A Linguistically Fair IQ Screening Tool for South Africa's Multilingual Reality

Julian M. Siebert

ACSENT Laboratory

Department of Psychology

University of Cape Town

Supervisor: Kevin G. F. Thomas

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Abstract

Neuropsychological assessment in linguistically heterogeneous settings is a complex undertaking. In South Africa, interpreting test performance relative to normative data from the global north can lead to serious misdiagnoses. This problem is exacerbated by the question of which language(s) to use when assessing multilingual individuals, because different test-related concepts may be accessible to them via different languages. This research attempts to provide a solution to both problems: It aimed to create a linguistically fair, inherently multilingual IQ screening tool, allowing multilingual English/Afrikaans/isiXhosa test-takers to draw on multiple languages when completing the measure, and predicting their intelligence more accurately than currently used monolingual tools. The newly developed Multilingual Vocabulary Test (MVT) was evaluated in two studies. Using a sample of undergraduate students (N = 65), Study 1 reports internal consistency values of α = .37 and α = .24 for a pen-and-paper and a digital version of the MVT, respectively, and correlations of r = .52 and r = .21 with two criterion measures, the 12-Item SA-WASI Vocabulary Subscale (Cawthra, 2016) and Raven's Advanced Progressive Matrices (APM), respectively. Study 2, using a different sample of university students (N = 248), reports an increased internal consistency of α = .77 and provides evidence that—in contrast to the criterion measures—the digital version of the MVT is largely unaffected by dominant language, language first acquired, and number of languages. Even though the psychometric analysis demands further improvements, the instrument's resistance to linguistic factors renders it an appropriate tool to assess multilingual individuals. Thus, the MVT provides a promising first step on the way toward more linguistically fair intelligence testing.

A Linguistically Fair IQ Screening Tool for South Africa's Multilingual Reality

Neuropsychological assessment in culturally and linguistically heterogeneous settings is a complex undertaking. In such settings, it is likely that not all test-takers match the characteristics of the test's, or the test battery's, standardization sample (Foxcroft, Roodt, & Abrahams, 2005; Watts & Shuttleworth-Edwards, 2016). Such mismatches can lead to serious misdiagnoses based on inappropriate interpretations of test performance (Foxcroft, 1997; Raven, 2000; Shuttleworth-Edwards & Kemp, 2004). It comes as no surprise, then, that Razani, Murcia, Tabares, and Wong describe the lack of appropriate measures to test cognitive ability in linguistically diverse populations as "one of the most serious challenges facing the field of neuropsychology" (2007, p. 107). I address this challenge by presenting and analysing a multilingual screening tool for intelligence that allows test-takers to draw on their knowledge in multiple languages, thus resulting in what might be a more accurate representation of their overall intellectual ability than commonly used monolingual tools (Bialystok, Craik, & Luk, 2012).

Clinical neuropsychologists in low- and middle-income countries are faced with the challenge of testing multilingual clinical populations particularly often (Ferrett, 2011; Sabanathan, Wills, & Gladstone, 2015; Semrud-Clikeman et al., 2016). With its 11 official languages, and an ethnically and genetically diverse population, South Africa is a prime example of a setting where the plurality of languages presents great challenges to neuropsychological assessment (Foxcroft, 1997; Watts & Shuttleworth-Edwards, 2016).

Further, Cockcroft, Alloway, Copello, and Milligan (2015) point out that, although the country's socioeconomic profile has changed significantly since the end of apartheid, research in the field has not kept in step with those changes. Especially in the early days of democracy (i.e., immediately after 1994), very little research into linguistic biases in South African psychometric testing was published (Foxcroft, 1997). Only recently did this undertaking gain momentum, with multiple studies exploring the development and norming of culturally and linguistically fair measures (see, e.g., Cawthra, 2016; Cockcroft et al., 2015; Ferrett, 2011; Foxcroft & Aston, 2006; Knoetze, Bass, & Steele, 2005; van Wyhe, 2012).

The decades-long lull in serious work considering ways to overcome those linguistic biases resulted in (a) a paucity of tests available in South African languages other than English and Afrikaans (Foxcroft & Aston, 2006; van Dulm & Southwood, 2013; van Wyhe, 2012), (b) a lack of normative data applicable to the vast majority of the South African population (Ferrett, 2011; Foxcroft, 2004), (c) a general absence of knowledge about, and

consequent adherence to, international psychometric standards (Nell, 2000), and (d) an almost complete unavailability of tests well suited to the multilingual reality experienced by the majority of South Africans, as well as by a growing number of individuals worldwide (Shuttleworth-Edwards, 2016; van Dulm & Southwood, 2013). Consequently, South African neuropsychologists have, for the most part, been forced to resort to assessment tools developed in the global north, and normed and standardized on Western (predominantly urban, white, industrialized, and English-speaking) populations (Cockcroft et al., 2015; Ferrett, 2011; Foxcroft et al., 2005).

In response to this lack of appropriate and useful tests with accompanying normative data, South African neuropsychologists regularly point out the need for locally appropriate normative data (Ferrett, 2011; Foxcroft, 1997). Even where locally developed population norms are available, their utility for South Africa's heterogeneous population is questionable. Thus, some scholars have suggested the field shift its focus from developing population norms to developing carefully and finely stratified norms for various subgroups of the population (Shuttleworth-Edwards, 2016). While the debate rages about whether there is greater utility in population norms or stratified norms (Lezak, Howieson, Bigler, & Tranel, 2012; Shuttleworth-Edwards, 2017; Taylor, 2016), some researchers in South Africa have taken to working on generating local adaptations and collecting normative data for tests used frequently in clinical practice (see, e.g., Cawthra, 2016; Ferrett, 2011; van Wijk & Meintjes, 2015; van Wyhe, 2012).

Currently, the most progressive measure in this regard is the South African-adapted Wechsler Abbreviated Scale of Intelligence (SA-WASI). In an attempt to address the paucity of appropriately stratified normative data for South Africa samples, Ferrett (2011) and van Wyhe (2012) developed Afrikaans and isiXhosa translations of the WASI and collected some preliminary normative data specific to test-takers' population group and level of education. Of particular interest here is a recent study by Cawthra (2016) suggesting that the (English) SA-WASI Vocabulary Subtest can successfully predict general intellectual functioning.

Although the local adaption of the WASI and the development of stratified normative data based on local samples are steps in the right direction, South African neuropsychologists need to turn to what is perhaps a more pressing issue: the reality of a multilingual South Africa. The (admittedly small) set of locally normed measures of intelligence are heavily linguistically biased. For instance, the SA-WASI has only been tested with speakers of English and Afrikaans (Cawthra, 2016; Ferrett, 2011; van Wyhe, 2012), even though only 9.6% and 13.5% of the South African population speak English and Afrikaans, respectively,

as their home language. The remainder speaks one of the nine other official languages—mostly isiZulu (22.7%) and isiXhosa (16%; Statistics South Africa, 2012). In the Western Cape province, where the SA-WASI was developed, almost a quarter of the population (approximately 1.4 million people) is overlooked by virtue of the fact that the measure has not been normed for isiXhosa.

So, although the developments described above follow a promising trend, a key question facing South African cross-cultural neuropsychology remains unaddressed: Which of a multilingual's languages is the best one to use in neuropsychological testing? Although it seems common sense that individuals are best tested in their home language, Nell (1999) cautions against this belief, arguing that individuals may have acquired concepts featuring in the measure via their medium of educational instruction (Griessel, 2005). Referring to personal communications with Van den Bergh, Nell further notes:

> [L]anguage is the most important single moderator of test performance, since the language in which the test is administered may make a range of concepts available to a non-native speaker of that language that are inaccessible in the speaker's home language, or, conversely, the translated version of a western test may deny the testee access to the language medium through which he or she has acquired most of his or her knowledge and experience (1994, p. 107).

In South Africa, individuals' home language and language of education often differ, or change in the course of their education (Cockcroft et al., 2015). In the Western Cape, coloured and black South Africans—with predominantly Afrikaans and isiXhosa, respectively, as their home languages—are particularly affected by this language bias. Grieve (2005) speaks of a double disadvantage: Their knowledge of English—even though it is their medium of educational instruction—is not at the same level as that of native English-speakers, and, at the same time, schooling in English hampers the development of their native languages. It is important, here, to differentiate between a multilingual's apparent conversational fluency and their test-readiness (Hebben & Milberg, 2009).

Moreover, as pointed out by Ferrett (2011), both Afrikaans and isiXhosa are particularly dynamic languages, heavily influenced by and with many borrowings from English (e.g., the isiXhosa word *i-radio*). High occurrences of code-switching—the transition from one language to another within a sentence or conversation (McCormick, 2002)—from Afrikaans and isiXhosa to English and vice-versa further blurs the lines between the different languages. The fact that each individual might have a unique and fluid pattern of

multilingualism renders the task of identifying the most appropriate test language a difficult one (Grosjean, 1989).

Taking into consideration this multilingual experience, any monolingual cognitive test (regardless of language) might underestimate a multilingual individual's true intellectual capabilities. A multilingual's total knowledge has been acquired via multiple languages and is thus likely not accessible via only one language (Hebben & Milberg, 2009). Hence, given that the majority of coloured and black South Africans grow up speaking multiple languages (either by choice, by circumstance, or by coercion, and to various degrees of fluency), it is only fair to assess them using a multilingual tool (Foxcroft, 1997; Hebben & Milberg, 2009). This speaks to Grosjean's (1989) cautioning call that, as "half the world's population is bilingual [, ...] using the monolingual as a yardstick is questionable" (1989, p. 14).

In conclusion, one has to remain cognisant of the fact that cross-cultural neuropsychological literature warns us that assessment results based on inappropriate (in this case, Western) norms are meaningless, and potentially dangerous, as in the case of false diagnoses (Foxcroft, 1997; Shuttleworth-Edwards & Kemp, 2004). Thus, linguistically heterogeneous settings like South Africa require neuropsychological measures that are linguistically sensitive, and whose results can be interpreted using appropriately stratified normative data. Given the central role language plays in testing, and the multilingual experiences of most South Africans, the development of an inherently multilingual screening measure of intelligence (as opposed to translations of a foreign-language measure into the test-taker's language) is of utmost importance to South African neuropsychologists.

