2 group on the other hand, a mean age of 26.73 and a standard deviation of 7.62 was obtained with a minimum age of 18 years and a maximum age of 40 years. This group had constituted if 29.2% males (n=12) and 70.8% females (n= 34) indicating that this sample group had more female than males. In terms of the years of formal education of participants in this group, 35.4% of participants (n= 17) had 12 years of formal education, while 43.8% of participants (n= 21) had 14 years of formal education. In the same regard, 87.5% of participants (n= 42) attended a public school demonstrating that the majority of participants in this sample group attended a public school. With regards to the code switching of participants, a minimum of 1 language being used on a daily basis and a maximum of 5 languages being used on a daily basis were observed. This is illustrated on Table 2.

**Table 2: Distribution data on Age, Gender, Years of formal education, Type of school and Code switching**

| **Variable** | **Group** | ***n*** | **%** | ***Mean*** | ***SD*** | **Minimum** | **Maximum** |
|---|---|---|---|---|---|---|---|
| Age | **Total** | 60 | - | 24.50 | 7.32 | 18 | 40 |
| | L1 | 12 | 20 | 26.25 | 6.24 | 18 | 35 |
| | L2 | 48 | 80 | 26.73 | 7.62 | 18 | 40 |
| Gender (Male) | L1 | 4 | 33.3 | | | | |
| | L2 | 14 | 29.2 | | | | |
| Gender (Female) | L1 | 8 | 66.7 | | | | |
| | L2 | 34 | 70.8 | | | | |
| Years of formal education | L1 | 12 | | | | 12 | 14 |
| 12 | | 5 | 41.7 | | | | |
| 13 | | 2 | 16.7 | | | | |
| 14 | | 5 | 41.7 | | | | |
| Years of formal education | L2 | 48 | | | | 12 | 14 |
| 12 | | 17 | 35.4 | | | | |

| | | | | | |
|---|---|---|---|---|---|
| 13 | | 10 | 20.8 | | |
| 14 | | 21 | 43.8 | | |
| Type of school | L1 | 12 | | | |
| Public school | | 8 | 66.7 | | |
| Private School | | 4 | 33.3 | | |
| Type of school | L2 | 48 | | | |
| Public school | | 42 | 87.5 | | |
| Private School | | 6 | 12.5 | | |
| Code Switching | L1 | 12 | | 1 | 3 |
| 1 | | 2 | 20 | | |
| 2 | | 8 | 16.7 | | |
| 3 | | 2 | 66.7 | | |
| Code Switching | L2 | 48 | 16.7 | 1 | 5 |
| 1 | | 4 | 80 | | |
| 2 | | 20 | 8.3 | | |
| 3 | | 17 | 41.7 | | |
| 4 | | 6 | 35.4 | | |
| 5 | | 1 | 12.5 | | |

Descriptive analysis on the COWAT F, A, S of the total sample (Table 3) revealed that COWAT A trial had the lowest mean and median (9.55, 10) while the COWAT F and S had very similar performances and distributions. This demonstrates that the COWAT A was the most difficult as compared to the other two letters. With regards to the standard deviations of the three trials they all had varying standard deviations ranging from 3.71 – 4.51. The minimum and maximum number of words produced in each trial was similar indicating a wide distribution of scores.

This table also reveals that within the L1 and L2 groups for all three trials COWAT A had the lowest mean and median (8.50, 9.82) (10, 10) respectively, notably COWAT F for the L1 group had a similar median to the COWAT A while COWAT F and S had very similar performances and distributions. Demonstrating that of all three letters, the COWAT A was the most difficult. All three trials for the L1 and L2 groups had similar standard deviations, notably, COWAT A for the L2 group had a rather low standard deviation of 3.71 while other trials for

both groups had standard deviations of approximately 5. The minimum and maximum number of words varied indicating a very wide distribution of scores.

With regards to the COWAT FAS Total score, the L2 group had the lowest mean (29.67), similar standard deviations were observed with approximately 12 words being produced however, there were differences between the median. The minimum and maximum words produced also varied indicating a very wide distribution of scores.

Regarding the number of errors made, the English L1 group had the lowest mean and median while the English L2 and Total group had very similar means and medians. Similarly, the English L1 also had the lowest standard deviation and the English L2 group and the total sample having comparable standard deviations. Furthermore, the minimum and maximum number of errors made revealed a spread of scores ranging from 0 to 8.

