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A South African-Adapted WASI Vocabulary Subtest: Construct Validity and Screening Tool
Potential

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Abstract

In resource-limited settings such as South Africa, there is a dire need for screening tools that can quickly determine cognitive ability in educational, clinical, and research settings. Study 1 of this thesis, a secondary analysis of data collected previously in our laboratory, aimed to investigate the utility of the South African-Adapted Wechsler Abbreviated Scale of Intelligence (SA-WASI) Vocabulary subtest as a screening tool to estimate intelligence quotient (IQ) in a sample of cognitively healthy South African children and adolescents ($N = 320$). Through the collection of new data, Study 2 built on Study 1 and aimed to investigate the construct validity of this subtest in comparison to criterion measures of IQ, and to conduct item-level analyses to determine its psychometric properties in a sample of English-speaking university students ($N = 36$). Together, results from Study 1 and Study 2 demonstrated that the SA-WASI Vocabulary subtest has good construct validity in relation to estimates of verbal and full scale IQ based on the SA-WASI and two other criterion measures. Item-level investigation in Study 2 resulted in the further abbreviation of this subtest, with a 12-item subtest proving to have psychometric properties comparable to those of the SA-WASI Vocabulary. These data suggest the 12-item subtest holds promise as a screening tool for the estimation of general intellectual functioning in English-speaking South African individuals aged 9-89 years. Future research should further investigate the psychometric properties and screening tool potential of the 12-item SA-WASI Vocabulary subtest across various age and linguistic ranges.

Keywords: Wechsler Abbreviated Scale of Intelligence; South Africa; Vocabulary subtest; screening tool; IQ; construct validity

A South African-Adapted WASI Vocabulary Subtest: Construct Validity and Screening Tool Potential

In resource-limited settings such as South Africa, there is an urgent need for brief, psychometrically-sound screening tools that can identify quickly whether an individual is cognitively impaired or not (Bernard, Boermeester, & Viljoen, 1998; Manly, Jacobs, & Ferraro, 2002; Myer et al., 2008; Robbins et al., 2013; Robertson, Liner, & Heaton, 2009). Because South Africa has few trained psychometricians, clinical psychologists, and especially neuropsychologists, it would be extremely advantageous to have screening tools that reduce the time and cost involved in administration, that decrease the need for expert interpretation, and that can be used by lay professionals (e.g., nurses; Joska et al., 2016; Watts & Shuttleworth-Edwards, 2016; Witten, 2015). However, it is imperative that such screening tools are scrutinised thoroughly to ensure that they have construct validity (the extent to which a test measures what it is designed to measure; Cronbach & Meehl, 1955); otherwise, one runs the risk of misidentification and misdiagnosis.

Most psychometric tests are developed in the global north. Their standardisation and normative datasets are therefore typically based on the performance of white, English-speaking, middle-class individuals (Razani, Murcia, Tabares, & Wong, 2007). Cultural and linguistic bias skewed towards the mainstream culture in which these tests were developed can hinder the performance of individuals unfamiliar with that culture and/or language, making the cross-cultural utility of these tests questionable (Ferrett, 2011; Foxcroft, Patterson, le Roux, & Herbst, 2004; Gergen, Gulerce, Lock, & Misra, 1997; van de Vijver & Poortinga, 1997). If the most well-standardised and widely-used tests are to be utilised outside of the countries in which they were developed, then those tests should be adapted, translated, and re-normed to ensure fair and ethical testing (Foxcroft, 1997, 2004; Nell, 2000).

South Africa is a socioeconomically diverse, multicultural, and multilingual country, and its population bears the burden of numerous psychological, psychiatric, and neurological disorders, all with potentially damaging cognitive consequences (Stein et al., 2008; Williams et al., 2007). Psychologists are tasked with assessing the severity of cognitive impairment, and evaluating its impact on everyday functioning. Hence, various attempts have been made to adapt standardised tests of cognitive functioning (which, as noted earlier, are typically developed and normed in the global north) for local use. For instance, Claassen, Krynauw, Holtzhausen, and Mathe (2001) produced a standardisation of the Wechsler Adult Intelligence Scale-Third Edition (WAIS-III; Wechsler, 1997) for use in this country. Various other studies have provided South African normative data for both original and adapted tests (see, e.g.,

Ferrett, 2011; Cavé & Grieve, 2009; Grieve & van Eeden, 2010; Shuttleworth-Edwards et al., 2004; Skuy, Schutte, Fridjhon, & O'Carroll, 2001). The focus of the currently proposed investigation is a South African adaptation of one of the core Wechsler subtests, Vocabulary. Performance on that subtest is often regarded as an appropriate proxy for intelligence quotient (IQ; Axelrod, 2002).

The construct of IQ, and its assessment, have generated much controversy since the concept was introduced to the psychological literature just over a century ago (see, e.g., Binet & Simon, 1905; Carroll, 1993; Cattell, 1943; Flynn, 1998; Herrnstein & Murray, 1994; Horn & Cattell, 1966; Mackintosh, 1998; Spearman, 1904; Stern, 1914; Terman, 1916; Wechsler, 1939). Some argue that IQ tests do not have good cross-cultural utility, and that IQ is largely a Western psychological construct, especially given that most measures of the construct have been developed in North America and Western Europe, and are designed for administration to individuals assimilated to the mainstream culture present in those geographic regions (Shuttleworth-Edwards, 2012; van de Vijver & Poortinga, 1997). Despite continuing disagreements about the relevance and the purpose of assessing IQ, it remains an important part of clinical and neuropsychological assessment of intellectual ability and cognitive impairment, particularly in educational, clinical, and research settings (Abu-Hilal, Al-Baili, Sartawi, Abdel-Fattah, & Al-Qaryouti, 2011; Bolton, 2003).

Although numerous psychometric assessments of intelligence have been developed, the Wechsler family of tests is used most widely in clinical settings (Sparrow & Davies, 2000). David Wechsler developed the Wechsler Intelligence Scale for Children (WISC; Wechsler, 1949) and the Wechsler Adult Intelligence Scale (WAIS; Wechsler, 1955), among others. Both instruments have undergone multiple revisions since their original publication, with the most recent being the fourth edition of the WAIS (Wechsler, 2008) and the fifth edition of the WISC (Wechsler, 2014). Although these tests are generally successful in producing an estimate of an examinee's IQ, they are time-consuming and labour-intensive to administer (Climie & Rostad, 2011). The Wechsler Abbreviated Scale of Intelligence (WASI; Wechsler, 1999), modelled on the WISC-III (Wechsler, 1991) and WAIS-III (Wechsler, 1997) batteries, was developed in response to the need for a short, yet reliable measure of intelligence (Lange & Iverson, 2008).

The WASI is useful for research purposes, for providing an estimate of IQ for individuals within a broad age range (6-89 years), as a screening tool, and for reassessment of those who have been administered a full, comprehensive IQ test (Axelrod, 2002; Canivez, Konold, Collins, & Wilson, 2009). It is an attractive and cost-efficient measure as it offers

relevant information while taking an hour less to administer than the WAIS-III (McCrimmon & Smith, 2013; Saklofske, Caravan, & Schwartz, 2000). Clearly, then, the use of the WASI, or individual WASI subtests, as screening tools in South African settings could be highly beneficial.

The WASI consists of four subtests: Vocabulary, Similarities, Block Design, and Matrix Reasoning. The first two are measures of Verbal IQ (VIQ), whereas the latter two are measures of Performance IQ (PIQ). Together, they provide an estimate of Full Scale IQ (FSIQ; Wechsler, 1999). The construct of VIQ involves aspects of intelligence relating to language and words, and bears strong similarity to Cattell's (1943) concept of crystallised intelligence (see also Canivez et al., 2009; Horn & Cattell, 1966). In other words, a large bank of acquired knowledge related to, or emerging from, the culture and language within which the test was developed predicts good performance on VIQ-related subtests. VIQ estimates are therefore sensitive to cultural and linguistic variation (Abu-Hilal et al., 2011; Foxcroft & Aston, 2006). PIQ subtests involve non-verbal and/or visual-spatial aspects of intelligence, and bear strong similarity to Cattell's (1943) concept of fluid intelligence (see also Canivez et al., 2009; Horn & Cattell, 1966). Despite the non-linguistic content of these subtests, PIQ estimates are also culturally biased (Rosselli & Ardila, 2003; Shuttleworth-Edwards et al., 2004). Of these subtests, Vocabulary has the highest correlations with VIQ and FSIQ (Canivez et al., 2009; Saklofske et al., 2000; van Wyhe, 2012; Wechsler, 1999). Given that Vocabulary appears to provide a reliable estimate of FSIQ, using it alone as a screening tool could further reduce administration time.

However, there have been some critiques of vocabulary being an accurate measure of intelligence. Many of these critiques centre on the fact that numerous non-organic factors contribute to one's language skills, and hence to one's performance on tests such as WASI Vocabulary. For instance, differences in level and quality of education can often account for poor performance on the subtest (Bornstein, Suga, & Prifitera, 1987; Shuttleworth-Edwards et al., 2004). Such education factors are particularly pertinent in South Africa, where differences in quality of education within and across racial and ethnic groups exist due to the unfair privileges that the White population received during the Apartheid regime (Shuttleworth-Edwards et al., 2004).

A difference between the language of test administration and the home language of the examinee is another factor that might affect performance on cognitive tests that feature verbal stimuli (Foxcroft & Aston, 2006; Nell, 1994). Herbst and Huysamen (2000) found assessment undertaken in a language other than the examinee's home language resulted in significantly

lowered scores, perhaps due to misunderstanding of test content and instructions. Hence, a major limitation of the WASI is that only English-language versions have been formally published. This situation is particularly problematic in countries like South Africa, where English is one of 11 official languages, and is the first language of only 9.6% of the population; isiZulu (22.7%), isiXhosa (16%), and Afrikaans (13.5%) are spoken more frequently as a first language (Statistics South Africa, 2011).

Test administrators must also be mindful of the language in which their examinees have been educated. Nell (1999) explains that administering tests in a person's home language may be limiting, as the concepts being assessed may have been acquired through the language in which s/he was formally educated.