Study Aim and Research Question

This study proposes a solution to a pressing and controversial problem facing cognitive assessment—that of which language(s) to use when assessing multilinguals. It does so by describing the development and testing of a multilingual intelligence screening tool. Study 1 assessed the criterion validity of the newly-developed Multilingual Vocabulary Test (MVT) by correlating individuals' performance on both a a pen-and-paper (p-MVT) and a digital (d-MVT) version of that instrument with that on two established measures of verbal and general intelligence, using a sample of undergraduate students at the University of Cape Town (UCT). Study 2 gathered additional data from a broader population, presenting more empirical evidence in support of the MVT's ability to predict IQ. Ultimately, this study paves the way toward more linguistic fairness in the realm of intelligence testing.

STUDY 1:
MVT Development and Preliminary Analysis

The aim of Study 1 was to provide a preliminary analysis of the internal consistency and criterion validity of the newly developed MVT. The pen-and-paper and the digital version were administered to a sample of UCT undergraduate students, analysed separately, compared to one another, and compared to the other outcome variables.

Methods

Design and setting. The study used an intra-individual repeated-measures design. Specifically, I correlated participants' performance on the MVT with their performance on two criterion measures: the 12-Item SA-WASI Vocabulary Subtest (Cawthra, 2016), and Raven's Advanced Progressive Matrices (Court & Raven, 1993; Raven, 2000). Most study procedures were conducted at the UCT Department of Psychology's ACSENT Laboratory; two questionnaires were administered online.

Participants. Initially, I enrolled 67 participants, but I had to exclude two datasets from the analysis, as their survey data were incomplete. Thus, the final sample (N = 65) consisted of 46 women and 19 men, aged 18-29 years (M = 20.46, SD = 2.49). They had completed 11-19 years of education (M = 13.60, SD = 1.52) and were currently studying toward a humanities undergraduate degree at UCT.

I used G*Power (Faul, Erdfelder, Buchner, & Lang, 2009) to obtain a post-hoc power analysis with α = .05, number of predictors = 4, and n = 34. Given that the MVT is a new measure, I could only estimate effect sizes. With effect size estimates of Cohen's f = .66 (corresponding to a partial R^2 value of .40), the software computed an achieved power of .97. With smaller effect size estimates f = .43, R^2 = .30 and f = .25, R^2 = .20, the computed power dropped to .86 and .63, respectively.

Recruitment. I recruited participants using convenience sampling from UCT's undergraduate student population via the Department of Psychology's Student Research Participation Programme (SRPP), and other departments' student mailing lists. In both cases, participants were invited to the study via email (Appendix A).

Eligibility criteria. The study only enrolled individuals who were (a) multilinguals self-reporting English and Afrikaans and/or isiXhosa as their home languages, and (b) aged 18-34 years, an age range consistent with that of the Wechsler IQ scales' reference group (Wechsler & Zhou, 2011). Individuals who self-reported psychological, psychiatric, or neurological disorder, as well as those taking any kind of chronic medication, were excluded from participation.

Measures. In addition to the newly developed MVT, I used four other measures, all of which I describe below.

Sociodemographic questionnaire. This online self-report instrument (Appendix B) gathers demographic and socioeconomic data. The obtained data allowed me to enter into my statistical models factors shown by previous studies to affect cognitive performance, such as age, sex, and level and quality of education (Ferrett, 2011; Grieve, 2005; Hebben & Milberg, 2009). The measure also recorded the race participants identified with, as many previous studies use this variable to approximate the above socioeconomic factors (see, e.g., Cawthra, 2016; van Wyhe, 2012).

Adapted Language Experience and Proficiency Questionnaire. This instrument (Appendix C) is based on the Language Experience And Proficiency Questionnaire (Marian, Blumenfeld, & Kaushanskaya, 2007). The measure collects information on participants' linguistic profile (e.g., acquisition order, dominance ratings, and years spent in each language environment), which served to identify predictor variables affecting performance on the MVT and the criterion measures.

For the purposes of this study, I adapted the LEAP-Q, originally published in English, to the South African linguistic context and to online administration. Specifically, native speakers of Afrikaans and isiXhosa, as well as university lecturers in relevant departments, assisted with translation and back-translation procedures. The LEAP-Q developers have previously successfully translated the measure into 16 languages without forfeiting construct validity (Bilingualism and Psycholinguistics Research Group, 2017), bolstering confidence in the translations used here.

The sociodemographic questionnaire and the adapted LEAP-Q were administered in a combined survey, hosted on the SurveyMonkey platform (www.surveymonkey.com).

Raven's Advanced Progressive Matrices. The APM (Court & Raven, 1993) is a brief nonverbal measure of the fluid intelligence component of general intelligence (*g*; Spearman, 1904). It measures abstract reasoning via an assessment of the test taker's ability to complete matrices of black-and-white geometric design patterns. Test takers see a pattern with a missing piece in the bottom-left corner and are required to select from eight response options the one piece that logically completes the pattern. It comprises a set of 36 items, preceded by a 12-item practice set (Kaplan & Saccuzzo, 2005). The APM is widely considered the closest possible approximation of fluid intelligence and, by some, even the closest approximation of *g* (Mackintosh, 1998; Strauss, Sherman, & Spreen, 2006). The instrument is reported to have internal consistency of $\alpha = .87$ and test-retest reliability of >.90 (Raven, Raven, & Court,

1998). To avoid fatigue effects, I opted to use the 20-minute timed version (see Hamel & Schmittmann, 2006).

I strictly followed the procedure outlined in the administration manual (Raven et al., 1998): First, I explained to participants how to correctly respond on the answer sheet provided, which they used for both the practice set and the test set. Then, using the practice set, I explained the task to the participants, illustrating it by pointing out the pattern in item 1, the cut-out patch, and the eight answer options. Next, I ran a finger along the horizontal and vertical lines in the pattern and elicited a response. I indicated incorrect responses and encouraged repeated trials. The process was repeated for the second item. If answered correctly, I instructed participants to complete the practice set in their own time, and ensured they understood the measure, before proceeding to the 20-minute timed task, using the 36-item set. After 10 minutes, I alerted participants to the fact that half of their allotted time had elapsed.

Despite being criticised in the debate surrounding culture-free testing, the APM is commonly considered one of the best approximations of culture-fair testing (Shuttleworth-Edwards & Kemp, 2004; Strauss et al., 2006). Some evidence for this claim comes from studies that assessed the APM's cross-cultural validity amongst a heterogeneous group of South African students. Its scores were found to be equally valid for black, Indian, and white individuals (Rushton & Skuy, 2000; Rushton, Skuy, & Bons, 2004). Although there are conflicting findings for other ethnic subgroups within South Africa (see, e.g, Grieve & Viljoen, 2000), the preponderance of the evidence suggests it is the best available measure for the purposes of studies such as this one.

12-Item SA-WASI Vocabulary Subtest. This measure (Appendix D) is an adaptation of the monolingual English SA-WASI Vocabulary Subtest (Ferrett, 2011), which measures verbal knowledge and expressive vocabulary (Wechsler, 2008; Wechsler & Zhou, 2011), and which has been found to be a reliable predictor of crystallised intelligence and of *g* (Abu-Hilal, Al-Baili, Sartawi, Abdel-Fattah, & Al-Qaryouti, 2011; Canivez, Konold, Collins, & Wilson, 2009; Saklofske, Caravan, & Schwartz, 2000). The measure is untimed and administered orally; participants are required to provide the meaning of words presented to them by the experimenter, one at a time. Cawthra (2016), performing an item analysis, showed that step-by-step deletion of 22 (out of the original 34) items increased Cronbach's alpha from .72 to .82. The remaining 12 items are presented in graded order, from least to most difficult, based on relative item difficulty. The shortened measure has high construct

validity, correlating strongly with SA-WASI Verbal IQ (VIQ) and Full Scale IQ scores, r = .76 and .70, respectively, both ps < .001 (Cawthra, 2016).

Multilingual Vocabulary Test. One of the major aims of this research was to develop this multilingual (Afrikaans/English/isiXhosa) instrument. The MVT was modelled on the SA-WASI Vocabulary Subtest described above. To meet clinicians' need for a quick IQ screening tool, and given Cawthra's (2016) successful abbreviation of the SA-WASI Vocabulary Subtest, the MVT also features 12 items.

Development. The multilingual nature of the measure required a carefully planned word-selection process. To address South Africa's multilingual reality, and to maintain fairness, items were translations of the same concept into Afrikaans, English, and isiXhosa. Items were chosen based on similar frequency of occurrence, and similar syllable length across the three languages. Native Afrikaans and isiXhosa speakers, and university lecturers in the relevant language departments, suggested items, translated and back-translated words meeting the above criteria, and provided culturally appropriate definitions to be used in the scoring rubrics.

Format and administration. The MVT was developed in both a paper-and-pencil (p-MVT) and digital (d-MVT) format (Appendices E and F, respectively), to tackle the need for a quick, easy-to-administer, and self-scored IQ screening tool in the clinical setting. The p-MVT requires test-takers to provide brief oral definitions of 12 words presented to them orally (and, if needed, visually), one at a time. The d-MVT (hosted on SurveyMonkey) differs insofar as the stimuli are only presented visually, and test-takers are required to select the most correct meaning from five response options. In both versions, items are presented in graded order, from easiest to most difficult, where difficulty was approximated by frequency of occurrence in the 5.3-billion-entry News on the Web Corpus (Davies, 2013).

An important aspect of the MVT's administration is that test-takers are allowed to respond to each item in whichever language they prefer, as all languages are presented simultaneously. Hence, test-takers can draw on their linguistic knowledge across all three languages present in the instrument, as opposed to only one language, as in the case of the original SA-WASI Vocabulary Subtest and the vast majority of other standardized cognitive tests. Such administration likely provides a more accurate representation of their overall cognitive abilities (Bialystok, 2009; Bialystok et al., 2012; Nell, 1994).