**Table 3: Descriptive Findings for COWAT F, A, S, COWAT FAS Total Score and Number of errors made.**

| Variable | Group | *n* | % | *Mean* | *SD* | Median | Minimum | Maximum |
|---|---|---|---|---|---|---|---|---|
| COWAT F | Total | 60 | | 11.6 | 4.35 | 12 | **2** | 20 |
| | L1 | 12 | 20 | 10.75 | 4.22 | 10.5 | 2 | 17 |
| | L2 | 48 | 80 | 11.84 | 4.39 | 12.5 | 4 | 20 |
| COWAT A | Total | 60 | | 9.55 | 3.81 | 10 | 1 | 17 |
| | L1 | 12 | 20 | 8.50 | 4.21 | 10 | 1 | 14 |
| | L2 | 48 | 80 | 9.82 | 3.71 | 10 | 2 | 17 |
| COWAT S | Total | 60 | | 12.75 | 4.51 | 13.5 | 2 | 22 |
| | L1 | 12 | 20 | 10.41 | 4.25 | 11 | 2 | 16 |
| | L2 | 48 | 80 | 13.33 | 4.42 | 14.5 | 3 | 22 |
| COWAT FAS Total Score | L1 | 12 | 20 | 29.67 | 11.84 | 32 | 5 | 46 |
| | L2 | 48 | 80 | 35.06 | 11.32 | 37.50 | 11 | 51 |
| Number of errors made | Total | 60 | | 0.82 | 1.29 | 0.5 | 0 | 8 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | L1 | 12 | 20 | 0.25 | 0.45 | 0 | 0 | 1 |
| | L2 | 48 | 80 | 0.96 | 1.39 | 1 | 0 | 8 |

### 8.2. Inferential Findings

Table 4 contains all independent samples T-test conducted on the sample. The independent samples T-test was conducted to investigate whether potential gender differences, differences in code switching, and differences in English groups exist in the COWAT FAS total score of the sample. Each of the variables were divided into two groups with gender being split into male and female, code switching being split into less than three languages and more than three languages used on a daily basis and English groups being split into English L1 and English L2.

The T-test was statistically non-significant difference for gender, code switching and English groups. Which indicates that there are no differences between males and females, participants who use less than three languages and participants who use more than three languages on a daily basis and English L1 and English L2 participants performance on the COWAT FAS.

**Table 4: Independent samples T-test for Age, Gender, Code switching, English L1 and L2 and the COWAT FAS total score.**

| Variable | *T* | df | Sig (2-tailed) | Mean difference | Standard error difference | 95% Confidence Interval | |
|---|---|---|---|---|---|---|---|
| | | | | | | Lower | Upper |
| COWAT FAS Total (Gender) | -.332 | 58 | .74 | -1.08 | 3.27 | -7.63 | 5.46 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| COWAT FAS Total (Code Switching) | -1.12 | 58 | .26 | -5.19 | 4.62 | -14.45 | 4.06 |
| COWAT FAS Total (English GroupsL1 and L2) | 1.65 | 58 | .10 | 6.06 | 3.66 | -1.28 | 13.40 |

A Spearman rho (p) was conducted was to explore whether the code switching (number of languages used on a daily basis) of participants will correlate with their performance on the COWAT FAS. Prior to calculating the (p), the assumptions of normality, linearity and homoscedasticity were assessed. The assumption of normality was violated with Shapiro Wilk = (.025, <.001) Kolmogorov-Smirnov = (.179, <.001). Furthermore, visually inspecting the scatterplot of the COWAT FAS scores against the number of languages used a daily basis confirmed that the relationship between these variables was linear and homoscedastic. The bivariate correlation between these variables was statistically non-significant, negative and weak, r (58) = -.006, p = .967. This demonstrates that the number of languages used on a daily basis by participants does not correlate with their performance on the COWAT FAS.

A Spearman rho (p) was conducted to explore whether the age of participants will correlate with their performance on the COWAT FAS. Prior to calculating the (p), the assumptions of normality, linearity and homoscedasticity were assessed. The assumption of normality was violated with Shapiro Wilk = (.010, .335) Kolmogorov-Smirnov = (.165, .200). Furthermore, visually inspecting the scatterplot of the COWAT FAS scores against the age of participants confirmed that the relationship between these variables was linear and homoscedastic. The bivariate correlation between these variables was significant, negative and

medium, r (58) = -.426, $p \leq 0.001$. This is illustrated in Table 5. This correlation demonstrates that the higher the age of a participant the lower their performance was on the COWAT FAS.

To explore whether the years of formal education of participants will correlate with their performance on the COWAT FAS a Pearson Product coefficient (r) correlation was conducted. Prior to calculating the (r), the assumptions of normality, linearity and homoscedasticity were assessed, and these assumptions were found to be met. The assumption of normality was not violated with Shapiro Wilk = (.303, .541) Kolmogorov-Smirnov = (.200, .200). The bivariate correlation between these variables was significant, positive and medium, r (58) = .327, p<.001. This demonstrates that higher levels of education result in a better performance on the COWAT FAS. This is illustrated in Table 6.