In summary, it is appropriate to administer a test in either the examinee's home language or the language in which s/he has been educated, but not in a language outside of these (Claassen et al., 2001). Hence, to reduce the language bias that might exist when using these tests cross-culturally, various attempts have been made to adapt, translate, and validate the verbal components of the WASI.

Abu-Hilal et al. (2011) adapted the WASI in a study assessing the instrument's psychometric properties in a sample of Arab school children. Similarly, a South African research group modified and translated the WASI verbal components into South African-appropriate English, Afrikaans, and isiXhosa versions. On the Vocabulary subtest, 9 of the 42 original words were replaced for purposes of cultural familiarity and translatability. For example, *alligator* was changed to *crocodile/krokodil/icrocodile*. Only English- and Afrikaans-speaking White and Coloured individuals aged 12-15 living in the Western Cape were tested (Ferrett, 2011; van Wyhe, 2012). Although the researchers were successful in producing stratified norms for the adapted test within this sample, they did not correlate these scores with scores on other measures of IQ, and they did not assess the psychometric properties of the adapted version of the subtest.

We need to assess the psychometric properties of this South African-adapted WASI (SA-WASI) Vocabulary subtest and determine whether it has construct validity to ensure that the adaptation measures what the original WASI Vocabulary was designed to measure. Furthermore, if the SA-WASI Vocabulary subtest is shown to correlate with VIQ and FSIQ indices, one might use this subtest as a screening tool in South African clinical and educational settings when an estimate of IQ is required.

Research Aim and Question

This research comprised two separate studies. The major aim of the first study was to determine, using child and adolescent control data collected previously by our research group (Ferrett, 2011; Kilchenmann, 2011; van Wyhe, 2012), the utility of the SA-WASI Vocabulary subtest as a screening tool to estimate IQ in educational, clinical, and research contexts. The major aim of the second study was to determine, using a sample of English-speaking university students, the construct validity of the SA-WASI Vocabulary subtest in relation to other tests of FSIQ. The second study also aimed to assess the SA-WASI Vocabulary on an item level in terms of relative item difficulty and internal consistency reliability in attempts to evaluate its' further abbreviation potential for use in resource-limited settings. In summary, the major question that the research intended to answer was: Is the SA-WASI Vocabulary subtest a valid estimate of IQ that possesses the potential to be utilised as a screening tool to estimate IQ and/or cognitive ability in South Africa?

Study 1: Methods

Design and Setting

This study featured a retrospective, quantitative design.

Participants

I undertook a secondary analysis of data collected within three different studies (Ferrett, 2011; Kilchenmann, 2011; van Wyhe, 2012). These datasets were collected from typically developing children and adolescents aged 9-15 years. The studies in question ran between 2009 and 2012.

Materials

South African-adapted Wechsler Abbreviated Scale of Intelligence. The SA-WASI (Ferrett, 2011) closely resembles the original WASI. The only differences from the original are adaptations to the verbal subtests (Vocabulary and Similarities) made in attempts to improve cultural appropriateness. The full SA-WASI was administered to these participants as part of the protocol of the original study in which they had been enrolled.

Procedure

I gathered biographical and educational information regarding each participant from the various studies from which data was mined. I also recorded individual performance on the SA-WASI Vocabulary subtest, SA-WASI VIQ, and SA-WASI FSIQ.

Statistical Analyses

In Study 1 and Study 2 analyses were completed using IBM SPSS Statistics Version 23.0. The threshold for statistical significance was set at $\alpha = .05$.

Preliminary analyses. I calculated descriptive statistics for each sociodemographic and outcome variable to illustrate the sample characteristics. I then conducted a series of independent-sample *t*-tests, chi-squared tests of contingency, Fischer's exact tests, and multiple linear regressions on continuous and categorical sociodemographic and outcome variables to investigate the potential existence of between-group differences.

Correlations. To investigate whether the SA-WASI Vocabulary subtest is an accurate estimate of VIQ and FSIQ, and, therefore, whether it might have utility as a screening tool, I conducted bivariate correlations examining the association between Vocabulary *T*-scores and (a) SA-WASI VIQ standard scores and (b) SA-WASI FSIQ standard scores. In both Study 1 and Study 2, I interpreted a correlation of $\pm .40$ or below as small, $\pm .50$ to $\pm .60$ as moderate and $\pm .70$ to ± 1 as large (Field, 2009; Tredoux & Durrheim, 2002).

Ethical Considerations

The research described here, and in Study 2, complies with the guidelines stipulated in the University of Cape Town (UCT)'s Codes for Research involving human subjects. Ethical approval was obtained for both studies from the UCT Department of Psychology Research Ethics Committee (reference number: PSY20016-027; see Appendix A).

Consent, voluntary participation, and confidentiality. For each of the larger studies from which the data from these participants were mined, parents/legal guardians signed informed consent documents, and children signed assent forms. Participation in these studies was completely voluntary. Regarding anonymity and confidentiality, I did not have access to the names of participants.

Risks and benefits. There were no risks involved in utilising the data from the various parent studies as each participant remained completely anonymous. Participants did not receive any form of compensation for the use of their data in this study. They had already, however, received compensation for their participation in the original studies.

Debriefing. No debriefing was required as the study involved only secondary data analysis.

Study 1: Results and Discussion

Sample Characteristics

Table 1 presents a summary of key sociodemographic characteristics of the current sample. All participants were aged between 9 and 15 years, and most had completed at least 6

years of education ($M_o = 6$). Regarding race and language, the modal participant was Coloured and spoke English as a home language.

Table 1 also presents the comparisons between male and female participants with regard to the continuous variables in this study (age and years of completed education). Potential between-group differences were explored using independent-sample *t*-tests. The underlying assumptions pertaining to homogeneity of variance and independence of observations were upheld for both outcome variables. The assumption of normality was upheld for years of completed education, but was only roughly upheld for age. The analyses detected no statistically significant between-sex-group differences in these variables.

Because race did not have an expected frequency larger than 5, potential differences between the groups of male and female participants were investigated using Fisher's exact test. This analysis did not find a statistically significant association between sex and race. A chi-squared test of contingency examined between-group differences in home language because the underlying assumption of independence of observations was upheld and expected frequencies on this variable were greater than 5. This analysis also did not detect any significant between-group differences.

Table 1
Sociodemographic Characteristics of the Current Sample (N = 320)

Variable	Total Sample (N = 320)	Boys (n = 150)	Girls (n = 170)	<i>t</i> / χ^2	<i>p</i>	ESE
Age (years)	13.27 (1.31)	13.27 (1.23)	13.26 (1.39)	-0.40	.405	0.01
Education (years) ^a	6.83 (1.31)	6.87 (1.29)	6.81 (1.34)	-0.37	.709	-0.03
Race				0.16	.702	0.02
Coloured	238 (74.38)	110 (34.38)	128 (40.00)			
White	82 (25.63)	40 (12.50)	42 (13.13)			
Home Language				3.31	.652	0.10
English	147 (45.77)	67 (20.94)	80 (25.00)			
Afrikaans	137 (42.95)	68 (21.25)	69 (21.56)			
isiXhosa	2 (0.63)	0 (0)	2 (0.63)			
Other	1 (0.031)	0 (0)	1 (0.313)			
Bilingual	23 (7.21)	10 (3.13)	13 (4.06)			
Mixed	10 (3.13)	5 (1.56)	5 (1.56)			

Note. For the variables *Age* and *Education*, means are presented with standard deviations in parentheses. For the variables *Race* and *Home Language*, raw numbers are presented with percentage in parentheses. ESE = effect size estimate (in this case, Cohen's *d* for t-tests and Cramer's *V* for chi-squared tests of contingency and Fisher's exact tests).

^aData were only available for 287 participants.

Test Performance

There was a wide range of performance on the SA-WASI Vocabulary subtest, SA-WASI VIQ, and SA-WASI FSIQ. Although the sample means fell within the Low Average range (T -score $M = 41.54$, $M = 89.20$, and $M = 87.66$, respectively), measures of variance suggested that performance was not at all consistent across participants ($SD = 13.91$, T -score range = 20-78, $SD = 19.08$, range = 54-152, and $SD = 16.84$, range = 55-142, respectively). In interpretive terms, performance on these measures ranged from Profound Impairment to Very Superior.

To investigate the high levels of performance variance in this sample, three stepwise multiple linear regression analyses were conducted to determine if sociodemographic characteristics had an effect on (a) scores on the Vocabulary subtest, (b) VIQ standard scores, and (c) FSIQ standard scores. The following demographic variables were simultaneously entered into each model: sex, age, education, race, and home language. The underlying assumptions pertaining to these regression models were adequately upheld. The first model suggested that sex, age, and race were significant predictors of Vocabulary performance, $R^2 = 0.26$, $p = .013$. The second model suggested that sex and race were significant predictors of SA-WASI VIQ scores, $R^2 = 0.30$, $p = .012$. In both of the aforementioned models, race accounted for a large amount of the performance variance, $R^2 = 0.22$ and $R^2 = 0.28$, respectively, and the R^2 change value increased only marginally when the other variables were included. Consistent with this patterns of results, race was the only sociodemographic variable that significantly predicted SA-WASI FSIQ scores, $R^2 = 0.37$, $p < .001$.

Assessing Construct Validity of the SA-WASI Vocabulary Subtest

Bivariate correlational analyses assessed the construct validity of the SA-WASI Vocabulary subtest as a measure of VIQ and FSIQ. There were significant, large, positive relationships between Vocabulary T -scores and (a) SA-WASI VIQ standard scores, $r = .94$, $p < .001$, and (b) SA-WASI FSIQ standard scores, $r = .86$, $p < .001$.

Although the results from Study 1 appear promising, further investigation into the construct validity of the SA-WASI Vocabulary could proceed by comparing it to criterion measures of FSIQ. In attempts to further investigate the psychometric properties of this subtest, analyses on an individual item-level could also be useful. Study 2 sought to make those further investigations.

Study 2: Methods

Design and Setting

The design of this study was correlational-relational (i.e., it attempted to establish an association between two different sets of measures, using a single sample). Data were collected via four measures, one of which assessed English fluency and the other three measured IQ. Because all of the IQ tests were administered in English, the task measuring English fluency was administered first for purposes of design standardisation and to exclude those who were not sufficiently fluent English-speakers. The three IQ-assessing instruments included two criterion measures that were measured against the SA-WASI. Administration of these three brief measures of IQ was counterbalanced to control for order effects.