Scoring. For both the p-MVT and d-MVT, responses are scored on a 0-2 scale. On the p-MVT, test-takers receive a score of 2 for providing a comprehensive definition, a score of 1 for an incomplete, yet directed definition, and a score of 0 for an irrelevant or vague

response. For instance, for item 12, *tumult*, the response *commotion*, *chaos*, and *temper* will result in 2, 1, and 0 marks, respectively (see scoring rubric in Appendix G). On the d-MVT, test-takers receive a score of 2 for choosing the most correct option, a score of 1 for choosing one of two good options, and a score of 0 for choosing one of two pure distractors. For instance, responses for item 10, *deliberation*, would be *rumination* (2 marks), *consideration* and *thinking* (both 1 mark), and *willingness* and *carefulness* (both 0 marks).

Procedure. The study took part in two stages, and I received ethical clearance for these procedures from the Ethics Review Committee of the Humanities Faculty at UCT (Appendix H). Individuals willing to participate signed up for a time slot of their choice on the SRPP site, hosted on Vula, UCT's intranet platform. They then received confirmation and subsequent reminder emails containing instructions on how to find the research laboratory, the date and time of their slot, and a link to an online survey containing a consent form, the sociodemographic questionnaire, and the adapted LEAP-Q. Participants were instructed to complete the online survey prior to their chosen time slot.

The link in the recruitment email took participants to an informed consent document (Appendix I). After giving consent, they were asked to complete the sociodemographic questionnaire and the adapted LEAP-Q. Both questionnaires were available in English, Afrikaans, and isiXhosa, and participants were given the choice to complete them in any one of these languages. Upon completion, they saw a message reminding them to attend the laboratory session they had signed up for.

For the second part of the study, I welcomed participants to the laboratory, provided them with a detailed explanation of the study purposes and procedures, and explained their rights as outlined in the informed consent document (Appendix J). After consenting to participation, myself or one of my research assistants (RAs; 4 female students recruited from a third-year psychology research class) administered the cognitive measures individually, in separate and quiet rooms, using the exact procedures outlined above. All participants completed the 12-Item SA-WASI Vocabulary Subtest and the APM, and the first 37 consecutive participants completed the p-MVT. After a preliminary face-value psychometric analysis, I finalised the d-MVT and changed the administration format to the digital version for the next 30 participants. The three measures were counterbalanced throughout to avoid practice and fatigue effects.

Upon completion of the test procedures, I used a set of open-ended questions (Appendix K) to encourage participants to comment on their testing experience. I answered any questions participants had, debriefed them (Appendix L), and thanked them for their

time. Psychology students received 3 SRPP points and an SRPP participation slip, while all other students received an entry form into a draw, where they stood a chance to win a R1 000 shopping voucher.

Statistical analyses. I used SPSS (version 24.0) to complete all statistical analyses in both studies. Unless stated otherwise, assumptions underlying the various types of inferential analyses were met, and α was set at .05 for all decisions regarding statistical significance; correlations were considered low when less than .40, moderate when between .40 and .70, and high when above .70 (Lachenicht, 2013).

Preliminary analyses. Initial reports of descriptive statistics outlined the sample's sociodemographic and linguistic characteristics. Independent-sample *t*-tests assessed between-sex differences for the continuous variables of age, years of education completed, current year of education, and number of languages spoken. Fisher's exact tests assessed for the presence of between-sex differences for the categorical variables of race, primary and high school types, dominant language, and language acquired first.

Psychometric analyses. I reported the MVT's internal consistency and provided an item difficulty analysis. Next, bivariate correlational analyses (using Pearson's *r*) described the magnitude of association between participants' performance on both MVT versions and the criterion measures. Correlating MVT scores with scores on the 12-Item SA-WASI Vocabulary Subtest and APM helped determine the measure's construct validity as an IQ screening tool.

Regression modelling. Three linear regression models sought to identify linguistic factors predicting performance on the p-MVT, d-MVT, and 12-Item SA-WASI Vocabulary Subtest, and assessed for shared factors. The findings of significant predictors were corroborated by means of independent-samples *t*-tests comparing test performance of English and non-English speakers. Subsequently, I attempted to explore the predictive quality of MVT performance, combined with other factors shown to affect cognitive performance, by entering them into a multiple regression model predicting general intellectual functioning, as measured by APM total score.

Results

Sample characteristics. As noted earlier, all participants (N = 65) completed the 12-Item SA-WASI Vocabulary Subtest and the APM, 35 completed the p-MVT (subsample 1), and 30 the d-MVT (subsample 2).

Table 1 summarizes the final sample's key sociodemographic characteristics. All participants had at least matriculated from high school (i.e., completed at least 12 years of

education). The modal participant was either black or coloured, female, primarily English-speaking, and studying at second-year level. As the table shows, analyses detected no significant between-sex differences with regard to years of education completed, year of study, number of languages spoken, race, most dominant language, language acquired first, and number of languages spoken. With regard to age, however, the analyses detected a significant between-sex difference, but simple linear regression models showed that age was not a significant predictor of performance on any of the outcome measures. This, and the relative homogeneity of the variable (ranges were 18-23 and 18-29 for women and men, respectively), allowed me to disregard age as a predictor of cognitive ability in this study.

In this set of between-group comparisons, all assumptions other than that of normality were upheld. This violation likely arose due to the relatively small sample size, so these results must be interpreted with caution.

Table 1

Sociodemographic Characteristics of the Study 1 Sample (N = 65)

Variable	Total Group (N = 65)	Women (n = 46)	Men (n = 19)	t / χ^2	p	Effect Size Estimate
Age (years)	20.46 (2.49)	19.74 (1.24)	22.21 (3.71)	4.05	< .001***	1.10
Education (years completed)	13.60 (1.52)	13.43 (1.31)	14.00 (1.92)	1.37	.174	0.37
Current Year of Study	2.11 (0.97)	2.02 (0.88)	2.32 (1.16)	1.11	.270	0.30
Number of Languages Spoken	2.62 (0.90)	2.63 (0.90)	2.58 (0.90)	0.21	.835	0.06
Race				3.47	.304	0.40
Black	26 (40.00)	17 (36.96)	9 (47.37)			
Coloured	24 (36.92)	20 (43.48)	4 (21.05)			
White	12 (18.46)	7 (15.22)	5 (26.32)			
Other/Not declared	3 (4.55)	2 (4.35)	1 (5.26)			
Dominant Language				3.23	.369	0.32
Afrikaans	6 (9.23)	5 (10.87)	1 (5.26)			
English	43 (66.15)	29 (63.04)	14 (73.68)			
isiXhosa	15 (23.01)	12 (26.09)	3 (15.79)			
Other	1 (1.54)	---	1 (5.26)			
Language Acquired First				2.63	.426	0.47
Afrikaans	9 (13.85)	8 (17.39)	1 (5.26)			
English	29 (44.62)	21 (45.65)	8 (42.11)			
isiXhosa	25 (38.46)	16 (34.78)	9 (47.37)			
Other	2 (3.08)	1 (2.17)	1 (5.26)			

Notes. For the continues variables (*Age*, *Education*, *Current Year of Study*, *Number of Languages Spoken*), means are presented with standard deviations in parentheses. For the remaining (categorical) variables, frequencies are given with percentages in parentheses. Group differences were assessed using independent-samples *t*-tests for the continuous variables and Fisher's exact tests for the categorical variables (as some of the expected cell frequencies were smaller than 5). Effect size estimates: Cohen's *d* for continuous variables and Cramer's *V* for categorical variables. If percentages do not add up to 100%, it is due to rounding.

***p < .001, two-tailed.

Test performance. Table 2 displays both subsamples' test performance. Given the uneven sex distribution in subsample 1 (i.e., those who completed the p-MVT), I investigated the effect of sex on performance on the outcome measures. As the Table shows, the analysis detected no significant between-sex differences on any of those measures. Further, none of the regression coefficients obtained in a set of linear regression models of sex on those four outcome measures were significant. Hence, in this sample, test performance on the p-MVT, d-MVT, 12-Item SA-WASI Vocabulary Subtest, and APM was not significantly influenced by sex.

Table 2

Mean Performance Scores on the Outcome Measures of the Study 1 (N = 65)

	Total Group		Women		Men		Range				
Measure	*N*	*M* (*SD*)	*n*	*M* (*SD*)	*n*	*M* (*SD*)	actual	potential	*t*	*p*	ESE
p-MVT	35	15.29 (2.69)	30	15.27 (2.70)	5	14.08 (3.03)	10-21	0-24	0.35	.727	0.17
d-MVT	30	17.60 (2.39)	16	17.56 (2.37)	14	17.64 (2.50)	12-22	0-24	0.09	.929	0.03
12-Item-SA-WASI Vocabulary Subtest	65	12.08 (3.97)	46	11.61 (3.91)	19	13.21 (3.98)	3-22	0-24	1.50	.410	0.41
APM	65	17.29 (4.11)	46	17.07 (3.73)	19	17.84 (4.99)	7-26	0-36	0.69	.493	0.19

Notes. Mean raw scores are presented with standard deviations in parentheses. Group differences were assessed using independent-samples *t*-tests. ESE = effect size estimate (in this case, Cohen's *d*).

MVT internal consistency analysis. Cronbach's α was .37 for the p-MVT and .24 for the d-MVT (12 items each). Both of these values are too low for the measure to be considered reliable (Finchilescu, 2013). When deleting individual items, alpha increases marginally to maximally α = .43 (deletion of item 8) and α = .33 (deletion of item 7) for the p-MVT and d-MVT, respectively. Due to the different modes of administration, however, the weak items differ between the versions. Split-half reliability, using the Spearman-Brown correction to account for loss of scale length, produces a marginally higher reliability coefficient for the p-MVT, r =.44, but a lower one for the d-MVT, r = .24. For illustrative purposes, I decided to continue with the analysis, despite the low reliability values, which mean that the instrument requires revision, as it is unlikely to produce consistent results across multiple administrations.