**Table 5: Correlation between Age, Code Switching and the COWAT FAS scores**

| Variable | Spearman rho Correlation | Sig (2-tailed) |
|---|---|---|
| COWAT FAS (Age) | -.426 | <.001 |
| COWAT FAS (Code switching) | -.006 | .967 |

**Table 6: Correlation between Years of formal education and the COWAT FAS scores**

| Variable | Pearson Product Correlation | Sig (2-tailed) |
|---|---|---|
| COWAT FAS (Years of formal education) | .327 | ***<.001** |

An independent samples T-test was conducted to address one of the aims of the study assessing whether there will be a statistically significant difference between young multilinguals who report English as their first language (n=12) and young multilinguals who report other languages as their first language (n=48) on the COWAT FAS. Prior to carrying out the independent samples T-test, the data were examined using SPSS Statistics to ensure all of its underlying assumptions were met. To test for normality, the skewness and kurtosis statistics were observed (L1 skewness = -.607 Kurtosis = -.137) (L2 skewness = -.371, Kurtosis = -.771). Shapiro Wilk statistic (L1 = .589, L2= .082) and Kolmogrov-Smirnov statistic (L1 = .200, L2 = .200) were also observed non-significant sig value was observed indicating that the data was normally distributed. The data was also tested for homogeneity of variance using the Levene's test for equality of variances was conducted which revealed a non-significant sig value (.104) revealing that the assumption was met. The independent samples T-test was statistically non-significant, with L1 (M= 28.83, SD = 8.354), and L2 (M= 32.77, SD = 11.961), t (58) = 1.65, P = .104 two tailed. This result reveals that there was no difference in performance between participants who reported having English as a first language and participants who reported having other languages as their first language. This is illustrated on Table 4.

To address another aim of the study which was to explore whether there was a statistically significant difference between males (n = 18) and females (n = 42) on their performance on the COWAT FAS an independent samples T-test was conducted. Prior to carrying out the independent samples T-test, the data were examined to ensure all of its underlying assumptions were met. To test for normality, the skewness and kurtosis statistics were observed (Male skewness = .13 Kurtosis = -1.12) (Female skewness = -.79, Kurtosis = -.16). Shapiro Wilk statistic (Male = .12, Female = .011) and Kolmogrov-Smirnov statistic (Male = .105, Female = .006) were also observed and a non-significant sig value was observed

indicating that the data was normally distributed. The data was also tested for homogeneity of variance using the Levene's test for equality of variances was conducted which revealed a non-significant sig value (.811) revealing that the assumption was met. The independent samples T-test was statistically, non-significant, with Male (M= 33.22, SD = 11.94), and Female (M= 34.31, SD = 11.48), t (58) = -.33, P = .74 two tailed. This is further illustrated on Table 4.

To address the final aim of the study which was to explore whether there is statistically significant difference between participants who attended a public school (n = 50) and participants who attended a private school (n = 10) on their performance on the COWAT FAS an independent samples T-test was conducted. Prior to carrying out the independent samples T-test, the data were examined to ensure all of its underlying assumptions were met. To test for normality, the skewness and kurtosis statistics were observed (Public school skewness = -.447 Kurtosis = -.660) (Private school = -1.384, Kurtosis = 1.506). Shapiro Wilk statistic (Public school = .200, Private school = .180) and Kolmogrov-Smirnov statistic (Public school = .101, Private school = .059) were also observed and a non-significant sig value was observed indicating that the data was normally distributed. The data was also tested for homogeneity of variance using the Levene's test for equality of variances was conducted which revealed a non-significant sig value (.331) revealing that the assumption was met. The independent samples T-test was statistically, significant, with Public school (M= 32.28, SD = 11.24), and Private school (M= 42.50, SD = 9.27), t (58) = -2.69, P = .009 two tailed. This result indicates that there is a difference in performance between participants who attended a public school and participants who attended a private school. This is further illustrated on Table 4.

## 9. Discussion

This study aimed to assess if there was a statistically significant difference between multilinguals who report English as their first language and multilinguals who report other languages as their first language on the COWAT FAS. The results of this study revealed that there was a statistically non-significant difference between these two groups; indicating that on phonemic verbal fluency as measured by the COWAT FAS, there is no difference between the performance of multilinguals who report English as their first language and multilinguals who report other languages as their first language. This finding goes against the notion that adult multilinguals who are fluent in multiple languages frequently perform worse than monolinguals in tasks evaluating facets of linguistic processing (Michael & Gollan, 2005).