All study procedures were completed in a research laboratory in the Department of Psychology at UCT.

Participants

An a priori power analysis indicated that a sample size of 36 would generate statistical power of 99.9% for a two-tailed test with an alpha level of .05 and a large effect size ($\rho = 0.71$; Faul, Erdfelder, Buchner, & Lang, 2009). The desired effect size was calculated by averaging correlation coefficients from similar studies (see Abu-Hilal et al., 2011; Axelrod, 2002; Canivez et al., 2009; Hays, Reas, & Shaw, 2002; Saklofske et al., 2000).

I used convenience sampling to recruit 36 participants (18 men and 18 women) via the UCT Department of Psychology's Student Research Participation Programme (SRPP). An email sent via the UCT Vula SRPP site (see Appendix B) invited psychology students to volunteer for this study if they met the eligibility criteria.

Eligibility criteria. Participants needed to be aged between 18 and 25 years. Those who had a history of psychological, psychiatric, or neurological disorders, who were using psychoactive medication, or who were not fluent English speakers, were excluded from participation.

Materials

Sociodemographic questionnaire. This questionnaire (see Appendix C) was created and used to gather general biographical information (e.g., sex, race, socioeconomic status (SES), age, date of birth, languages spoken etc.), educational information (e.g., high school attended, high school language of instruction, years of completed education, etc.), and general information pertaining to psychological history and status, medication use, and the area in which the participant resided during childhood.

Controlled Oral Word Association Test. The Controlled Oral Word Association Test (COWAT; Benton & Hamsher, 1976) is used to assess verbal (phonemic and semantic) fluency by measuring the spontaneous production of unique words within a specified time

limit (usually 1 minute; Abwender, Swan, Bowerman, & Connolly, 2001; Benton, Hamsher, & Sivan, 1994; Strauss, Sherman, & Spreen, 2006).

Phonemic fluency tasks require participants to generate, within the given time limit, as many words as possible beginning with a given letter of the alphabet. This study used the standard letter set of 'F', 'A', and 'S' because this set is internally consistent ($r = .83$), has adequate test-retest reliability ($r = .74$), and possesses good construct validity when compared against other letter combinations (Strauss et al., 2006; Tombaugh, Kozak, & Rees, 1999). In a study conducted with a sample of English-speaking university students in the United States (US), the mean word output was F = 12, A = 10.7, and S = 14. The mean total phonemic fluency was 36.9, with a standard deviation of 10.1 (Portocarrero, Burright, & Donovanick, 2007).

Semantic fluency tasks require the naming, within the given time limit, of as many items as possible from a specific semantic category. This study employed the commonly used 'animals' category as it has been found to possess the strongest psychometric properties in comparison to other options (Strauss et al., 2006). Portocarrero et al. (2007) found 21.9 ± 4.6 to be the mean number of animals listed by English-speaking university students in the US.

South African-adapted Wechsler Abbreviated Scale of Intelligence. In the current study, I administered the full SA-WASI; this battery took roughly 30 minutes to complete.

Criterion measures.

Shipley Institute of Living Scale-2. The Shipley Institute of Living Scale-2 (SILS-2; Shipley, Gruber, Martin, & Klein, 2009) was designed as a rapid (20-25 minutes) assessment of cognitive ability and/or impairment (Kaya & Delen, 2012). The SILS-2 Composite A score is obtained by summing scores on the Vocabulary and Abstraction subtest items, while the Composite B score is obtained by summing scores on the Vocabulary and Block Pattern subtest items. Both Composites provide a score estimating overall cognitive ability; therefore, for purposes of this study, only the Vocabulary and Abstraction subtests were administered. The SILS-2 is commonly used as a brief measure of IQ as it has an internal consistency reliability estimate of .91, possesses good test-retest stability, and has correlations of .86, .77, and .69 with the WAIS-III, WASI, and Wechsler Intelligence Scale for Children-Fourth Edition (WISC-IV; Wechsler, 2004), respectively, thus suggesting that it has good construct validity (Lodge, 2013; Shipley et al., 2009).

Kaufman Brief Intelligence Test, Second Edition. The Kaufman Brief Intelligence Scale, Second Edition (KBIT-2; Kaufman & Kaufman, 2004) was designed as a brief, individually administered measure of crystallised and fluid intelligence in children and adults

aged 4-90 years. The battery includes three subtests (Riddles, Verbal Knowledge, and Matrices), and takes approximately 20 minutes to administer. Riddles and Verbal Knowledge provide estimates of VIQ, whereas Matrices provides an estimate test of non-verbal IQ. Performance on the three subtests together provides an estimate of overall IQ (i.e., the KBIT-2 IQ Composite score). The KBIT-2 IQ Composite has a mean internal reliability of .93 and correlates strongly with WASI FSIQ and WAIS-III FSIQ ($r = .90$ and $r = .89$, respectively), suggesting that it possesses high construct validity (Bain & Jaspers, 2010).

Procedure

I met the participant in the research laboratory. The participant read and signed an informed consent document (see Appendix D) before completing the sociodemographic questionnaire. Thereafter, I administered the COWAT tasks following the standardised procedures described in Lezak, Howieson, Loring, Hannay, and Fischer (2004). If the participant scored less than 1.5 standard deviation from the means reported by Portocarrero et al. (2007; i.e., obtained a total phonemic fluency score below 22, or listed fewer than 15 animals), s/he would have been thanked for participating and debriefed. These individuals would have been automatically excluded from further participation as their COWAT performance suggested their level of English-language fluency may have hindered performance on the English-language IQ measures that followed. However, all participants who signed-up to this study were eligible to continue and IQ testing proceeded.

I employed a block random assignment before the participant arrived to ensure that equal numbers of men ($n = 6$) and women ($n = 6$) were assigned to each of the six orders in which test administration could proceed, where: A = ABCD, B = ABDC, C = ACBD, D = ACDB, E = ADBC, and F = ADCB. These IQ measures were counterbalanced and each test was administered following standard procedures outlined in the various test manuals. Once the battery of tests had been administered, the participant was thanked, debriefed, and encouraged to ask questions.

Statistical Analyses

Preliminary analyses. I calculated descriptive statistics for each sociodemographic and outcome variable to illustrate the sample characteristics. I then conducted a series of independent-sample *t*-tests, chi-squared tests of contingency, Fischer's exact tests and simple linear regressions on continuous and categorical sociodemographic and outcome variables to investigate potential between-group differences.

Correlations. To investigate the construct validity of the SA-WASI Vocabulary subtest as a measure of VIQ, I conducted bivariate correlations examining the associations

between the SA-WASI Vocabulary *T*-scores and (a) SILS-2 Vocabulary standard scores, and (b) KBIT-2 Verbal standard scores. Furthermore, bivariate correlations investigated the construct validity of the SA-WASI Vocabulary subtest as a measure of FSIQ by examining the associations between the *T*-scores on the subtest and (a) SILS-2 Composite A standard scores, and (b) KBIT-2 IQ Composite standard scores.

Item analysis. The starting point on the SA-WASI Vocabulary for individuals 9 years or older is item 9 therefore data for items 1-8 were non-existent in this study. I analysed raw data from the SA-WASI Vocabulary subtest using relative item difficulty. These analyses assessed whether the linear trend of increasing difficulty as the test items proceed is present in the SA-WASI as it is purported to be in the original WASI. Furthermore, I assessed the internal consistency reliability of the SA-WASI Vocabulary subtest using Cronbach's alpha correlation coefficient. Specifically, I examined whether, and how much, the alpha value changed if each subtest item was deleted.

Ethical Considerations

Consent, voluntary participation, and confidentiality. Each participant signed an informed consent document. This document outlined the study, stated that participation was voluntary, notified participants that they may withdraw from the study at any time with no penalty, and asserted that data would be kept completely confidential (i.e., it would only be viewed and used by those involved in the research for the purposes of this study). To ensure anonymity and confidentiality, each participant was assigned a number from 1 to 36; this number was also keyed to their sex and condition to which they were assigned.

Risks and benefits. Participation in this study did not carry any risks. However, testing would have ceased if it were in any way distressing to the participant. Participants were not provided with their IQ scores. If requested, an interpretive range would have been provided, however, no student expressed interest in obtaining these results. Students received 4 SRPP points as compensation for participation.

Debriefing. All participants were thanked at the end of their participation and asked if they had any questions pertaining to the study or to the battery of tests that had been administered. The researchers' email address was provided on their proof of participation slip, and any further queries or concerns were addressed via email.

Study 2: Results and Discussion

Sample Characteristics

Table 2 presents a summary of key sociodemographic characteristics of the sample. All participants were aged between 18 and 25 years, and had completed at least 12 years of formal education (i.e., they had passed Matric). Most participants were in their second year of study at UCT ($M_o = 2$). Regarding other sociodemographic characteristics, although there was some diversity, the modal participant was White, a monolingual English speaker, educated in a public high school, and from a higher SES bracket.

Regarding the continuous variables depicted in Table 2, I explored potential differences between the groups of male and female participants using a series of independent-sample t -tests. The underlying assumptions pertaining to homogeneity of variance and independence of observations were upheld, while normality of distribution was only roughly upheld; this may be explained by the relatively small sample size ($N = 36$). The analyses detected no statistically significant between-group differences in terms of years of completed education and current year of study.

The analysis did, however, detect a statistically significant between-sex-group difference with regard to age. A series of simple linear regressions assessed whether age predicted performance on any of the COWAT, SA-WASI, SILS-2, and KBIT-2 outcome variables. None of the regression coefficients obtained from these analyses were significant. Hence, one might conclude that, in this sample, age is not a significant predictor of performance on any of the outcome variables.

Regarding the categorical variables depicted in Table 2, I explored potential between-sex-group differences using a chi-squared test of contingency for race and Fisher's exact tests for the other categorical variables (because, although the underlying assumption of independence of observations was upheld, the expected frequencies were not greater than 5). Those analyses detected no statistically significant association between sex and race, home language, first language, number of languages spoken, high school status, or SES.