MVT construct validity. The analysis detected a significant, moderate, positive correlation between scores on the p-MVT and those on the 12-Item SA-WASI Vocabulary Subtest, $r(33) = .52$, $p = .001$, as well as smaller, non-significant positive correlation between scores on the p-MVT and those on the APM, $r(33) = .20$, $p = 246$.

However, the strength of the correlation between the two measures differed depending on the participant's dominant language. When examining data only from those who reported English as their dominant language (n = 24), there was a significant, strong, positive correlation between scores on the p-MVT and those on the 12-Item SA-WASI Vocabulary Subtest, $r(22) = .77$, $p = .006$. In contrast, when examining data only from those who reported Afrikaans or isiXhosa as their dominant language (n = 11), the statistics were $r(9) = .35$, $p = .090$. This pattern of data suggests that either multilinguals are disadvantaged when tested using the 12-Item SA-WASI Vocabulary Subtest, or that two instruments measure different constructs.

Regarding the d-MVT, the analysis detected a significant, positive but small correlation between scores on that instrument and those on the 12-Item SA-WASI Vocabulary Subtest, $r(28) = .38$, $p = .038$. However, there was no significant correlation between scores on the d-MVT and those on the APM, $r(28) = .003$, $p = .988$. Even when restricting this sample to those reporting English as their dominant language, the analyses detected no significant correlations. This set of results highlighted the need for changes to the d-MVT.

Test-takers' MVT experience. The decision to continue with the analysis was bolstered by the fact that, beside the psychometric properties, an important factor in interpreting the results of cognitive tests is the test-takers' experience when taking the test

(Leong, Park, & Leach, 2013). When asked about their testing, all participants, apart from one, indicated that they preferred the MVT over the 12-Item SA-WASI Vocabulary Subtest, for the same reasons that motivated the development of the instrument: They enjoyed having the option to respond in whatever language they felt they knew a given word best, as they felt it better represented their actual knowledge. Moreover, participants claimed that being able to refer to another language than the one they responded in boosted their confidence in their responses.

MVT item difficulty analysis. Figure 1 displays the item difficulty levels and response patterns for the p-MVT. Apart from the small drop for item 2 (*picture*|*prent*|*umfanekiso*) and the spike of item 11 (*effort*|*poging*|*umzamo*), item difficulty is relatively low and constant up to item 6, and then gradually and smoothly increases up to the last item. Even though the frequency of 1- and 2-mark responses is erratic for the first eight items, the curves cross at item 9, indicating that, from this item onward, more people scored 1 mark than 2 marks—another indicator of increased difficulty.

Figure 2 displays the item difficulty levels and response patterns for the d-MVT. Here, the pattern is less straightforward: Overall item difficulty remains relatively constant, and it is difficult to discern a clear response pattern across the first four items. From item 5 onward, however, more people score 2 marks than 1 mark, a contraindication of item difficulty. This drastic change in response pattern, despite featuring the same stimuli as the p-MVT, is most likely due to the multiple-choice administration format.

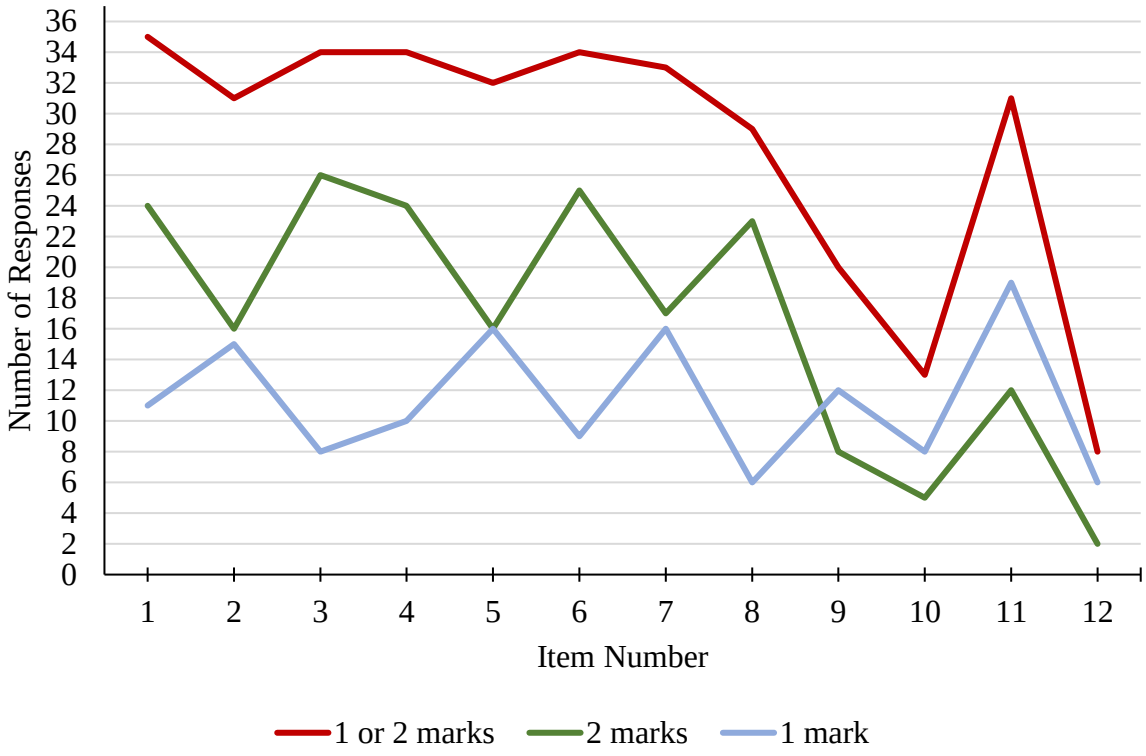

Figure 1. Item response patterns and item difficulty for the p-MVT (n = 35) in Study 1.

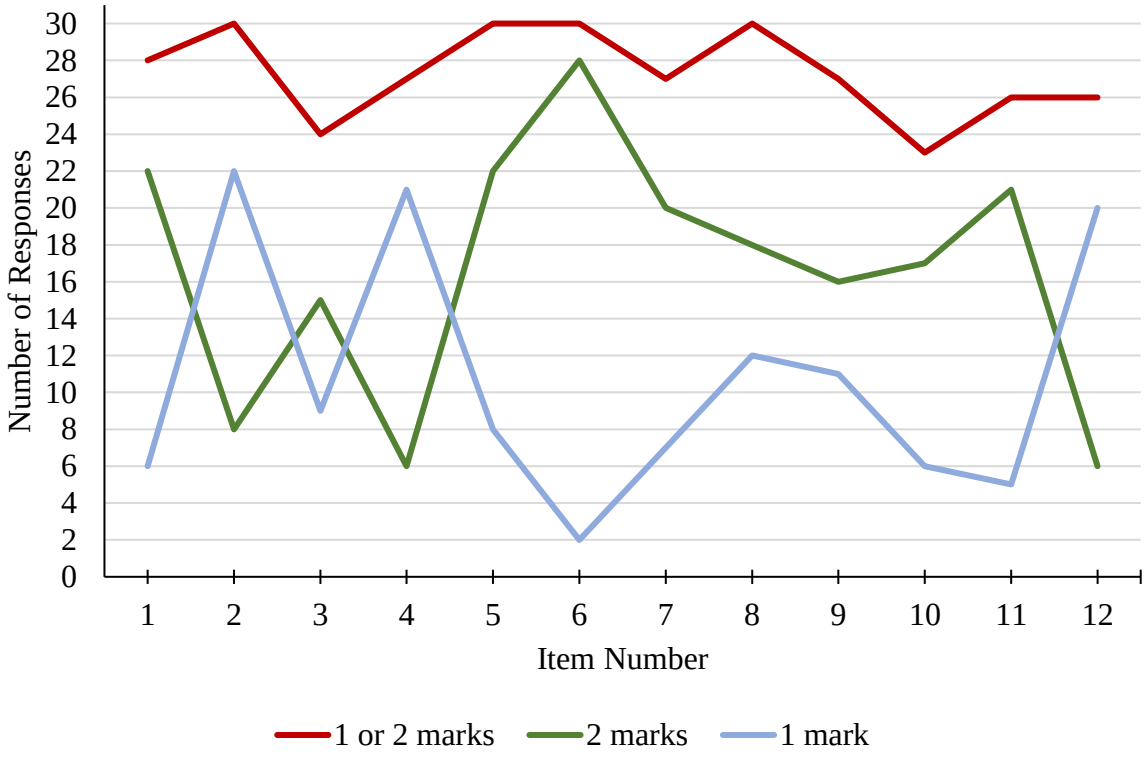

Figure 2. Item response patterns and item difficulty for the d-MVT (n = 30) in Study 1.

Regression modelling predicting IQ. One of the ancillary aims of Study 1 was to derive a multiple regression model predicting general intellectual functioning (operationalised as APM score) based on the MVT. Given the unfavourable outcome of the psychometric analysis of the MVT, particularly the low correlation between scores on the instrument and those on the APM, it was not possible to derive such model.

Nonetheless, nine linear regressions screened for significant predictive factors arising from participants' linguistic profile (i.e., the variables of language acquired first, most dominant language, and number of languages spoken, as measured by the adapted LEAP-Q) on performance on the p-MVT, d-MVT, and 12-Item SA-WASI Vocabulary Subtest.

Linguistic factors as predictors of test performance. Table 3 summarises the results of the linear regression The analysis clearly shows that, while performance on the 12-ITEM SA-WASI Vocabulary Subtest was significantly influenced by participants' linguistic profile, both versions of the MVT are neither affected by the language test takers acquired first, nor by their most dominant language, or by the number of languages they speak.

To further illustrate this, mean comparison show that those reported having acquired English as a first language outperformed their peers who reported having acquired any other language first on the 12-Item SA WASI Vocabulary Subtest, $t(63) = 3.81$, $p < .001$, Cohen's $d = 0.96$. A similar picture emerged when comparing those who reported English and those who reported any other language as their most dominant language, $t(63) = 4.21$, $p < .001$, Cohen's $d = 1.10$. For both MVT versions, I did not detect any such significant between-groups differences, with all ps > .075.