Unlike the findings of this study, Gollan et al. (2007) contend that the production words in a second language requires more time as compared to the production of in a first or dominant language. As a result, multilinguals with a balanced vocabulary in all languages frequently perform poorly when responding in their stronger language as compared to their monolingual counterparts (Gollan et al., 2007). Similar to this, Roselli et al. (2002) revealed multilingual deficits in letter fluency tests. It is crucial to note, though, that these deficits are inconsistent due to questions about the validity and reliability of the study's results. However, Gollan et al. (2002) also reported a poor performance in Spanish-English multilinguals as compared to their English monolingual counterparts in three quarter of the letter fluency trial tasks. It should be emphasized that although the multilingual participants in this study claimed to have the same level of English proficiency as the monolingual participants, their English ability was not formally tested (Gollan et al., 2002).

Another factor linked to a multilingual disadvantage is the possession of a smaller vocabulary size by multilinguals. Fernandes et al. (2007) observed that after correcting for language variations, the group difference in word recall was eliminated. Similar findings were

made by Bialystok and Feng (2009), who discovered that multilinguals recalled more words when their vocabulary size was taken into account. Furthermore, Bialystok et al. (2008) found that multilinguals who had comparable vocabulary sizes to monolinguals performed similarly on letter fluency tests. This result suggests that vocabulary knowledge plays a mediating function in multilingual performance on tasks requiring lexical access. In other words, it can be inferred that the results of this study in which no statistical difference were observed between multilinguals with English as a first language and multilinguals with other languages as a first language could be linked to the vocabulary size possessed by the participants. Given that the majority of participants were first- and second-year university students and individuals with 12 to 14 years of formal education it can be assumed that they all possessed similar vocabulary sizes which could account for the non-statistical difference between the groups.

Similar to the vocabulary size of participant, previous studies likened the poor performance of multilinguals to low English proficiency. The contrary findings of this study can be linked to the English proficiency. The majority of participants had received their education in English and could converse adequately in the language the COWAT FAS test was administered (English). This therefore reveals that when vocabulary size and English proficiency is taken into account this eliminates the multilingual disadvantage in phonemic verbal fluency tasks. It is also important to note that this study did not assess the proficiency of participants in English as well as their vocabulary sizes and neither did it investigate the moderating properties of these.

This study also sought to investigate whether demographic variables such as the age, gender and code switching assessed through the number of languages spoken by participants correlate with the performance on the COWAT FAS.

With regards to the correlation between code switching and performance on the COWAT FAS, this study found that there was no correlation between code switching which

was assessed using the number of languages participant used on a daily basis and their performance on the COWAT FAS. Findings regarding the relationship between code switching and cognitive performance have been inconsistent. Diverse studies have shown a positive relationship between codeswitching and improved cognitive control (Barbu et al., 2018; Hartanto & Yang, 2016; Peeters & Dijkstra, 2018). Although it is unclear which precise aspects of cognitive control greatly influence code switching, certain research has demonstrated that code switching techniques improve inhibitory control (Ooi et al., 2018; Verreyt et al., 2016).

Despite the fact that previous studies show how code switching supports cognitive shifting, other studies have been unable to identify a connection between code switching and cognitive control (Paap et al., 2017; Yim & Bialystok, 2012). The findings of this study are in line with Paap et al., (2017) who found no correlation between code switching and phonemic verbal fluency. The similarity in findings is likely due to a similarity in the sample that was utilised in the studies. As Paap et al. (2017) also mostly included undergraduate students, their sample of 236 students is comparable to the sample used in this study. If these undergraduate students gave their language ability in two or more languages a 4, they were considered multilingual. In other words, they "can converse with little difficulty with a native speaker on most everyday topics, but with less fluency than a native speaker" (Paap et al., 2017, p. 8). Similarly, Paap et al. (2017) grouped their multilinguals in to L1 and L2 groups, however, these groups were operationalised as L1 being regarded as the language with the highest proficiency rating and L2 being regarded as the language with the second highest proficiency rating. Unlike this present study where multilinguals were grouped as English L1 in which English was reported as participants first language and English L2 in which other languages were reported as participants first languages. Hence, it can be assumed that given similarities in the sample the language proficiency and switching used by participants in both studies should be approximately the same thus, yielding comparable results.