Table 2

Sociodemographic Characteristics of the Current Sample (N = 36)

Variable	Total Sample (N = 36)	Men (n = 18)	Women (n = 18)	<i>t</i> / χ^2	<i>p</i>	ESE
Age (years)	20.42 (1.93)	21.11 (1.84)	19.72 (1.81)	-2.28	.029*	0.76
Education (years)	13.58 (1.75)	13.89 (2.19)	13.28 (1.13)	-1.05	.301	0.35
Current Year of Study	2.03 (0.81)	2.06 (0.87)	2.00 (0.77)	-0.20	.840	0.07
Race				7.59	.067 [†]	0.48
Black	7 (19.44)	6 (33.33)	1 (5.56)			
Coloured	10 (27.78)	5 (27.78)	5 (27.78)			
Indian	3 (8.33)	0 (0)	3 (16.67)			
Mixed	1 (2.78)	1 (5.56)	0 (0)			
White	15 (41.76)	6 (33.33)	9 (50.00)			
Home Language				4.96	.059 [†]	0.38
English	29 (80.56)	12 (66.67)	17 (94.44)			
English and other	3 (8.33)	2 (11.11)	5.56 (1)			
Other	4 (11.11)	4 (22.22)	0 (0)			
First Language				0.81	.329	0.15
English	30 (83.33)	14 (77.78)	17 (94.44)			
Other	6 (16.67)	4 (22.22)	1 (5.56)			
No. of Languages Spoken				0.82	.785	0.14
Monolingual	20 (55.56)	10 (55.56)	10 (55.56)			
Bilingual	13 (36.11)	6 (33.33)	7 (38.89)			
Trilingual	3 (8.33)	2 (11.11)	1 (5.56)			
High School Status				1.09	.489	0.17
Public	23 (63.89)	10 (55.56)	13 (72.22)			
Private	13 (36.11)	8 (44.44)	5 (27.78)			
Socioeconomic Status ^a				3.80	.124	0.33
Lower	6 (16.67)	5 (27.78)	1 (5.56)			
Higher	27 (75.00)	11 (61.11)	16 (88.89)			
N/A	3 (8.33)	2 (11.11)	1 (5.56)			

Note. For the variables *Age*, *Education*, and *Current Year of Study*, means are presented with standard deviations in parentheses. For the variables *Race*, *Home Language*, *First Language*, *Number of Languages Spoken*, *High School Status*, and *Socioeconomic Status*, raw numbers are presented with percentage in parentheses. ESE = effect size estimate (in this case, Cohen's *d* for t-tests and Cramer's *V* for chi-squared tests of contingency and Fisher's exact tests).

^aSES was estimated from a combination of three indicators: self-reported SES (low, middle, or high), the annual fee structure of the high school the participant attended, and the average income of the area in which the participant had spent the majority of his/her life (Statistics South Africa, 2011). Three participants were unable to report SES, and were schooled and raised internationally; therefore, data for these individuals was not included in the analyses.

[†]*p* < .10. **p* < .05

Test Performance

Table 3 displays participants' performance on each of the outcome variables. Regarding the COWAT data, *z*-scores were calculated for each outcome variable using normative data from Portocarrero et al. (2007). These scores ($z = 0.26$, $z = 0.19$, $z = 0.17$, $z = 0.24$, and $z = -0.07$, for overall phonemic verbal fluency, letter F, letter A, letter S, and overall semantic verbal fluency, respectively) suggested that COWAT performance of this sample was in the range conventionally labelled as Average.

Regarding the IQ data, the sample's mean scores on the three major summative measures (SA-WASI FSIQ, SILS-2 Composite A, and KBIT-2 IQ Composite) were markedly similar, all falling within the Average range. The mean scores on all other IQ indices also fell within the Average range, with the exception of SA-WASI PIQ (High Average range).

Scores on the three major overall IQ measures correlated positively and significantly with one another. Specifically, the analyses detected moderate-strength correlations between (a) the SA-WASI FSIQ and SILS-2 Composite A, $r = .63$, $p < .001$ and (b) the SILS-2 Composite A and KBIT-2 IQ Composite, $r = .67$, $p < .001$. It also detected a large, significant correlation between the SA-WASI FSIQ and KBIT-2 IQ Composite, $r = .72$, $p < .001$.

Independent-sample *t*-tests examined whether there were any significant differences between the performance of men and women on each outcome variable. The assumption of independence of observations was upheld for all variables, whereas normality of distribution was only roughly upheld. Homogeneity of variance was violated for data regarding the COWAT letter F, SILS-2 Vocabulary subtest, and SILS-2 Composite A. Hence, for those three outcome variables, the results for equal variances not assumed were recorded. As Table 3 shows, the analyses detected no significant between-group differences.

Considering the results obtained in Study 1, I conducted series of chi-squared tests of contingency measuring the effects of race on outcome variables. The assumptions of independence of observations and expected frequencies greater than 5 were upheld. The results indicated that the only outcome measure for which a significant between-race-group difference existed was the SA-WASI FSIQ ($X^2 = 109.34$, $p = 0.16$).

Table 3
Test Performance of the Current Sample (N = 36)

Variable	Total Sample (N = 36)	Men (n = 18)	Women (n = 18)	Range	<i>t</i>	<i>p</i>	ESE
COWAT							
Phonemic fluency total	39.28 (9.33)	40.33 (8.70)	38.22 (10.06)	25-58	-0.67	.505	0.22
Letter F	12.69 (3.71)	13.11 (3.12)	12.28 (4.27)	6-19	-0.67	.509	0.22
Letter A	11.36 (3.91)	11.83 (4.13)	10.89 (3.72)	6-19	-0.72	.476	0.24
Letter S	14.86 (3.63)	14.67 (3.61)	15.06 (3.75)	9-22	0.32	.753	-0.11
Semantic fluency total	21.61 (4.45)	22.94 (3.96)	20.28 (4.61)	15-30	-1.86	.072 [†]	0.62
SA-WASI							
Verbal IQ	106.56 (9.36)	105.67 (11.13)	107.44 (7.40)	84-130	0.56	.576	-0.19
Vocabulary	54.81 (7.71)	52.94 (7.90)	56.67 (7.25)	38-67	1.47	.150	-0.49
Similarities	53.53 (6.30)	53.94 (7.45)	53.11 (5.07)	40-70	-0.39	.697	0.13
Performance IQ	111.36 (12.37)	111.56 (11.49)	111.17 (13.53)	79-132	-0.09	.926	0.03
Block Design	57.81 (8.38)	58.50 (8.40)	57.11 (8.54)	34-69	-0.49	.626	0.16
Matrix Reasoning	55.89 (6.87)	55.17 (6.51)	56.61 (7.33)	39-68	0.63	.536	-0.21
FSIQ	109.89 (10.54)	109.44 (10.96)	110.33 (10.40)	87-130	0.25	.804	-0.08
Full-2 IQ	109.22 (11.44)	106.94 (10.77)	111.50 (11.93)	86-127	1.20	.237	-0.40
SILS-2							
Vocabulary	107.89 (12.12)	108.06 (15.21)	107.72 (8.44)	76-128	-0.81	.936	0.03
Abstraction	109.78 (13.76)	112.06 (15.37)	107.50 (11.94)	80-143	-0.99	.328	0.33
Composite A	111.28 (12.89)	112.89 (16.17)	109.67 (8.65)	82-142	-0.75	.463	0.25
KBIT-2							
Verbal	103.69 (12.01)	101.78 (13.29)	105.61 (10.62)	83-126	0.96	.346	-0.32
Non-Verbal	106.61 (14.31)	104.67 (16.24)	108.56 (12.24)	61-130	0.81	.423	-0.27
Composite	106.31 (13.21)	104.11 (14.83)	108.50 (11.37)	72-132	1.00	.326	-0.33

Note. Performance outcomes for the COWAT were measured in the number of appropriate words produced within the given time limit. SA-WASI subtest scores are *T*-scores that have a normative mean of 50 and a standard deviation of 10. All other recorded IQ scores are the age-appropriate standard scores that have a normative mean of 100 and a standard deviation of 15. ESE = effect size estimate (in this case, Cohen's *d*). COWAT = Controlled Oral Word Association Test. SA-WASI = South African-adapted Wechsler Abbreviated Scale of Intelligence. FSIQ = Full Scale Intelligence Quotient. SILS-2 = Shipley Institute of Living Scale-2. KBIT-2 = Kaufman Brief Intelligence Test, Second Edition.

[†]*p* < .10.

Assessing Construct Validity of the SA-WASI Vocabulary Subtest

Bivariate correlational analyses assessed the construct validity of the SA-WASI Vocabulary subtest as a measure of VIQ. The analyses detected significant, moderate, positive relationships between *T*-scores on the subtest and (a) SILS-2 Vocabulary standard scores, $r = .46, p < .05$, and (b) KBIT-2 Verbal standard scores, $r = .58, p < .001$.

Similar bivariate correlational analyses assessed the construct validity of the SA-WASI Vocabulary subtest as a measure of FSIQ. The analyses detected significant, moderate, positive relationships between Vocabulary *T*-scores and (a) SILS-2 Composite A standard scores, $r = .49, p < .001$, and (b) KBIT-2 IQ Composite standard scores, $r = .57, p < .001$.

Item Analysis

Relative item difficulty. Raw data from the SA-WASI Vocabulary subtest were analysed to determine relative item difficulty. Figure 1 shows there was not a smooth linear trend of increasing difficulty (as reflected by decreasing performance as the sequence of items processed). Instead, performance was inconsistent with conventional expectation, with participants scoring better on some items administered later in the subtest than on those administered earlier.