Table 3
Summary of Linear Regressions Predicting the Effect of Linguistic Factors on Test Performance

	12-Item SA-WASI Vocabulary Subtest (N = 65)		p-MVT (n = 35)		d-MVT (n = 30)	
Variable	R^2	p	R^2	p	R^2	p
English acquired first	.19	< .001***	.18	.446	.11	.076
English as most dominant language	.13	.033*	.01	.580	.05	.234
Number of languages spoken	.11	.008**	<.01	.908	<.01	.987

Notes. *English acquired first* and *English as most dominant language* are dummy variables created for the purpose of the regression analyses.
***$p < .001$, two-tailed. **$p < .01$, two-tailed. *$p < .05$, two-tailed.

Discussion

Study 1 aimed to provide a preliminary psychometric analysis of the MVT and to identify factors influencing performance on the instrument. I assessed the instrument's criterion-related validity as an IQ screening tool, using the 12-Item-SA WASI Vocabulary Subtest and the APM as criterion measures, and reported the internal consistency of both versions of the MVT. Although the construct validity and internal consistency values observed are too low to recommend the use of the measure without changes, I continued to analyse the MVT's psychometric properties for illustrative purposes, because (a) this project constitutes a pilot study for this form of assessment, and (b) further examination of the instrument was encouraged by the positive feedback I received from participants in short, open-ended interviews after the test sessions. Even though these results do not allow for the MVT to be considered equivalent to the 12-Item SA-WASI Vocabulary Subtest, the reduced influence of one's linguistic profile (comprising factors with huge variation in South Africa) on test performance, compared to the 12-Item SA-WASI Vocabulary Subtest, warranted a continuation of the MVT project. Therefore, the data obtained in Study 1 were used to improve the d-MVT for further analysis in Study 2.

STUDY 2:

Providing More Evidence for the Improved Digital MVT

The major purpose of this study was to gather more empirical data to bolster the evidence for the MVT's usefulness as an IQ screening tool. Prior to doing so, however, I made some minor changes to the digital MVT, based on the psychometric analysis described in Study 1.

Methods

Design and setting. This correlational study was conducted entirely online, using the SurveyMonkey platform.

Participants. I used convenience sampling to recruit participants. Using various channels of electronic distribution (e.g., UCT Department of Student Affairs mailing list, faculty-specific email lists, and websites), I circulated an invitation to participate to the general student population of UCT. Other than the requirement of multilingualism, the same eligibility criteria as were applied for Study 1 were applied here. Because the study was administered entirely online, all relevant criteria were assessed via self-report.

A total of 281 people responded to the invitation email (Appendix M) by clicking onto the link taking them to the survey. Of that number, 248 began the survey and completed

at least part of the d-MVT, but only 106 completed the entire survey. These 106 participants, who constituted the final sample used for the regression analyses, comprised 84 women and 22 men, they were aged 18-34 years (M = 22.78, SD = 3.71), and had 8-24 years of education (M = 15.19, SD = 2.90).

I computed a post-hoc power analysis with α = .05, number of predictors = 4, and n = 106 using G*Power (Faul et al., 2009). With effect size estimates of Cohen's f = .66 (corresponding to a partial R^2 value of .40) or f = .43, R^2 = .30, the software computed an achieved power of .99. Only with effect size estimate smaller than f = .12, R^2 = .11 did the computed power drop below .90.

Measures. This study used some of the measures described in Study 1: the sociodemographic questionnaire, the adapted LEAP-Q, and the MVT (combined into a single online survey hosted on the SurveyMonkey platform). A difference to note, however, is that the MVT was modified based on the results obtained in Study 1. First, some minor changes were made to the answer options for items 4, 6, 7, 10, 11, and 12. These changes were made in response to answers given by Study 1 participants on both the p-MVT and d-MVT, feedback from participants who had completed the d-MVT, as well as ongoing discussion with language experts during and after Study 1. Then, items were presented in new graded order, informed by the item difficulty analyses described in Study 1. The new order of items was: 6, 5, 1, 8, 7, 11, 10, 9, 2, 3, 4, 12 (see Appendix N).

Procedure. Upon clicking on the link in the recruitment email, participants saw an informed consent document (Appendix O). After having read that document and given consent to participate, they saw the d-MVT instructions and then completed that measure. Subsequently, they were asked to complete the adapted LEAP-Q and the sociodemographic questionnaire. The survey concluded with a page showing a thank-you message, as well as my contact details, in case participants were left with any questions.

Statistical Analyses. Analogous to Study 1, I created a complete set of descriptive statistics and investigated the presence of between-groups differences drawing on the data from all complete surveys (n = 106), using Fisher's exact tests and independent-samples t-tests as appropriate. I then used this subsample to replicate the regression analysis carried out in Study 1, in order to establish whether language acquired first, most dominant language, number of languages spoken, and years of education completed predicted d-MVT score in this sample.

Given that the total sample (N = 248) began the d-MVT (even though they did not complete the sociodemographic questionnaire and LEAP-Q), the psychometric analysis of the

modified d-MVT draws on all 248 datasets. For this study, I computed internal consistency using Cronbach's alpha and I describe the item difficulty curve of the modified d-MVT.

Results

Sample characteristics. Table 3 summarises the key sociodemographic characteristics of the subsample used for the analysis of factors affecting d-MVT performance (n = 106). The modal participant was white, female, a first-language English-speaker, and a postgraduate student. Analyses detected no significant between-sex with regard to age, years of education completed, current year of study, number of languages spoken, race, dominant language, and language acquired first. The assumption of normality was not met for age and current year of education, which, again, demands a cautious analysis.

Table 4

Sociodemographic Characteristics of the Study 2 Subsample Used for the Analysis of Factors Influencing d-MVT Performance (n=106)

Variable	Total Group (n = 106)	Women (n = 84)	Men (n = 22)	t / χ^2	p	Effect Size Estimate
Age (years)	22.78 (3.71)	22.60 (3.44)	23.50 (4.63)	1.02	.311	0.24
Years of Education Completed	15.19 (2.90)	15.14 (2.71)	15.36 (3.59)	0.32	.752	0.08
Current Year of Study[a]	3.28 (2.10)	3.15 (2.05)	3.76 (2.26)	1.18	.240	0.28
No. of Languages spoken	2.80 (1.12)	2.74 (1.10)	3.05 (1.21)	1.14	.256	0.27
Race				5.02	.161	.20
Black	14 (13.21)	9 (10.71)	5 (22.73)			
Coloured	15 (14.15)	12 (14.29)	3 (13.64)			
White	62 (58.49)	53 (63.10)	9 (40.91)			
Other/Not declared	15 (14.15)	10 (9.43)	5 (22.73)			
Dominant Language				6.74	.999	.06
Afrikaans	5 (4.72)	4 (4.76)	1 (4.55)			
English	94 (88.68)	74 (88.10)	20 (90.91)			
isiXhosa	1 (0.94)	1 (1.19)	---			
Other	6 (5.6)	5 (5.95)	1 (4.55)			
Language Acquired First				2.45	.475	.15
Afrikaans	17 (16.04)	15 (17.86)	2 (9.10)			
English	50 (47.17)	54 (64.29)	16 (72.72)			
isiXhosa	5 (4.72)	3 (3.57)	2 (9.10)			
Other	14 (13.21)	12 (14.29)	2 (9.10)			

Notes. For the continues variables (*Age*, *Education*, *Current Year of Study*, *Number of Languages Spoken*), means are presented with standard deviations in parentheses. For the remaining (categorical) variables, frequencies are given with percentages in parentheses. Group differences were assessed using independent-samples *t*-tests for the continuous variables and Fisher's exact tests for the categorical variables (as some of the expected cell frequencies were smaller than 5). Effect size estimates: Cohen's *d* for continuous variables and Cramer's *V* for categorical variables. If percentages do not add up to 100%, it is due to rounding.

[a] Data from all those currently studying (n = 99, 78 women, 21 men)

MVT performance. Analyses suggested that the changes made to the d-MVT, as well as the bigger sample size, produced a different set of results than reported in Study 1: For this study, M = 16.79, SD = 4.10, whereas for Study 1 M = 17.60, SD = 2.39, with the between-group statistics $t(247) = -3.08$, $p = .002$, Cohen's $d = 0.59$. Figure 3 shows the distribution of scores, approximating the desired normal distribution. The leftward skew is likely due to the fact that the online mode of administration did not allow me to discern between participants who skipped an item because they genuinely did not know the answer and those who abandoned the task. This is likely to underestimates the actual mean, because, when excluding all those who skipped or scored 0 three times before item 5, the results change to M = 17.23, SD = 3.25, $t(239) = -1.75$, $p = .081$, Cohen's $d = 0.34$.