In contrast, in the study by Soveri et al. (2011) it was revealed that participants who reported more code switching possessed greater executive functioning which was assessed through a verbal fluency task. However, the findings of this study could not be replicated as this current study found no correlation between code switching and verbal fluency. This may be linked to the fact that in the study by Soveri et al (2011) participants' language skills were assessed by asking participants to rate their language skills based on their reading, speaking, writing and speech and comprehension. Furthermore, the types of switching utilised by participants was assessed by taking into account the tendencies of participants to switch from one language to the other and the tendencies of participants to engage in contextual and unintended switches (Soveri et al., 2011). Hence, variations in the results between this present study and Soveri et al. (2011) is likened to the fact that the only language assessment conducted within this present study was a self-report regarding the number of languages used by participants on a daily basis.

The inconsistent results have been attributed to the absence of standardised measurements of habitual code switching experience in multilinguals (Han et al., 2022). In the existing literature, self-reported questionnaires are frequently employed to assess how frequently multilingual code switching occurs daily. Additionally, the ecological validity of laboratory-based experimental paradigms used to study the connection between code switching and cognitive control may be compromised (Green & Abutalebi, 2013).

The findings of this study revealed that the age of participants correlates with their performance on the COWAT FAS. In line with the findings of this study, age has been identified to substantially influence performance on verbal fluency tasks (Brickman et al., 2005; Cavaco et al., 2013). Similarly, Strauss et al. (2006) claim that phonemic verbal fluency performance is influenced by age, with an increase shown from childhood to adulthood and a decline seen in older ages.

This is consistent with the study's findings, which showed that verbal fluency performance decreased with increase in participants age as shown by the negative correlation between age and performance. These findings support a large (n= 3977) study conducted by Olabarrietta-Landa et al. (2015) in Argentina, Chile, Bolivia, Puerto Rico, Peru, Paraguay, Hondurus, Guatamala and Mexico. Although the studies whose findings were replicated by results of this study made use of significantly larger sample sizes and were from a different population, all the studies assessed phonemic verbal fluency using the same letters F, A, and S.

Other research, however, has not been able to establish a link between age and phonemic verbal fluency performance (Casals-Coll et al., 2013; Steiner et al., 2008; Tallberg et al., 2008; Villodre et al., 2006). This is demonstrated by the Casals-Coll et al. (2013) study (n=179), which found no correlation between age and performance in phonemic verbal fluency. Discrepancies in the results between this contrasting study and the present study is likely due to differences in the sample. Furthermore, Casals-Coll et al. (2013) assessed phonemic verbal fluency using letters P, M and R unlike this study which made use of letters F, A, and S. These differences could explain the discrepancies in the results as it is assumed that if similar samples and letters were utilised comparable results would have been obtained.

This study did not find a statistically significant difference between the performance of males and females on the COWAT FAS. Research has produced contradictory findings about the relationship between gender and verbal fluency abilities performance (Sokołowski et al., 2020). In some studies, women outperform men on phonemic verbal fluency (Costa et al., 2014; Halari et al., 2006; Scheuringer et al., 2017). While similar to the findings of this study, other studies report no difference between the performance of males and females on verbal fluency tasks (Brickman et al., 2005; Cavaco et al., 2013; Tallberg et al., 2008).

On the other hand, Loonstra et al. (2001) showed that women performed better than men on phonemic verbal fluency when they examined the effect of gender on verbal fluency performance.This is in line with other studies have also found that women perform better than men on phonemic verbal fluency (Harrison et al., 2000; Piatt et al., 2004; Tombaugh et al., 1999) researchers have determined that women use clustering and switching more effectively than males, which is the reason for the performance gap. (Weiss et al., 2006). Notably, clustering strategies were not investigated in this study, and this may explain the difference in results.

The results of this study revealed that the years of formal education of participants correlates with their total score on the COWAT FAS. Kosmidis et al. (2004) associates this correlation to the fact that an increase in an individual's years of formal education indicates that they had been taught language processing skills, working memory and they possess an increased motivation to perform well on tasks, effective memory and abstract thinking abilities.

Similarly, early cognitive enrichment may be responsible for part of the diversity in adult cognitive performance (Schaie, 2005). With higher educational levels being consistently linked to higher levels of cognitive ability (Tucker-Drob et al., 2009). Parisi et al. (2012) state that even if the precise mechanisms are yet unknown, one theory is that educational experiences lay the groundwork for sustained cognitive stimulation throughout one's life, leading to better cognitive performance in later adulthood.

This explanation can be applied to this present study as participants with higher years of formal education (>12 years) had taken part in tertiary education (university) where the aforementioned skills are taught and required in order to succeed in this environment. Hence, their performance on the FAS task reflects familiarity and increased possession of these cognitive skills.