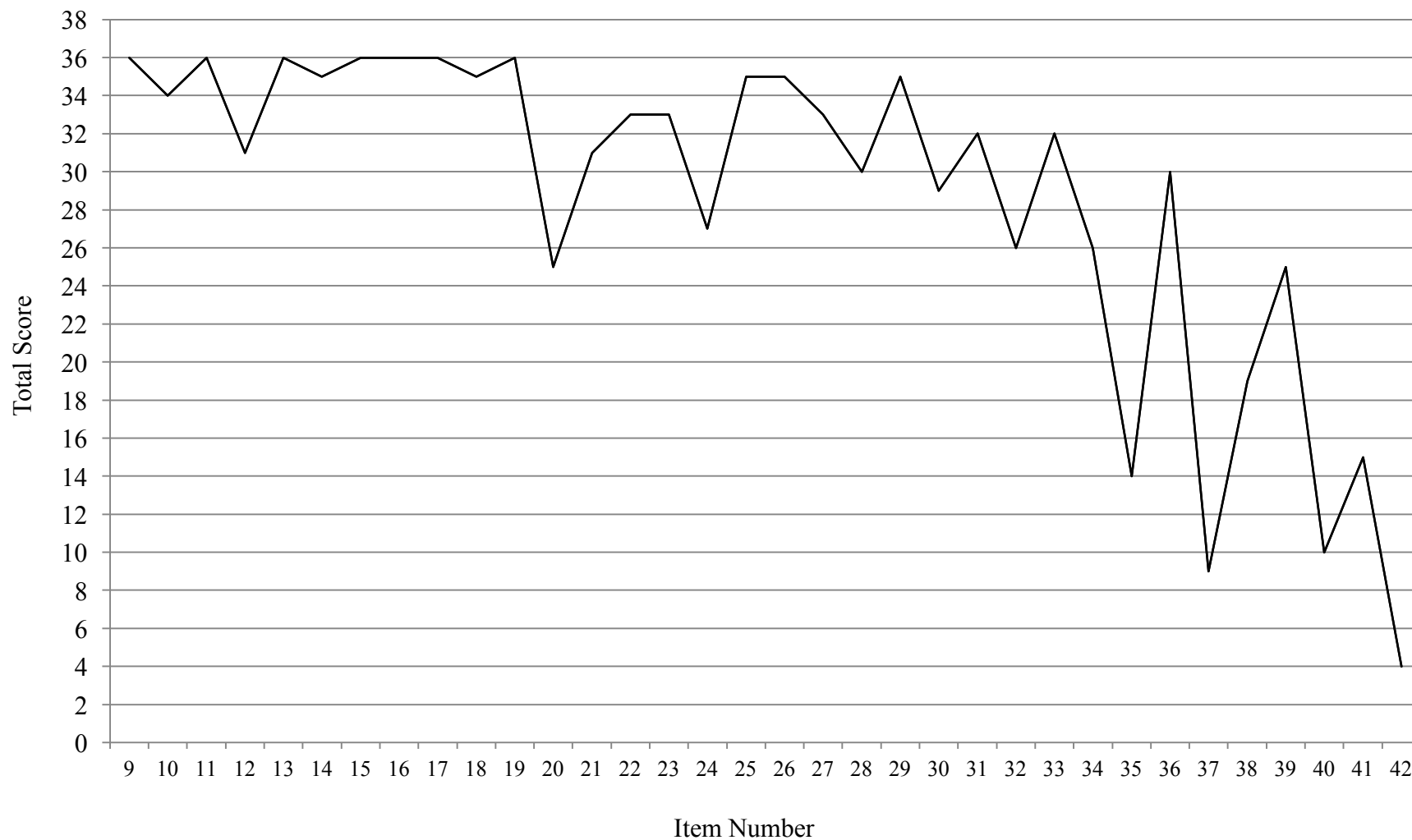


Figure 1. Item responses and relative item difficulty on items 9 through 42 on the SA-WASI Vocabulary subtest ($N = 36$). The Total Score was calculated by converting all participants raw scores of 1 or 2 (partially correct or correct responses) for each item on the SA-WASI Vocabulary to 1 and summing them to a total out of 36.

Internal consistency reliability. I assessed internal consistency reliability of the SA-WASI Vocabulary subtest using Cronbach's alpha correlation coefficient. I also examined how much the alpha value changed if each subtest item was deleted. The first step of the analysis suggested that $\alpha = .72$ when all 34 possible items (i.e., items 9-42) were included. However, deleting 22 of those items allowed α to improve substantially, to .82. Deleting more items than that did not increase the internal correlation consistency. Hence, this analysis suggests that a subset of 12 items (items 9, 10, 20, 24, 31, 32, 33, 35, 37, 40, 41, and 42) would create an effective abbreviated Vocabulary subtest.

Relative item difficulty on the 12-item subtest. The raw data scores were re-analysed to determine relative item difficulty on this 12-item SA-WASI Vocabulary subtest. Figure 2 shows that the linear trend of increasing difficulty was not completely smooth. However, this trend was an improvement on the pattern illustrated in Figure 1. Peaks and valleys within the linear trend in Figure 2 still exist, but there is a consistent downward trend, which is what one hopes to see in a cognitive test such as this. Performance on the first two items is the best (on item 9, 34 participants obtained a full score and on item 10, 23 participants provided correct responses), whereas performance on the last item is the worst (only three participants obtained a full score on item 42). The middle items show slight inconsistency in the downward pattern, but are still relatively correctly placed. To ensure a smooth trend of increasing item difficulty, the middle items needed to be re-arranged slightly. Hence, the proposed order of administration for the 12-item Vocabulary subtest is: 9, 10, 31, 33, 24, 32, 20, 41, 35, 40, 37, and 42. Figure 3 illustrates the smooth linear trend of increasing item difficulty for this test order.

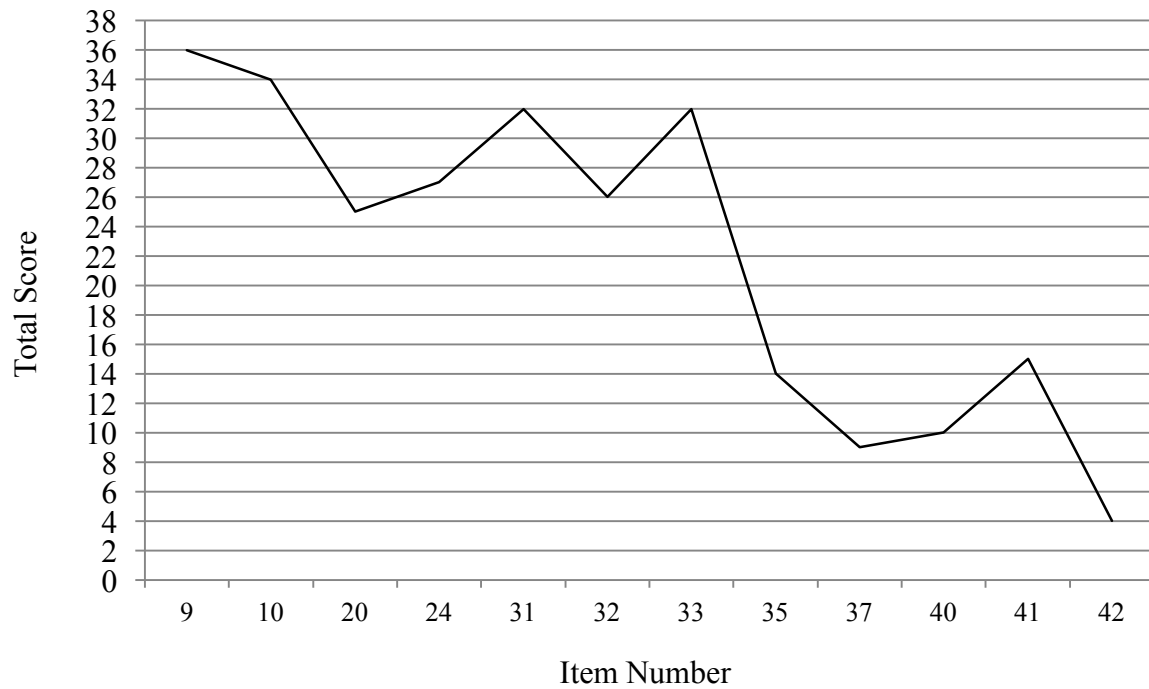


Figure 2. Item responses and relative item difficulty on the proposed items of the 12-item SA-WASI Vocabulary subtest ($N = 36$).

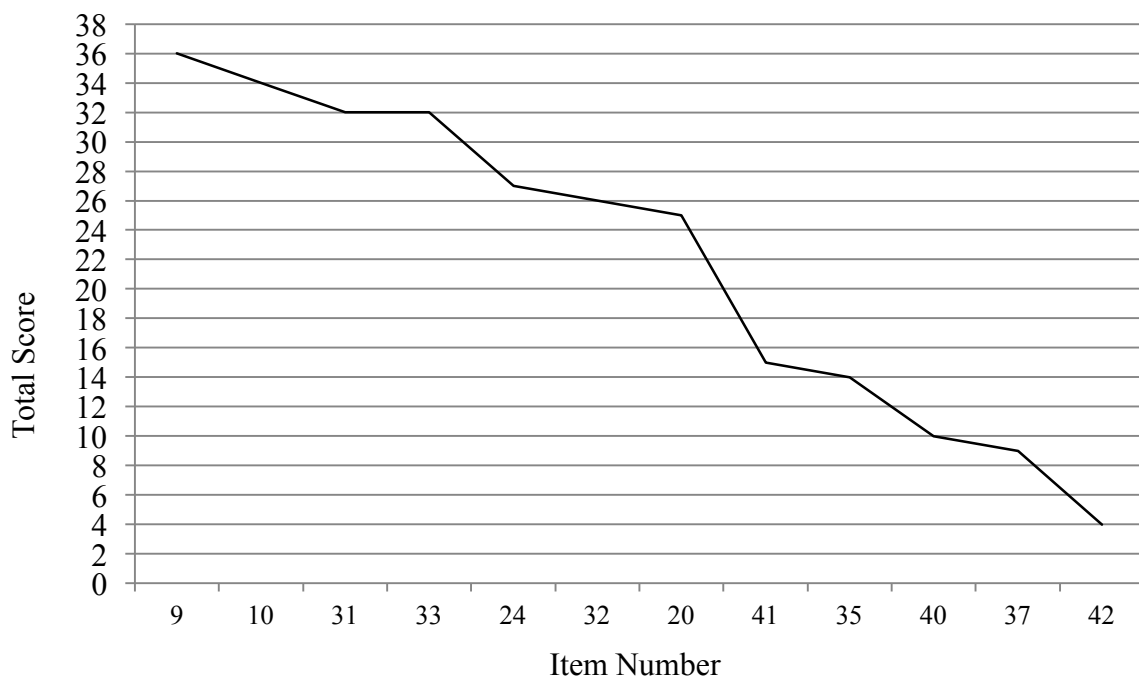


Figure 3. Item responses and relative item difficulty on the re-arranged order of the 12-item SA-WASI Vocabulary subtest ($N = 36$).