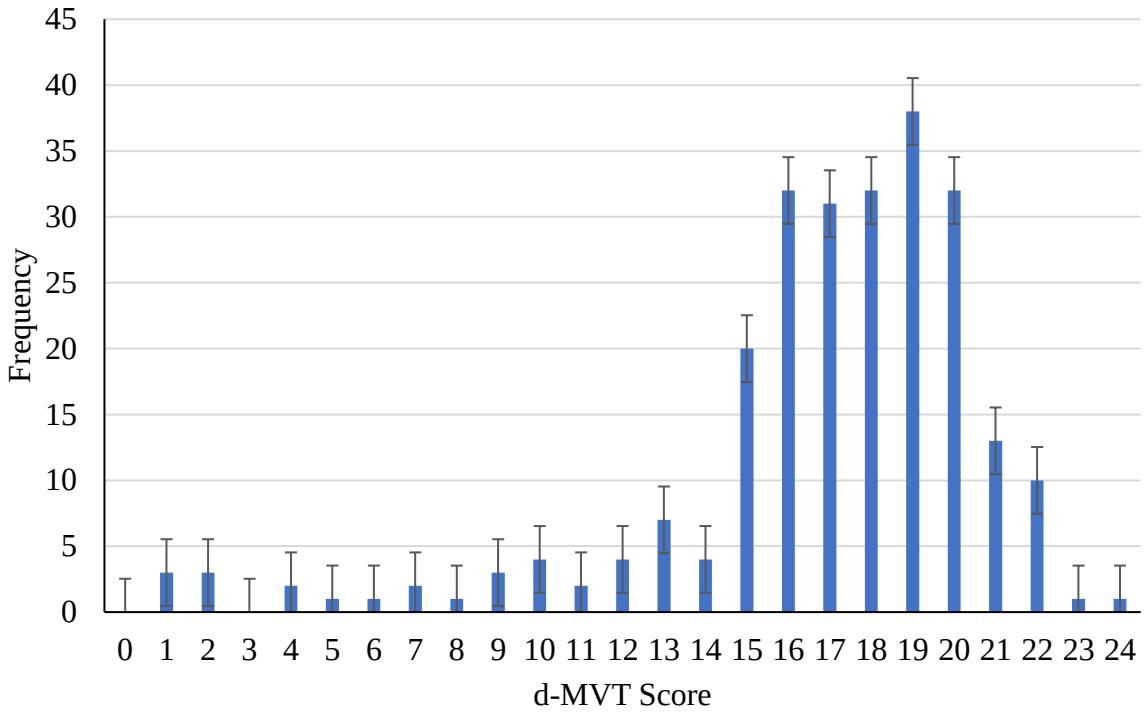

Figure 3. Frequency distribution of d-MVT scores in Study 2 (N = 248).

d-MVT internal consistency. Cronbach's coefficient alpha value was .77, which indicates a strong internal consistency. Thus, I conclude that the changes made based on the results of Study 1 proved effective and provided compelling evidence for the reliability of the modified d-MVT, as they increased α by a magnitude of .40 over the version of the d-MVT used in Study 1.

Item difficulty analysis. The modified item order and the changes made to items 4, 6, 7, 10, 11, and 12 had positive effects. As Figure 4 illustrates, the overall item difficulty curve showed a fairly smooth, yet slow downward trend, with the exception of items 11 (formerly

item 4, *announce|aankondigh|ukwazisa*) and 12 (*tumult|rumoer|isidubedube*). Even though the pattern is erratic from item 7 onward, from items 1 to 6, more test-takers score 2 marks than 1 mark, with a downward trend, indicating an appropriate difficulty grading.

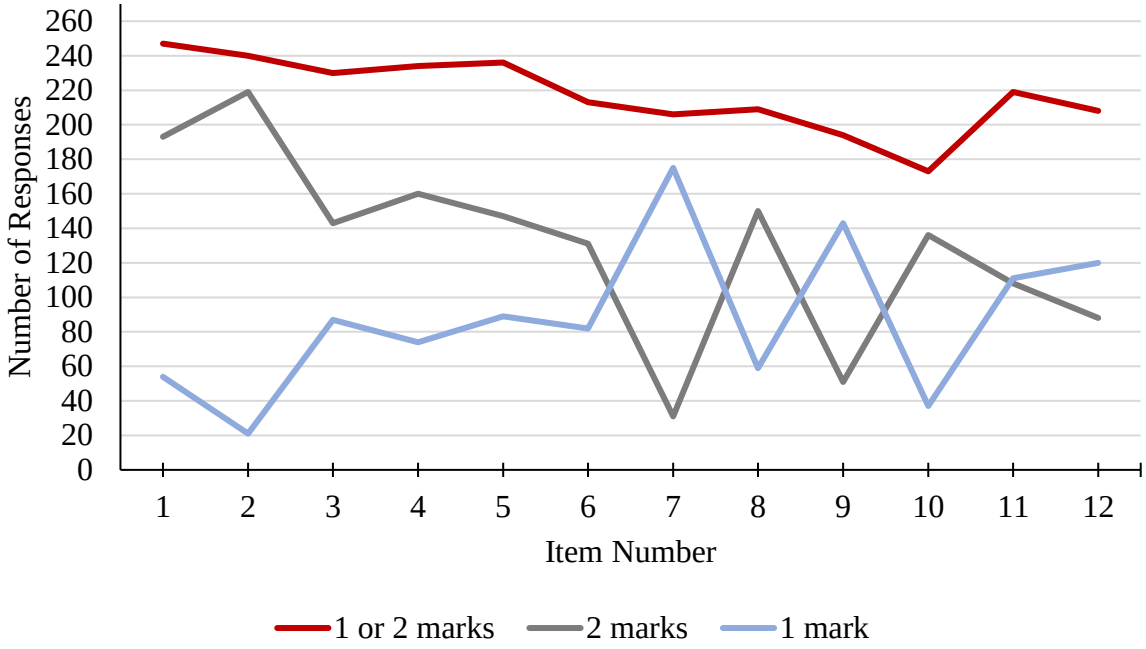

Figure 4. Item response patterns and item difficulty for the d-MVT (*N* = 248) in Study 2.

Predictors of d-MVT performance. Table 5 shows the results of a series of linear regression models of the linguistic profile variables used in Study 1 on d-MVT performance in Study 2. Neither of the linguistic factors found to significantly influence performance on the 12-Item SA-WASI Vocabulary Subtest in Study 1 were correlated with or predicted d-MVT performance in this sample. Hence, this data corroborates the results the Study 1 findings.

Table 5
Summary of Simple Linear Regression Models Predicting d-MVT Performance (n = 106)

Variable	R^2	*p*
English acquired first	<.01	.602
English as most dominant language	.03	.103
Number of languages spoken	<.01	.427

Discussion

One aim for Study 2 was to gather more data from a broader population, in order to provide empirical data to test a modified version of the d-MVT. The increase in Cronbach's alpha by .40 can be attributed, at least partially, to the changes made to the d-MVT based on the results and observations from Study 1. Thus, the results from Study 2 suggest positive outcomes in attempts to develop an inherently multilingual IQ screening measure.

General Discussion

I designed this study with the aim of proposing a solution to the cross-cultural neuropsychological problem of fair and valid cognitive assessment in multilingual populations. The specific aims of the project were addressed in two distinct, yet logically linked, studies. Study 1 aimed to develop and preliminarily assess the psychometric properties of the newly developed Multilingual Vocabulary Test (MVT), designed to be a linguistically fair multilingual IQ screening tool. I pursued this aim by correlating the MVT scores of a sample of university students with their scores on two established criterion measures, the 12-Item SA-WASI Vocabulary Subtest (Cawthra, 2016) and the Advanced Progressive Matrices (Raven et al., 1998). I then used regression analyses to identify sociodemographic and linguistic factors that had a significant influence on MVT performance. Study 2 continued investigating the MVT by providing more empirical data for the psychometric analysis of a modified (based on results obtained in Study 1) digital version of the instrument, and by re-running the same regression analyses as in Study 1 using a bigger and more diverse sample. Together, the results from Studies 1 and 2 allow me to provide an initial evaluation of the MVT's psychometric properties and its potential utility in clinical, educational, and research settings, and to identify some key factors influencing performance on the instrument. The results of both studies are integrated and discussed below.

Psychometric Properties of the p-MVT and d-MVT

I developed a pen-and-paper and a digital version of the MVT (the p-MVT and the d-MVT, respectively). I briefly describe the final versions and analyse their psychometric evaluations here. I then provide explanations of the results, as well as suggestions of how to further improve the measures.

p-MVT. Solid reliability analyses require a sufficiently large and heterogeneous sample (Finchilescu, 2013; Kline, 1993). Study 1 did not meet these criteria, as it was too small (n = 35) and as it consisted predominantly of female UCT undergraduate students; this

is likely a major reason for the observed weak internal consistency, α = .37, of the p-MVT. Despite the fact that deletion of individual items raised α to .43, this is not necessarily desirable, as it further reduces the length of an already brief scale. In any case, even after such changes, the instrument's internal consistency is still far below the recommended cut-off values for basic exploratory research measures of .70, let alone for clinical measures (Nunally, 1978).

Furthermore, the low criterion-related validity, suggested by a bivariate correlation of r = .21 with the APM does, at this stage, not bolster confidence in the use of the p-MVT as a screening tool for general intellectual functioning. A bivariate correlation with scores on the 12-Item SA-WASI Vocabulary Subtest at r = .52, p = .001, however, proved more promising, though still lower than desired if one is to claim equivalence. Nonetheless, these results can serve as valuable guides for future research, especially given that this study constituted the first-ever administration of the p-MVT.

Future research should seek to modify the p-MVT in ways similar to those of the d-MVT in Study 2. Hence, such modifications might include rearranging the items in new graded order, based on item difficulty and re-evaluating the scoring rubric. With regard to item difficulty, however, the current version of the p-MVT fares well: Apart from one outlier, the item difficulty curve shows a smooth downward trend in the latter half of the scale. Nevertheless, if after the proposed changes the psychometric properties fail to improve, the logical next steps would be a closer review and potential replacement of the items, as well as an increase in scale length. Common psychometric practice suggests developing a greater number of items than needed, which allows for the deletion of weak items after pilot administration (Clark & Watson, 1995).

d-MVT. In Study 1, the reliability statistics for the d-MVT were even lower than those of the p-MVT. However, given that Study 2 was conducted entirely online, I could make changes to the d-MVT after Study 1, in order to gather more empirical evidence evaluating a revised version of the d-MVT. I calculated the revised version's internal consistency based on a sample (N = 248) more than twice the size of the required minimum recommended by Kline (1993), which bolsters confidence in the analysis.

The recorded increase of Cronbach's coefficient alpha to .77, however, was likely caused not only by the increased sample size, but also by the changes made to items 4, 6, 7, 10, 11, and 12, as well as to the item order of the d-MVT after Study 1. The changes I made to the instrument were based on (a) the item difficulty levels obtained in Study 1, (b) the selection frequency of response options by Study 1 participants, and (c) qualitative feedback I

received from Study 1 participants, as well as on (d) the p-MVT responses provided by the Study 1 participants. These changes resulted in a new graded order according to item difficulty, as well as in the replacement of the least frequently (or never) chosen response options (Appendix N). Given the positive effect of the d-MVT revision process preceding Study 2, similar changes ought to be made to the measure after the second round of administration.