On a similar note, Nogueira's et al. (2016) findings showed a correlation between participants' phonemic verbal fluency test scores and their years of formal education. Similar to Kosmidis et al. (2004) Nogueira et al. (2016) associated the influence of education on phonemic verbal fluency task performance to an increase in the individual's exposure to vocabulary. Although the results of Nogueira et al. (2016) were obtained from a Portuguese sample where similar educational systems are utilised with that of South Africa, this explanation can be applied to this present study. The participants in this study had all completed their high school education (grade 12) which indicated that they had the adequate vocabulary size to produce words in the language the test was being administered (English).

Overall, the results of this study provide fresh insight regarding the performance of multilinguals in South Africa who report English as either their first language or other languages as their first language. Although no differences were identified between these groups of individuals on their performance on the COWAT FAS, demographic factors such as the age of participants and their years of formal education were revealed to have an impact on their performance on the COWAT FAS. These findings have been linked to factors such as cognitive decline related to aging and cognitive stimulation derived from the skills obtained from educational institutions.

### 9.1. Limitations of the study

A limitation of this study stems from the combination of secondary data with primary collected data. The combination of a secondary data source is identified as a limitation as selection bias could have occurred. Given that the selection strategies utilised in the recruitment of participants were different as a result of the nature and overarching aims of the studies.

Another limitation of this study is its sample size and the power of the statistical analyses. This study had a sample size of N = 60 with an unequal distribution between the groups L1 = 12 and L2 = 48. This could have impacted the tests of normality which led to use of non-parametric statistical tests such as the Spearman rho corelation. Furthermore, given that this study aimed to provide results that could be generalised to a multicultural context (South Africa) this sample size fails to reflect that. South Africa has a population of over 60 million individuals (Stats SA, 2021) and the results derived from a sample of 60 participants cannot be generalised to such a population. Similarly, the categorisation of gender in this study is highlighted as a limitation. This study failed to take into account the diverse genders present in the South African context as a vast number of individuals do not identify as either male or female.

Finally, another limitation of this study stems from its use of a non-standardised self-report questionnaire to assess code switching (Han et al., 2022) and a lack of a formal assessment of language proficiency in participants. The utilisation of a non-standardised measure fails to reflect the true nature of participants code switching abilities, rather this self-report focuses solely on the number of languages the participants use on a daily basis. Similarly, the lack of a formal assessment of participants language proficiency provides this study with superficial information regarding participants level of familiarity and skill with a particular language.

### 9.2. Recommendations and Implications

It is recommended that to address the limitation regarding the use of a secondary data source, future studies should aim to avoid selection bias by utilising a larger sample size and employing the use of quota sampling to select participants who will take part in the study.

To address the second limitation, it is recommended that future studies utilise a larger sample representative of the linguistic and socioeconomic background of the population. This would strengthen the generalizability of the study and ensure that the results of are truly a representation of the individuals in the given context. Similarly, future studies should be sensitive to the genders that participants identify as. Other genders present within the context the study is being carried out should be included to ensure the diversity and inclusivity of the study.

To address the final limitation of this study, it is recommended that future studies make use of standardised measures to assess code switching and language proficiency in participants. Rather than using self-report questionnaires, future studies could make use of measures like the Bilingual Switching Questionnaire (BSQW) (Rodriguez-Fornells et al., 2012) which provide an in-depth knowledge about the nature of code switching in bilinguals.

Despite the limitations, this study provides information regarding differences in performance on a phonemic verbal fluency test within a multicultural and multilinguistic context (South Africa). It provides fresh insight into the performance of multilinguals in South Africa as well as demographic factors that influence performance on this test which creates a foundation for more studies to be conducted on this topic. Furthermore, this study's findings contribute to the debate regarding a bilingual advantage and disadvantage as it presents interesting findings deviating from the premise of these debates.

## 10. Conclusion

This study reported no statistically significant difference between multilinguals who have English as a first language and multilinguals who do not have English as a first language. Interestingly, it was revealed in the statistical analyses that although gender, and code switching do not correlate with the performance of participants on the COWAT FAS, the age and years

of formal education of participants does correlate with their performance on the COWAT FAS. It was also revealed that as the participants age increased there was a decline in the performance of participants. Limitations regarding sample size, sampling strategies, and lack of assessment of English proficiency are important because they can limit the generalizability of these findings.

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## 12. Appendices

### Appendix 1: Demographic Questionnaire

Source: Ferreira-Correia (2019)

Age:

Gender:

Have you undergone neuropsychological testing before? Yes____ No____

Which is your home language?

_____

Languages you know in order of dominance:

| | | | | |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |
| 6 | 7 | 8 | 9 | 10 |

Languages you use on daily basis:

| | | | | |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |
| 6 | 7 | 8 | 9 | 10 |

Language/s educated in (years):

_____

_____

_____

How many years of formal education do you have?