Assessing construct validity of the 12-item subtest. Bivariate correlational analyses assessed the construct validity of the 12-item Vocabulary subtest as a measure of VIQ. The analyses detected significant, moderate, positive relationships between scores on the

abbreviated subtest and (a) SILS-2 Vocabulary standard scores, $r = .51, p < .001$, and (b) KBIT-2 Verbal standard scores, $r = .54, p < .001$. The analyses also detected a significant, large, positive relationship between scores on the abbreviated subtest and SA-WASI VIQ scores, $r = .76, p < .001$.

Finally, bivariate correlational analyses assessed the construct validity of the 12-item Vocabulary subtest as a measure of FSIQ. The analyses detected significant, moderate, positive relationships between scores on the abbreviated subtest and (a) SILS-2 Composite A standard scores, $r = .55, p < .001$, and (b) KBIT-2 IQ Composite standard scores, $r = .53, p < .001$, and a significant, large, positive relationship between scores on the abbreviated subtest and SA-WASI FSIQ standard scores, $r = .70, p < .001$.

General Discussion

The overarching purpose of this research was to determine whether the SA-WASI Vocabulary subtest (Ferrett, 2011), an adapted version of the original WASI Vocabulary subtest (Wechsler, 1999) is a valid estimate of FSIQ in South Africa, and if this adapted Vocabulary subtest can be used as a screening tool to estimate general intellectual functioning in this country. To achieve this purpose, I conducted two separate studies that, together, test the SA-WASI Vocabulary's potential as a screening tool, construct validity, relative item difficulty, and internal reliability consistency. More specifically, Study 1 (a secondary analysis of data collected in previous studies conducted by UCT's ACSENT laboratory) aimed to investigate the screening tool potential of the SA-WASI Vocabulary subtest, while Study 2 aimed to determine the construct validity of the subtest in relation to other tests of FSIQ. Study 2 also aimed to conduct individual item analyses to investigate additional psychometric properties of the subtest. Through the collection of original data, Study 2 built on the findings of Study 1, and allowed the item-level evaluation of the subtest. It thus enabled the construction of an effective abbreviated instrument that might be useful in resource-limited settings such as South Africa.

Below, I discuss the findings related to each of these aims separately.

Study 1: SA-WASI Vocabulary as an Estimate of FSIQ

The main aim of Study 1 was to investigate, using data from healthy children and adolescents, the utility of the SA-WASI Vocabulary subtest as a screening tool to estimate IQ in educational, clinical, and research contexts. The data was sampled from three independent studies conducted previously in our laboratory (Ferrett, 2011; Kilchenmann, 2011; van Wyhe,

2012). All participants in Study 1 were aged between 9 and 15 years, most had completed between 4 and 10 years of education, and most were Coloured, English home language-speakers.

Analyses suggested that, within this sample, there were no statistically significant sex differences with regard to age, years of completed education, race, and home language. Perusal of age-adjusted standard scores suggested that, relative to the US standardisation sample, the average participant in this sample scored in the range conventionally defined by Wechsler (1999) as Low Average on the SA-WASI Vocabulary subtest, SA-WASI VIQ, and SA-WASI FSIQ (i.e., a *T*-score score of between 37 and 42, and standard scores of between 70 and 85, respectively). Measures of variance indicated that performance on these measures was quite inconsistent across participants. Stepwise multiple linear regression analyses investigated this variance in performance. Participant race was the strongest sociodemographic influence on Vocabulary subtest *T*-scores, VIQ-, and FSIQ standard scores, explaining 22%, 28%, and 37% of the variance in these outcome variables, respectively. Participant age and sex had small but significant effects within two of those models (both age and sex for Vocabulary, and only sex for VIQ).

The race effect detected in Study 1 is consistent with previous research findings (Ferrett, 2011; Manly et al., 2002; Shuttleworth-Edwards et al., 2004). However, it is important to note that there is consensus in the literature that such findings are not explained by race per se, but by non-biological factors that race is believed to be a proxy for. These factors include: SES, access to high-quality education, quality of completed education, and parental education (Manly et al., 2002; Nell, 1994; Shuttleworth-Edwards et al., 2004). Substantial differences may have existed between Coloured and White participants in this sample with regards to these factors and could therefore provide explanation for the race effect that exists.

The screening tool potential of the SA-WASI Vocabulary subtest was investigated through a series of bivariate correlational analyses that estimated the construct validity of the subtest as a measure of VIQ and FSIQ. These analyses detected large, positive, and statistically significant relationships between *T*-scores on the subtest and SA-WASI VIQ and FSIQ standard scores, respectively. This finding, then, is evidence for the construct validity of SA-WASI Vocabulary subtest as a measure of verbal- and general intellectual functioning. This evidence, in turn, suggests that the SA-WASI Vocabulary subtest has good potential as a screening tool to estimate IQ in South African educational, clinical, and research contexts.

The current findings, which are the first to investigate the construct validity of the SA-WASI Vocabulary subtest, are consistent with those reported by Canivez et al. (2009), Saklofske et al. (2000), and Wechsler (1999), all of whom examined the construct validity of the original WASI Vocabulary subtest. In their sample of 152 children, adolescents, and adults, Canivez et al. (2009) found large, positive, and statistically significant correlations between scores on the subtest, on the one hand, and separate WASI VIQ and FSIQ scores, on the other. Similarly, Saklofske et al. (2000) found large, positive, and statistically significant correlations between scores on the subtest and VIQ and FSIQ outcome measures in a sample of Canadian schoolchildren ($N = 64$). Wechsler (1999) tested the construct validity of the WASI Vocabulary subtest during its development. In both the child and adult samples, the Vocabulary subtest had stronger correlations with the WASI VIQ and FSIQ estimates than all other WASI subtests.

Although these findings are promising, particularly given their consistency with similar studies elsewhere, there are additional steps one must take before strongly recommending the use of the SA-WASI Vocabulary subtest as an IQ screening tool. Study 2 addressed some of those steps.

Study 2: Construct Validity of the SA-WASI Vocabulary Subtest Relative to Other IQ Tests

The major aim of Study 2 was to determine the construct validity of the SA-WASI Vocabulary subtest (English version) in relation to other tests of FSIQ. In contrast to Study 1, this study used original data, collected from 36 English-speaking university students. A key difference between this study and Study 1 was that here I used three different IQ outcome measures: the SA-WASI and two criterion measures, the SILS-2 and KBIT-2.

The sample in Study 2 was relatively homogenous in terms of sex, age, current year of study, education, languages spoken, and SES. Analyses detected no significant association between these sociodemographic variables and performance on the IQ measures.

In terms of test performance, participants in this study performed as expected given their relatively high levels of education, English fluency, and SES. On average, the z -scores on the COWAT, the T -scores on SA-WASI subtests, and the standard scores on most other outcome variables fell within the range conventionally defined as Average (Benton et al., 1994; Kaufman & Kaufman, 2004; Portocarrero et al., 2007; Shipley et al., 2009; Tombaugh et al., 1999; Wechsler, 1999). On average, SA-WASI PIQ and SILS-2 Composite A standard scores fell within the High Average range. These results are consistent with previous South African research indicating that highly educated, English-speaking individuals in this country

perform just as well on IQ measures as the US standardisation samples do (e.g., Foxcroft & Aston, 2006; Grieve & van Eeden, 2010; Shuttleworth-Edwards et al., 2004). Although the sample was relatively homogenous, significant race group differences were found on SA-WASI FSIQ standard score performance. As previously discussed, the race effect that appears to exist here is likely explained by non-biological proxies for race for which detailed sociodemographic information was not available (Manly et al., 2002; Nell, 1994; Shuttleworth-Edwards et al., 2004).

To further validate the SA-WASI Vocabulary subtest, building on the results obtained in Study 1, I conducted a series of bivariate correlational analyses comparing subtest scores to those on criterion VIQ and FSIQ measures. The analyses detected moderate, positive, and statistically significant relationships between subtest *T*-scores and SILS-2 Vocabulary, and KBIT-2 Verbal standard scores, respectively. These results are consistent with those of Study 1 in suggesting that the SA-WASI Vocabulary subtest does in fact possess construct validity in its estimation of verbally-based general intellectual functioning. Separate analyses detected moderate, positive, and statistically significant relationships between Vocabulary subtest *T*-scores and SILS-2 Composite A, and KBIT-2 IQ Composite standard scores, respectively. Again, these results are consistent with those of Study 1 in suggesting that the SA-WASI Vocabulary subtest does in fact possess construct validity in its estimation of overall general intellectual functioning.

Although two previous studies have looked at the construct validity of cognitive tests (Raven's Advanced Progressive Matrices and Griffiths Scales of Mental Development) in South Africa (see Rushton, Skuy, & Bons, 2004; Luiz, Foxcroft, & Stewart, 2001), this is the first study to investigate the construct validity of any of the Wechsler tests in South Africa. However, the results from Study 2 are consistent with those of studies investigating associations between WASI, SILS-2, and KBIT-2 test performance. For instance, Shipley et al. (2009) found moderate-to-large correlations between WASI FSIQ and SILS-2 IQ Composite A scores within both adult ($n = 200$) and child ($n = 80$) samples from the US. In the same study, Shipley et al. (2009) found moderate-to-large correlations between WASI Vocabulary *T*-scores and SILS-2 Composite A standard scores. In a test review of the KBIT-2, Bain and Jaspers (2010) found, in their US sample of 80 children (ages 7-19) and 62 adults (ages 35-52), large correlations between that instrument's (a) verbal component and WASI VIQ scores, and (b) IQ Composite and WASI FSIQ scores. Bain and Jaspers (2010) also found moderate correlations, similar to those found in Study 2, between WASI Vocabulary *T*-scores and KBIT-2 IQ Composite standard scores.