In terms of item difficulty, both the initial and the revised version of the d-MVT showed far less variation than the p-MVT. In principal, measures of intellectual function should be characterised by an increase in item difficulty from the first to the last item. However, in many applied settings, and particularly in clinical ones, the primary need is for a measure that detects below-average functioning, rather than for one that provides a fine differentiation between test-takers' cognitive abilities (Kline, 1993), as is the case with, for example, the Boston Naming Task (Kaplan, Goodglass, & Weintraub, 2001). Hence, the rather steady item difficulty levels are not a primary concern.

MVT Performance as a Predictor of Intellectual Ability

One of the secondary aims of this research was to build a regression model predicting general intellectual functioning from MVT scores and select sociodemographic and linguistic variables. However, even though p-MVT performance moderately and significantly correlated with performance on the 12-Item SA-WASI Vocabulary Subtest, the low correlation between p-MVT and APM scores rendered such undertaking impossible. Regardless of what other linguistic, sociodemographic, or educational factors were included in the regression model, p-MVT score was not a significant predictor of APM outcome. The same applied when I used d-MVT score as a predictor of APM score. Nevertheless, the regression models revealed a pattern of test performance based on participants' language profile.

Language Effects in VIQ Screening

Regardless of how one evaluates the evidence presented on the MVT, this study has one clear message: Monolingual intelligence screening is an unacceptable solution for a multilingual population. The regression analyses contained in both Study 1 and Study 2 indicate a significant influence of various linguistic factors on 12-Item SA-WASI Vocabulary Subtest performance. Such effects frequently go unnoticed, as test-takers' home language is often not considered a direct predictor but is regarded as an aspect of race, which often serves as a proxy for home language in South Africa (Cawthra, 2016). However, the findings mirror those presented in previous South African studies (see, e.g., Foxcroft & Aston, 2006; van

Wyhe, 2012). I discuss each of the linguistic factors influencing performance on the p-MVT, d-MVT, and 12-Item SA-WASI Vocabulary Subtest separately below.

Language acquired first. The language participants acquired first, often referred to as their home language, is closely related to their cultural and, in South Africa, racial identity (Banda, 2000; Desai, 2013; Van De Vijver & Rothmann, 2004). Hence, studies reporting race as a significant predictor of IQ performance do, at least in part, inadvertently report effects of participants' first language on test results. Additionally, other than this study, which differentiated between *language acquired first* and *most dominant language*, most studies only measure participants' home/first language and thereby either assume it to be the dominant one, or fail to acknowledge a potential difference.

In the current study, I found no significant predictive power of the language participants had acquired first on p-MVT and d-MVT performance, but I detected an association between that variable and performance on the 12-Item SA-WASI Vocabulary Subtest. Having acquired English as a first language—which is the case for only 10% of South Africans (Statistics South Africa, 2012)—is a significant predictor of 12-Item SA-WASI Vocabulary Subtest scores and produces significantly higher scores compared to having acquired any other language as a first language. This piece of data confirms the home language effect on the SA-WASI Vocabulary Subtest van Wyhe (2012) reported for her sample of 12-15-year-old first language Afrikaans-speakers, who performed significantly worse on the SA-WASI Vocabulary Subtest than first language English-speakers. Here, those other languages were predominantly Afrikaans and isiXhosa, spoken as a first language by large groups of coloured and black South Africans, respectively (Statistics South Africa, 2012). This relatively neat mapping of languages onto racial groups provides an explanation for the frequently reported significant race effects on cognitive testing (see, e.g., Cockcroft et al., 2015; Shuttleworth-Edwards & Kemp, 2004).

Most dominant language. I discovered an almost identical pattern for participants' most dominant language: There was no significant association between self-reported most dominant language and MVT performance, but in the regression models most dominant language was a significant predictor of performance on the 12-Item SA-WASI Vocabulary Subtest. Even though the effects are the same, the fine distinction between language acquired first and most dominant language is an important one, as 77% of participants (across both studies) reported a difference between these two. This has further implications in the current practice of having either an individual's home language or their language of educational

instruction as the default language of assessment (Griessel, 2005; Nell, 2000)—the exact problem this research project aimed to address.

Number of languages spoken. The analyses suggested that number of languages spoken significantly predicted performance on the 12-Item SA-WASI Vocabulary Subtest, with a negative correlation coefficient, but that it bore no association to MVT performance. In other words, the more languages one speaks, the worse one performs on that WASI subtest. The implications of this piece of data become clearer if we look at the 'causes' of multilingualism; given the hegemonic status of English, South African non-English first-language-speakers are under great pressure to learn English (Alexander, 2012). Those are predominantly black and coloured South Africans, who often navigate two different languages at home and in their educational institution (Cockcroft et al., 2015; Grieve, 2005). Hence, these two population groups are likely to be disproportionately disadvantaged when undergoing cognitive testing using a language-sensitive measure such as the 12-Item SA-WASI Vocabulary Subtest.

What becomes clear here is that historically disadvantaged groups continue to be disadvantaged in the realm of psychometric assessment. They are outperformed by those speaking English as their first and dominant language. Those matching these criteria are mostly white South Africans, who more closely resemble the Western populations from which most currently used norms are derived (Foxcroft et al., 2005; Watts & Shuttleworth-Edwards, 2016). The use of appropriately stratified normative data is perhaps a solution, but such data are scarce and their production is resource-intensive. Furthermore, the multi-layered factors influencing cognitive testing render the identification of appropriate norms difficult (see Lezak et al., 2012; Shuttleworth-Edwards, 2017; Taylor, 2016).

In short, even though more research on the MVT is needed, information presented here suggests that the currently used South African-adapted WASI Vocabulary Subtest is influenced by various linguistic factors and, therefore, cannot ensure a fair assessment of multilingual populations. Further, the preliminary psychometric data on the MVT, and the associated regression models, have provided a solid foundation for the development of a linguistically fair and inherently multilingual screening tool for IQ.

Suggestions for Future Research

The primary limitation of this research, and especially of Study 1, is the small sample size. As the drastically increased internal consistency of the d-MVT in Study 2 demonstrated, Cronbach's alpha is influenced by sample size and sample homogeneity. The bigger and more heterogeneous the sample is, the more accurate is the internal validity estimate

(Finchilescu, 2013). Although participants were sufficiently diverse in terms of their language profiles, they were exclusively UCT students, most likely performing above population means on the outcome measures, and from an above-average socioeconomic background. Thus, future studies should recruit more participants from wider and more socioeconomically and educationally diverse populations, as that would allow for a more powerful psychometric analysis.

Moreover, given that Cronbach's alpha is sensitive to scale length (Cortina, 1993), I suggest expanding the MVT to the standard SA-WASI Vocabulary Subtest length of 34 (42 for children under the age of 6; Ferrett, 2011). This length increase would likely result in an increased internal consistency. It could, however, also serve as an item bank (Weiss, 2013) based on which a renewed attempt to shorten the scale analogous to Cawthra's (2016) work could be made, by selecting the best items for an abbreviated measure.

Additionally, given the fair variability in terms of conceptualisations and approaches to measuring intellectual functioning (Brouwers & van de Vijver, 2015; Cattell & Horn, 1978; Kline, 1991), I recommend future researchers use a greater variety of criterion measures, both verbal and nonverbal. Establishing concurrent validity with such measures would confirm that they are, in fact, tapping into the same construct.

Conclusion

Linguistic diversity constitutes one of the greatest challenges in the field of neuropsychology (Razani et al., 2007). Currently used measures, such as the 12-Item SA-WASI Vocabulary Subtest, which is greatly influenced by test-takers' linguistic profile, produce less favourable outcomes for those whose first or dominant language is not English and for those who speak multiple languages. In a response to this state of affiars, the current research produced a measure that allowed test-takers to draw on their knowledge domains in multiple languages, which is, in turn, likely to result in a more accurate representation of their overall intellectual ability (Bialystok et al., 2012).

The project highlighted some of the practical challenges impeding the development of inherently multilingual cognitive measures. Yet, it also produced empirical evidence for the feasibility and psychometric potential of such quick, easy to administer, and efficiently scored measures, by successfully improving the d-MVT in Study 2. Therefore, I conclude that this study's development and psychometric investigation of the MVT provides a promising first step toward more linguistically fair intelligence screening by acknowledging the multilingual experience and reality of the majority of South Africans.

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Appendix A

Recruitment Email: Study 1

From: *Julian M. Siebert, <SBRJUL003@myuct.ac.za>*
Subject: *Get 3 SRPP points in an exciting cross-cultural neuropsychology study*

Dear all,

You are invited to take part in an exciting research study in the field of cross-cultural neuropsychology. I am conducting a study on multilingual intelligence testing, aiming to develop a linguistically fair intelligence screening tool for the multilingual population of South Africa's Western Cape province.
The study will take place **in the ACSENT Laboratory** (ground floor of the Psychology Department) in various individual slots throughout September and October 2017.
Participation will take approximately **60-80 minutes**; thus, you will be awarded **3 SRPP points**.

Please note that in order to participate you are required to:

- be between 18 and 34 years old;
- be bilingual;
- be fluent in English;
- be fluent in either Afrikaans, or isiXhosa, or both;
- **not** have have a history of psychiatric, neurological, or psychological disorders;
- **not** be taking any psychiatric, or other chronic medication.

If, and only if, you meet these criteria, you can sign up for this study using the 'Sign-up' tab in the left sidebar of the SRPP 2017 Vula page. **Please take note of the timeslot you sign up for and come to the ACSENT Laboratory five minutes prior to the starting time.**

Please make sure to fill in this brief sociodemographic and linguistic profile survey before coming to your time slot: www.surveymonkey.com/r/mvtresearch

Should you have any further questions, please contact me at SBRJUL003@myuct.ac.za.