What is the highest level of formal education you have achieved?

School history

| Level School | School 1/type | School 1/type | School 1/type |
|---|---|---|---|
| Primary School | | | |
| Highschool | | | |
| University | | | |
| Others | | | |

Profession:

Occupation:

Current:

Past:

Special Hobbies/ Talents:

**Appendix 2. Letter of permission**


The Principal Investigator
The Neurocognitive Profile of Huntington Disease-Like 2: A Comparison with Huntington Disease and Healthy Controls
University of the Witwatersrand
1 Jan Smuts Avenue,
Braamfontein 2000,
Johannesburg,
South Africa

02/05/2022

Dr, Aline Ferreira Correia

Re: Request for data collection

My name is Hillary Banjo. I am a Masters student at the school of Human and Community Development at the University of the Witwatersrand, Johannesburg. As part of my degree, I am conducting a study titled "Phonetic verbal fluency in Multilingual speakers". This study aims to explore differences in performance of multilingual individuals who have English as their first language and individuals who do not have English as their first language on a phonemic fluency test assessed by the Controlled Oral-Word Association Test FAS (COWAT). While also accounting for covariates that may have an impact on these participants' performance on this task.

I would like to request access to the data from the healthy controls on the COWAT-FAS, including their anonymous demographic details (age, years of education and language experience variables I plan to use this data solely for the purpose of this study and I guarantee that no third parties would have access to this data without your consent.

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

Yours sincerely,

Hillary Banjo

Hillary

0731254392

**Appendix 3. Letter of permission to the registrar**


The Registrar
University of the Witwatersrand
1 Jan Smuts Avenue,
Braamfontein 2000,
Johannesburg,
South Africa

02/05/2022

Dear Carol Crosley

Re: Permission to conduct research at University of the Witwatersrand.

My name is Hillary Banjo. I am studying for a MA in Social and Psychological Research in the School of Human and Community Development at the University of the Witwatersrand. I am seeking permission to do part of my data recruitment and collection at University of the Witwatersrand.

I am conducting research on the topic 'Phonetic verbal fluency in Multilingual speakers' under Dr Aline Ferreira-Correia's supervision. Given the multicultural context of South Africa, the performance on verbal fluency tasks (such as the Controlled Oral Association Tests) is likely to be influenced by the differences in linguistic backgrounds (such as speaking one or more languages on a daily basis). Verbal fluency tasks are often used in neuropsychological assessment due to their diagnostic value, which is biased when the impact of multilingualism on the performance of this task is not taken into consideration.

I would like to kindly request your permission to distribute invitations to potential participants via placing posters in different notice boards in campus, as well as distributing online invitations via your office (see attached poster).
This study has been approved by (Ethics committee full name and clearance number) and involves undergraduate students between 18 to 30 years of age that have between 12 to 14 years of education (therefore first or second year students). If individuals with these characteristics agree to participate, they will be asked a few questions about themselves (e.g., age and years of education) and about the languages that they know and speak. After that, a task will be conducted in which they will be asked to list words in different categories. This

will be a brief activity, and the entire participation would take approximately 10 minutes. Participants will be allowed to choose to do this activity in person or online.

Participation in this study will be voluntary, confidential, and anonymous. No compensation, monetary or otherwise, will be offered. Risks, beyond those linked to daily living, are not anticipated. Participants will not be penalized if they refuse to take part or if they decide to withdraw at any point (Participant Information Sheet and Consent Form are attached).

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

Yours sincerely,

Hillary Banjo

Hillary
0731254392
2500105@students.wits.ac.za

Supervisor:
Dr. Aline Ferreira Correia
Senior Lecturer/Clinical Psychologist/Neuropsychologist
Psychology Department
University of the Witwatersrand
Aline.FerreiraCorreia@wits.ac.za
+27 72 200 9292

## Appendix 4. Participant Information Sheet


# PARTICIPANT INFORMATION SHEET (PIS)

Dear Sir / Madam

My name is Hillary Banjo. I am a Masters student at the school of Human and Community Development at the University of the Witwatersrand, Johannesburg. My supervisor is Dr Aline Ferreira Correia. As part of my degree, I am conducting a study titled "Phonetic verbal fluency in Multilingual speakers", and I would like to invite you to participate in this research. This study aims to explore differences in performance of multilingual individuals who are native and non-native English speakers in a verbal fluency task. Verbal fluency is the capacity to find (in your mind) precise information under specific search criteria.