The findings of Study 2 complement those of Study 1, in suggesting that the SA-WASI Vocabulary subtest has good potential as a screening tool for estimation of VIQ and FSIQ in South Africa. Although a screening tool of this nature would be advantageous, further reduction of its length would increase the ease of administration and decrease testing time. In order to investigate the possibility of such reduction, I conducted item-level analysis of the Vocabulary subtest. This analysis also sought to further confirm the subtest's psychometric soundness.

Study 2: Individual Item Analysis of the SA-WASI Vocabulary Subtest

Study 2 also aimed to assess the individual SA-WASI Vocabulary items in terms of relative difficulty and internal consistency reliability. I investigated the latter by calculating Cronbach's alpha correlation coefficient for the entire set of items, and then if individual items were deleted. Deletion of 22 of the 34 items improved alpha substantially, with further deletions leading to a decrease in the internal consistency reliability. Hence, I proposed an abbreviated SA-WASI Vocabulary subtest, consisting of 12 items.

The relative item difficulty of the full SA-WASI Vocabulary needed to be assessed to determine whether the subtest had a smooth linear trend of increasing difficulty, similar to that intended by the designers of the original WASI Vocabulary subtest. My analyses found that performance by the current sample on the SA-WASI Vocabulary was inconsistent with that intention: some items administered later in the subtest appeared to be easier for participants (i.e., many participants scored well on those items) than those administered earlier on in the subtest (i.e., fewer participants scored well on those items). This finding is problematic because the measure specifies a discontinue rule where testing should cease if the participant obtains a score of zero on five consecutive items. Hence, if several of the more difficult items are administered early, the subtest could be discontinued prematurely, and an inaccurate estimate of IQ might result. The consequences of this situation could be dire, regardless of the setting in which it is being utilised.

Furthermore, I analysed the raw data from the 12 items of the abbreviated SA-WASI Vocabulary to evaluate relative item difficulty. The 12-item subtest had an improved relative item difficulty trend, but the order of the items in the middle of the test were still causing peaks and valleys in the trend line. These items were therefore re-arranged before reaching a final proposed order of administration of this 12-item subtest. This proposed order of administration is: 9 - *bird*, 10 - *calendar*, 31 - *complicated*, 33 - *haste*, 24 - *entertain*, 32 - *impulse*, 20 - *cart*, 41 - *ruminare*, 35 - *intermittent*, 40 - *formidable*, 37 - *impertinent*, and 42 - *tirade* (see Appendices E and F for the test sheet and scoring manual).

This 12-item SA-WASI Vocabulary subtest starts and ends with the same items that the original SA-WASI subtest did, but the order of items administered in the body of the subtest have been significantly re-arranged to obtain the optimum trend of increasing relative item difficulty. Of the nine items that Ferrett (2011) adapted within the SA-WASI Vocabulary subtest, only one is included in the abbreviated version of the Vocabulary subtest (item 31 - *complicated*).

Finally, I tested the construct validity of the proposed 12-item subtest using similar bivariate correlational analyses as before. The first set of analyses detected moderate-to-large, positive, and statistically significant relationships between scores on the 12-item subtest and standard scores on the (a) SILS-2 Vocabulary index, (b) KBIT-2 Verbal index, and (c) SA-WASI VIQ index. The second set of analyses detected moderate, positive, and statistically significant relationships between scores on the 12-item SA-WASI subtest and standard scores on the (a) SILS-2 Composite A index, and (b) KBIT-2 IQ Composite index. Taken together, these results suggest that, even though 22 items had been removed from the Vocabulary subtest, the abbreviated version had good construct validity and moderately estimated FSIQ when comparing it against criterion measures. The correlations obtained from these two sets of analyses are comparable to those rendered when assessing the full SA-WASI Vocabulary subtest against the aforementioned measures. These results are promising as they illustrate the feasibility of utilising the 12-item subtest in place of the original version. The most promising result, however, was the large, positive, and statistically significant relationship between the 12-item Vocabulary subtest and SA-WASI FSIQ standard scores. In sum, these findings suggest that the 12-item SA-WASI Vocabulary subtest is a good estimate of verbal- and general intellectual functioning, and has strong potential to be utilised as an IQ screening tool in South Africa.

Limitations and Directions for Further Research

The first major limitation was the relatively limited dataset used in Study 1. I was unable to access a significant amount of sociodemographic information and raw performance data regarding participants. Future research should aim to investigate additional sociodemographic characteristics and the effects that they have on IQ variables; especially those pertaining to SES, access to high-quality education, quality of completed education, and parental education to explore the reported between-race-group differences. Furthermore, raw data should be used to conduct item-level analyses similar to those featured in Study 2. These analyses are particularly important because the relative item difficulty and internal

consistency reliability within child and adolescent samples may differ from those within adult samples.

A second limitation is that items 1-8 of the SA-WASI Vocabulary subtest were not analysed as only individuals over the age of 9 years were included in Study 1 and Study 2. The WASI (and SA-WASI) administration rules dictate different starting points for various age bands. Individuals aged 9 years and older begin their administration at item 9, whereas those aged 6-8 years start at item 5. The first four items are only tested when the reverse rule applied, i.e., if a participant aged 6-8 years obtains a score of zero on either item 5 or item 6 (Wechsler, 1999). It would be beneficial if future investigations obtained data from individuals younger than 9 years of age, so that one could gather information about performance on items 1-8, and then adapt the instrument for use as a screening tool across the entire age range for which the WASI is applicable.

A third limitation is that, although the 12-item SA-WASI Vocabulary subtest should, in principle, be applicable to individuals across the age range of 9-89 years, this screening tool was developed solely on the basis of results obtained from a sample aged 18-25 years. A direction for future research should be to assess SA-WASI Vocabulary performance across the entire 9-89 age range. The construct validity of this screening tool should furthermore be assessed on the basis of that performance, and additional analyses should assess whether the same 12 items hold the screening tool strength that this study found them to possess. Norms within these age bands could also be created so that one is able to accurately interpret the 12-item subtest total scores out of a possible 24 points.

A fourth limitation is that this screening tool was developed using an English-speaking adult sample. The measures within Study 2 were all administered in English, and therefore the Afrikaans and isiXhosa versions of the SA-WASI (Ferrett, 2011) were not investigated. In conjunction to assessing performance across various age bands, research should also be conducted across different language groups. If screening tools could be created from the Afrikaans and isiXhosa versions of the SA-WASI, the utilisation of such tools could span a much larger proportion of the South African population given that almost 40% of the South African population is either first-language English-, Afrikaans-, or isiXhosa-speaking (Statistics South Africa, 2011).

Summary and Conclusion

In South Africa, there is a dire need for brief, psychometrically-sound screening tools that quickly identify whether an individual is cognitively impaired or not while simultaneously minimising the administration time, costs, and expertise involved in

assessment (Bernard et al., 1998; Manly et al., 2002; Joska et al., 2016; Myer et al., 2008; Robbins et al., 2013; Robertson et al., 2009). Although the original WASI was designed as a short, reliable measure of intelligence and has since been used as a screening tool, the further reduction of this instrument so that it can be used as a brief screening tool could prove extremely beneficial, especially in resource-limited low- and middle-income countries such as South Africa (Canivez et al., 2009; Lange & Iverson, 2008; Robbins et al., 2013). Because this study found that the SA-WASI Vocabulary subtest possessed strong construct validity in estimating both VIQ and FSIQ, using it as a screening tool is feasible.

Furthermore, analyses reported here provided evidence for the value of reducing the Vocabulary subtest to 12 items. This abbreviated subtest proved to be psychometrically promising, with high internal consistency reliability and VIQ- and FSIQ construct validity. Utilising a screening tool of this length could provide an estimate of IQ in resource- or time-limited clinical settings; with proper standardisation and collection of normative data, it would reduce the amount of expert interpretation required and be used easily by lay professionals. It could also be extremely beneficial for use in research studies that require certain eligibility criteria to be met before the completion of cognitively complex tasks or to determine whether further neuropsychological testing is required. These features are especially appealing within South Africa, where resource-limited educational, clinical, and research settings are further marked by the presence of relatively few trained psychometricians, clinical psychologists, and especially neuropsychologists (Joska et al., 2016; Watts & Shuttleworth-Edwards, 2016; Witten, 2015).

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Appendix A
Ethical Approval Letter

Appendix B
SRPP Email

Announcement

Subject Get next semester's SRPP points in early!
Saved by Tara Cawthra
Modified date 15-June-2016
Groups site

Message

Hi all,

I am running a psychometric research study through the Department of Psychology. The project aims to validate the South African adaptation of the Wechsler Abbreviated Scale of Intelligence (SA-WASI) through the comparison of scores on this test to scores on other brief measures of intelligence.

In order to participate in this study you need:

- 1. To be a fluent English-speaker**
- 2. To be between the ages of 18-25**
- 3. NOT have a history of psychological, psychiatric or neurological disorders**
- 4. NOT currently be taking any psychiatric/chronic medication**

If you meet the aforementioned criteria, you can sign up on the 'Sign-up' tab on this Vula site. Please do not sign-up if you are not eligible. Please take note of the time and date of your slot if you sign-up.

Upon arrival, you will complete two administrative forms. An English fluency task will then be administered as a screening tool. If you ARE NOT found to be English-fluent, you will receive **1 SRPP point** for your participation. Participation up to this point will take approximately 30 minutes.

If you ARE found to be English-fluent, I will go on to administer the other psychometric tests after which you will receive **4 SRPP points** for your 120 minutes of participation in the full study.

If you have any further questions with regards to this study, please email me on taracawthra@gmail.com.

Regards,
Tara Cawthra

Disclaimer:

It is generally accepted that the decision to include or exclude individuals from participating in a study depends on the focus, objective, nature of research and context in which the research is conducted. Some research may be focused on a certain individual (such as in a person's life history), or a group of individuals who share a specific characteristic (e.g., an identifiable group of asthma sufferers who happen to be all of one sex; a religious order that is restricted to one sex). Other examples include research that is focused on specific cultural traditions or languages, or on one age group (e.g., a study of posture corrections in adolescents). These are regarded as appropriate forms of inclusion and exclusion of individuals or groups in research studies - so long as the selection criteria for those to be included in the research are relevant to answering the research question.