If you agree to participate, I will ask you a few questions about you (e.g. age and years of education) and about the languages that you know and speak. After that, I will conduct three minute task to assess verbal fluency. The entire participation should take approximately 10 minutes. You can choose to do this activity in person or online. We will arrange a time and place (or link) that is convenient to you.

Participation in this study is voluntary and you will not receive any compensation, monetary or otherwise, and will not be penalised in any way if you decide not to participate. You can refuse to answer specific question and can stop participation at any time during the process of data collection. No risks linked to participation in this study are anticipated.

Your participation will be confidential and anonymous. The results will be analysed in groups, so it will be impossible to single out your results. The report resulting from this research will be available in the online library of the University of the Witwatersrand, which offers access to material on the world-wide web. The findings will also potentially be published in scientific journals. If you wish to have access to the results, you may request so by contacting me. The results are expected to be ready in July 2023. With your permission, other researchers (such as my supervisor) may use the data collected from this research study, but your name will not be used or included in any database.
If you have any questions during or afterwards about this research study, feel free to contact me or my supervisor on the details listed below. If you have any concerns or complaints about the ethical procedures of this research study, you are welcome to contact the University Human Research Ethics Committee (Non-Medical), telephone +27(0) 11 717 1408, email hrecnon-medical@wits.ac.za.

Yours sincerely,
Hillary Banjo

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**Appendix 5. Consent Form**


# Consent Form

**Phonetic verbal fluency in Multilingual speakers**
**Hillary Banjo**

I, ……..., agree to participate in this research project titled phonetic verbal fluency in Multilingual speakers by Hillary Banjo.

I agree to the following:

(Please circle the relevant options below)

| | | |
|---|---|---|
| The research study was explained to me. I understand what this study is about. | YES | NO |
| I understand that I can volunteer to take part in the study | YES | NO |
| I understand I can withdraw from this study at any time | YES | NO |
| I agree that my participation will remain anonymous (my name will not be used by the researcher in their research report) | YES | NO |
| I agree that other researchers may use the information I provide in my questionnaire and task, but my name and any personal information will not be used. | YES | NO |

…… (signature)
…… (name of participant)
…… (date)

# Appendix 6. Ethics Certificate

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

**SCHOOL OF HUMAN AND COMMUNITY DEVELOPMENT ETHICS COMMITTEE**
**CONSTITUTED UNDER THE UNIVERSITY HUMAN RESEARCH ETHICS COMMITTEE (NON-MEDICAL)**

| | |
|---|---|
| **CLEARANCE CERTIFICATE:** | **PROTOCOL NUMBER: MASPR/22/01** |
| **PROJECT TITLE:** | Phonetic verbal fluency in Multilingual speakers. |
| **INVESTIGATOR** | Banjo Hillary (2500105) |
| **SCHOOL/DEPARTMENT OF INVESTIGATOR** | SHCD/Psychology |
| **DATE CONSIDERED** | 30 May 2022 |
| **DECISION OF THE COMMITTEE** | Approved unconditionally |
| **RISK LEVEL** | Low Risk |
| **EXPIRY DATE** | 31 December 2024 |

**ISSUE DATE OF CERTIFICATE** 11 July 2022 **CHAIRPERSON** (Dr Sahba Besharati)

cc: Dr. Aline Ferreira Correia (Supervisor)

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**DECLARATION OF INVESTIGATOR**

To be completed in duplicate and **ONE COPY** returned to the Chairperson of the School/Department ethics committee.

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

**Signature** **Date** **12/07/2022**

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

**Appendix 7. Ferreira-Correia (2019) Ethics Certificate**

R14/49 Dr David Graham Anderson et al

**HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)**

**CLEARANCE CERTIFICATE NO. M140872**

| | |
|---|---|
| **NAME: (Principal Investigator)** | Dr David Graham Anderson et al |
| **DEPARTMENT:** | Neurology<br>Wits Donald Gordon Medical Centre<br>Charlotte Maxeke Johanesburg Academic Hospital<br>Bloemfontein, Polokwane and Northen Gauteng |
| **PROJECT TITLE:** | The Phenotype of Huntington Disease Like 2 (HDL2) |
| **DATE CONSIDERED:** | 29/08/2014 |
| **DECISION:** | Approved unconditionally |
| **CONDITIONS:** | |
| **SUPERVISOR:** | Prof A Krause |
| **APPROVED BY:** | Professor P Cleaton-Jones, Chairperson, HREC (Medical) |
| **DATE OF APPROVAL:** | 09/10/2014 |

**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 Secretary in Room 10004, 10th floor, Senate House, University.
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 resubmit the application to the Committee. **I agree to submit a yearly progress report.**

Principal Investigator Signature _____ Date _____

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