Appendix C
Sociodemographic Questionnaire

UNIVERSITY OF CAPE TOWN

Department of Psychology

SOCIODEMOGRAPHIC QUESTIONNAIRE

A. DEMOGRAPHICS

Sex: _____

Race: _____

SES (low, middle, or high): _____

Age: _____

Date of birth: _____

Language spoken at home: _____

Language you consider your first language: _____

Other languages in which you are fluent: _____

B. EDUCATION

In what setting were the majority of your schools? Rural/Urban (circle one)

In what language were you educated? _____

What was the name of your high school? _____

Was this school a public or a private school? Public/Private (circle one)

Have you completed any qualifications post-matric? Yes/No (circle one)

If yes, please specify what qualifications: _____

What year of study are you currently in? (e.g. 1st, 2nd) _____

How many years of education have you completed? _____

What degree are you studying towards? (e.g. BA, BSc) _____

What are your majors? _____

C. GENERAL INFORMATION

What area did you live in while growing up? _____

Have you ever been or are you currently diagnosed with a psychological, psychiatric, neurological or learning disorder? Yes/No (circle one)

If yes, please specify what disorder(s): _____

Are you currently taking any psychiatric/chronic medications? Yes/No (circle one)

If yes, please specify what medication(s) you are taking: _____

Appendix D
Informed Consent Form

UNIVERSITY OF CAPE TOWN

Department of Psychology

INFORMED CONSENT

Validity of the South African adapted Wechsler Abbreviated Scale of Intelligence Research Study

This form provides you with information about this study and seeks your informed consent to participate. Before you agree to take part in this study, please read the information below and ask the researcher (Tara Cawthra) questions about anything that you do not understand. The data collected in this study is to be used towards the completion of an Honours degree in the Department of Psychology at the University of Cape Town.

Study Purpose

The purpose of this research is to attempt to validate the South African adaptation of the Wechsler Abbreviated Scale of Intelligence (SA-WASI) through the comparison of scores obtained on this test with scores obtained on other brief measures of intelligence.

Participation Tasks and Benefits of Participation

If you agree to participate in this study, you will complete a demographic questionnaire after which verbal fluency tasks will be administered as a screening tool to determine whether or not you are English-fluent. If you are not English-fluent, testing will come to an end and you will receive 1 SRPP point for your participation. Participation up to this point will take 30 minutes. If you are found to be English-fluent, the researcher will administer three brief measures of intelligence (SA-WASI, Kaufman Brief Intelligence Test, Second Edition and the Shipley Institute of Living Scale-2) after which you will receive 4 SRPP points for your participation in this study. Participation in the full study will take approximately 120 minutes.

Participation, Withdrawal, Confidentiality and Risks

Participation in this study is completely voluntary and you may withdraw from the study at any time without any consequences. All information will be treated with confidentiality; at no point will your name or personal details be disclosed to anyone other than the researcher. There are no foreseeable risks involved in this study and there are no costs involved on your behalf.

I, _____, give my informed consent to participate in this study.

Signature: _____ Date: _____

Researcher's Signature: _____ Date: _____

Course code for SRPP points to be assigned to: _____

If you have any further questions or concerns about the study, you can contact the researcher (Tara Cawthra) on taracawthra@gmail.com or supervisor Dr Kevin Thomas on kevin.thomas@uct.ac.za for ethical concerns contact Mrs Rosalind Adams on 021 650 3417 or rosalind.adams@uct.ac.za

Appendix E**12-Item SA-WASI Vocabulary Subtest: Test Sheet**

SOUTH AFRICAN-ADAPTED WECHSLER ABBREVIATED SCALE OF INTELLIGENCE

12-ITEM VOCABULARY SUBTEST

Test Sheet

Name: _____ ID: _____
 Date of Birth: _____ Age: _____
 Address/School: _____ Grade: _____
 Examiner: _____ Date: _____

Instructions:

Start Point: Start at Item 1 and administer all items.

Discontinuance Rule: Stop testing after 5 consecutive scores of 0.

Scoring: Score items up to discontinuance point (i.e., 5 consecutive scores of zero).

Item	Response	Score
1. Bird		
2. Calendar		
3. Complicated		
4. Haste		
5. Entertain		
6. Impulse		
7. Cart		
8. Ruminare		
9. Intermittent		
10. Formidable		
11. Impertinent		
12. Tirade		
TOTAL		/24

Appendix F

SA-WASI 12-Item Vocabulary Subtest: Scoring Sheet

SOUTH AFRICAN-ADAPTED WECHSLER ABBREVIATED SCALE OF INTELLIGENCE

12-ITEM VOCABULARY SUBTEST

Scoring Manual

Instructions:

Scoring: Score items up to discontinuance point (i.e., 5 consecutive scores of zero).

Item	Response	Score
1. Bird	It could be a pet Q It lives in a tree Q It's pretty	0
	It flies Mammal that flies (sings, has wings) It has wings (feathers, a beak) Q It sings (in the spring) It makes nests Chicken Hawk Parakeet Cardinal etc.	1
	A feathered creature that flies An animal (that can fly) A winged animal that has feathers on its body Fowl	2
2. Calendar	Can carry one with you Wall calendar Made of paper It tells you what time it is Q	0
	Schedule Appointment book It helps you plan (your time or schedule) It shows which days are holidays It has the days (months, years) Q	1
	It tells you what day and month it is Something that tells you the date An orderly list of the days of the week and months of the year	2
3. Complicated	Can't get it right / solve it Can't explain it Don't understand it Not understandable Problematic Struggle to do	0
	Not straight-forward Hard / not easy Complex Tricky Not clear Confusing / made up of different parts Mixed-up / not well defined	1
	Something that is made up of intricate parts or aspects that are difficult to understand or analyse Not easily comprehended or understood Not simple (Very) involved Not as easy as it seems Not easily worked out/resolved Difficult to analyse or explain Not easy to find an answer Not easy to explain Hard to explain (Very) difficult Intricate	2
4. Haste	Wasting time Haste makes waste	0
	Carelessness Do something without care (thinking) Quickly Fast Quick	1
	Hurry Rashness Rush Swiftmess Quickness Rash action Done quickly Speed Rapidity of motion Moving rapidly In a hurry Do something fast	2
5. Entertain	To have fun Q Take care of	0

	To perform To keep someone (you) busy Q Putting on a show A comedian, TV, or radio can entertain you Activity to provide amusement Enjoyment A person who amuses others To make people laugh (happy) Q Play a musical instrument (Sing, Dance, Tell jokes) Q	1
	Amuse Contemplate Consider To provide diversion To show a good time To keep occupied (hold the attention of) To perform (sing, dance) for others' enjoyment To make others laugh with your actions To think about (consider) something To host a party (social event) To extend hospitality toward	2
6. Impulse	Wanting to do something Q You did it automatically Q Sudden Q I did it on impulse Q	0
	Spontaneity Q Urge; Drive; Momentum Q Spur of the moment Q To act (do something) on a whim (on the spur of the moment, without thinking) Q A quick moment of decision making Q Impetuous; Spontaneous Q An instinctive (involuntary, immediate) response or reaction; Reaction Response	1
	Impetus An urge for sudden action Sudden urge An inner drive that makes you do something on the spur of the moment (without thinking) A feeling which compels you to do something Stimulus transmitted in a muscle or nerve fibre	2
7. Cart	A horse pulls it Q For transportation Q You push (pull) it Q	0
	Something you drive around in when you play golf Something you put (carry) things in (when shopping) You load things in it and use it to carry things around Something you push that holds things Haul Carry A box with wheels Grocery basket Way of transporting goods A container that holds stuff Q	1
	Small-wheeled vehicle used to store or carry things Something that has wheels and carries things Wheeled vehicle drawn by a horse (pony, dog) Wagon Buggy Wheelbarrow	2
8. Ruminare	To talk about something Q To remember something I ruminate about my taxes Q	0
	Something to do with thinking Q To lament about past events To think about Q To worry excessively (about things that aren't there) Q To dwell on something Q An animal that eats grass (that has more than one stomach) Digest Q	1
	Reflect Ponder Cogitate Muse Contemplate To chew (the cud) To thoroughly consider To go over in the mind repeatedly Mull (think) over	2
9. Intermittent	It occurs on a regular sequence Intermittent showers A pause A break Q Something comes between other things Q In between In the middle Q Scattered Q	0
	Put time between Q Unpredictable occurrence of some action Q Like your windshield wipers are going at different times	1
	Periodic Occasional Spasmodic Sporadic Every now and then Coming and going at intervals To happen in an irregular pattern Something that starts then stops Not continuous With interruptions Without synchronicity On-again, off-again, not steady Erratic Inconstant Irregular	2
10. Formidable	Worthy opponent Q ; Worthy; Great Q ; A formidable intellect	0
	Difficult; Hard; Tough; Scary Q Overwhelming; Challenging Q ; Competitive; Strong Q Strenuous; Laborious; Toilsome Q Powerful Q Something to be respected; An opponent with superior abilities to yourself Q	1
	Daunting Awesome Awful Appalling Dreadful Horrible Horrifying Terrible Intimidating Threatening Ominous Difficult to defeat or overcome Presents a difficult, challenging or overwhelming obstacle Imposing Gives the impression of	2

	having great strength and authority	
11. Impertinent	Foolish Pretentious Q Cocky Smart	0
	Obnoxious; Disobedient Q Unessential; Insignificant; Unimportant Q Intrusive; Meddlesome Q Not necessary Q Not pertaining to the current subject Someone that gets on people's nerves Annoying Q Not a very nice person Q Sarcastic and smart-alecky Not to the point Q Fresh	1
	Irrelevant Impudent Brazen Saucy Sassy Pert Insolent Rude Disrespectful Flippant Lack of etiquette Out of line and disrespectful Something that is not appropriate	2
12. Tirade	A tantrum A temper tantrum A fit of anger Lose one's temper Outburst Q A fit of inner feeling Rampage A commotion Associated with violence and anger, letting go of human or natural control Upheaval Raising Cain To be forceful and angry Bossy person Q	0
	Verbal fuss Yelling To yell A scolding Argument Flood of words A speech A long speech	1
	A long emotional speech marked by anger or censure Ranting and raving Laying into somebody verbally Verbal tantrum Verbal browbeating Volume of rapid language, generally some quality, such as punishment, about it An angry speech A harangue Hostile flow of words Cussing somebody out, having a go at them	2