Regards,
Julian M. Siebert

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 B

Sociodemographic Questionnaire

Sociodemographic Questionnaire

ACSENT Laboratory

University of Cape Town

Participant ID:

1. Demographics

1.1 Age:

1.2 Sex:

1.3 Race*:

2. Education

2.1 Are you currently studying? (please tick) O Yes O No

2.1.1 If yes, what year are you in?

2.1.2 If yes, what degree are you enrolled for?

2.1.3 What are your majors?

2.1.4 What language are you studying in?

2.2 What is your highest qualification?

2.3 How many years of education have you completed?

2.4 These questions pertain to your primary school:

2.4.1 Was it in a rural or urban setting? O Rural O Urban

2.4.2 What was the name of the school?

2.4.3 Was it a public or a private school?

2.4.4 What was the language of instruction?

2.5 These questions pertain to your high school:

2.5.1 Was it in a rural or urban setting? O Rural O Urban

2.5.2 What was the name of the school?

2.5.3 Was it a public or a private school?

2.5.4 What was the language of instruction?

3. General Information

3.1 What area did you live in while growing up?

3.2 Have you ever been or are you currently diagnosed with a psychological, psychiatric, neurological or learning disorder? If yes, please specify:

3.3 Are you currently taking any psychiatric/chronic medications? If yes, please specify:

*This will help us to better distinguish between the different language experiences different racial groups tend to show as first-language speakers of a given language.

Appendix C

Adapted Language Experience And Profile Questionnaire (LEAP-Q)

Adapted Language Experience And Profile Questionnaire (LEAP-Q)
Part A

Participant ID:	

1. Please list all the languages you know **in order of dominance**:

1._____ 2._____ 3._____ 4._____ 5._____

2. Please list all the languages you know **in order of acquisition** (your native language first):

1._____ 2._____ 3._____ 4._____ 5._____

3. Please list what percentage of the time you are **currently** and **on average** exposed to each language (*Your percentages should add up to 100%):*

Language:					
Percentage:					

4. When choosing to read a text available in all your languages, in what percentage of cases would you choose to read it in each of your languages? Assume the original was written in another language, which is unknown to you (*Your percentages should add up to 100%):*

Language:					
Percentage:					

5. When choosing to speak with a person who is equally fluent in all your languages, what percentage of time would you choose to speak each language? Please report the percentage of total time (*Your percentages should add up to 100%):*

Language:					
Percentage:					

6. Please name the cultures with which you identify. On a scale **from zero to ten**, please rate the extent to which you identify with each culture. (Examples of possible cultures are *black, South African, christian, etc.):*

Culture:					
Rank:					

Based on: Marian, Blumenfeld, & Kaushanskaya (2007). The Language Experience and Proficiency Questionnaire (LEAP-Q): Assessing language profiles in bilinguals and multilinguals. *Journal of Speech, Language, and Hearing Research, 50*(4), 940-96.

Adapted Language Experience And Profile Questionnaire (LEAP-Q)
Part B (to be filled in for each language)

Participant ID:
Language:

1. Age when you… …this language.

began acquiring	became fluent in	began reading in	became fluent reading in

2. Please list the number of years and months you spent in each language environment.

	years	months
A province where this language is spoken:		
A family where this language is spoken:		
A school/workplace where this language is spoken:		

3. On a scale from 0 to 10, please select your level of **proficiency** in speaking, understanding, and reading this language *(circle the appropriate number):*

	None					*Adequate*					*Perfect*
Speaking:	0	1	2	3	4	5	6	7	8	9	10
Understanding:	0	1	2	3	4	5	6	7	8	9	10
Reading:	0	1	2	3	4	5	6	7	8	9	10

4. On a scale from 0 to 10, please select how much the following factors contributed to you learning this language (*circle the appropriate number):*

	Not a contributor					*Moderate*					*Most important*
Interacting with friends:											
	0	1	2	3	4	5	6	7	8	9	10
Interacting with family:											
	0	1	2	3	4	5	6	7	8	9	10
Reading:											
	0	1	2	3	4	5	6	7	8	9	10
Language tapes/self-instruction:											
	0	1	2	3	4	5	6	7	8	9	10
Watching TV:											
	0	1	2	3	4	5	6	7	8	9	10
Listening to the radio:											
	0	1	2	3	4	5	6	7	8	9	10

5. Please rate to what extent you are currently exposed to this language in the following contexts:

	Never				*Half of the time*					*Always*
Interacting with friends:	0	1	2	3	4	5	6	7	8	9	10
Interacting with family:	0	1	2	3	4	5	6	7	8	9	10
Watching TV:	0	1	2	3	4	5	6	7	8	9	10
Listening to radio/music:	0	1	2	3	4	5	6	7	8	9	10
Reading:	0	1	2	3	4	5	6	7	8	9	10
Language-lab/self-instruction:	0	1	2	3	4	5	6	7	8	9	10

6. In your perception, how much of a foreign accent do you have in this language:

None				*Moderate*					*Pervasive*
0	1	2	3	4	5	6	7	8	9	10

7. Please rate how frequently others identify you as a non-native speaker *based on your accent* in this language:

Never				*Half of the time*					*Always*
0	1	2	3	4	5	6	7	8	9	10

Based on: Marian, Blumenfeld, & Kaushanskaya (2007). The Language Experience and Proficiency Questionnaire (LEAP-Q): Assessing language profiles in bilinguals and multilinguals. *Journal of Speech, Language, and Hearing Research, 50*(4), 940-967.

Appendix D

12-Item SA-WASI Vocabulary Subtest

South African-Adapted Wechsler Abbreviated Scale of Intelligence
12-Item Vocabulary Subtest

Participant ID:

Instructions: Start at item 1 and administer all items. Stop testing after discontinuance point (5 consecutive scores of 0). Score items up to discontinuance point.

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

Appendix E

Multilingual Vocabulary Test (pen-and-paper version)

Multilingual Vocabulary Test (MVT)
12-Items

Participant ID: _____
Examiner: _____
Date: _____

Instructions: Start at item 1 and administer all items. Stop testing after discontinuance point (5 consecutive scores of 0). Score items up to discontinuance point.

Item		Response	Score
1	E: **horse**		
	A: **perd**		
	X: **ihashe**		/2
2	E: **picture**		
	A: **prent**		
	X: **umfanekiso**		/2
3	E: **train**		
	A: **trein**		
	X: **uloliwe**		/2
4	E: **announce**		
	A: **aankondig**		
	X: **ukwazisa**		/2
5	E: **suggest**		
	A: **voorstel**		
	X: **ukucebisa**		/2
6	E: **convince**		
	A: **oortuig**		
	X: **ukweyisela**		/2

Multilingual Vocabulary Test (MVT) 12-Items (continued)			
Item		**Response**	**Score**
7	E: **excellence**		
	A: **uitnemendheid**		
	X: **ukugqwesa**		
8	E: **recurrent**		
	A: **terugkerend**		
	X: -**phindaphindayo**		/2
9	E: **impetuous**		
	A: **oorhastig**		
	X: -**dyuduzayo**		/2
10	E: **deliberation**		
	A: **deliberasie**		
	X: **ukucamngca**		/2
11	E: **effort**		
	A: **poging**		
	X: **umzamo**		/2
12	E: **tumult**		
	A: **rumoer**		
	X: **isidubedube**		/2
Total:			**/24**

Appendix F

Multilingual Vocabulary Test (digital version)

Multilingual Vocabulary Test (MVT)
12-Items

Please provide the closest meaning of the word below.
Kies asseblief die naaste betekening van die word onder.
Khetha elona intsingiselo echanekileyo ehambelana nalamagama.

horse	**perd**	**ihashe**
□ riding animal	□ rybare dier	□ silwanyana esikhwelwayo
□ farm animal	□ plaas dier	□ isilwanyana sasekhaya
□ hoofed animal	□ gehoefde dier	□ isilwanyana esikhabayo
□ big animal	□ groot dier	□ isilwanyana esikhulu
□ strong animal	□ sterk dier	□ isilwanyana esinamandla

On-screen representation resembles the above. An item list is provided below.

d-MVT Items and Response Options (Study 1)

Item	English	Afrikaans	isiXhosa	Score
1	**horse**	**perd**	**ihashe**	
	○ riding animal	○ riding animal	○ isilwanyana esikhwelwayo	2
	○ farm animal	○ plaas dier	○ isilwanyana sasekhaya	1
	○ hoofed animal	○ gehoefde dier	○ isilwanyana esikhabayo	1
	○ big animal	○ groot dier	○ isilwanyana esikhulu	0
	○ strong animal	○ sterk dier	○ isilwanyana esinamandla	0
2	**picture**	**prent**	**umfanekiso**	
	○ painting	○ skildery	○ ifoto	2
	○ artwork	○ kunswerk	○ umzobo	1
	○ still	○ stillewe	○ omboniso	1
	○ caption	○ opskrif	○ isazobe	0
	○ show	○ skou	○ umabonwakude	0
3	**train**	**trein**	**uloliwe**	
	○ locomotive	○ lokomotief	○ inqwelo enamakhareji	2
	○ carriage	○ wa	○ igutsi	1
	○ railway	○ spoorlyn	○ ingqwelo ende	1
	○ vehicle	○ motor	○ ingqwelo	0
	○ transport	○ vervoer	○ imoto	0
4	**announce**	**aankondig**	**ukwazisa**	
	○ proclaim	○ verkondig	○ ukuvakalisa	2
	○ make known	○ bekend maak	○ ukudumisa umba	1
	○ state	○ verklaar	○ ukusasaza iindaba	1
	○ communicate	○ kommunikeer	○ ukuthetha	0
	○ talk	○ praat	○ ukucacisa	0

5	**suggest**	**voorstel**	**ukucebisa**	
	○ propose	○ aanbeveel	○ ukuveza iimbono	2
	○ argue	○ argumenteer	○ ukubonisa	1
	○ imply	○ impliseer	○ ukunceda umntu	1
	○ say	○ sê	○ ukuyalela	0
	○ scream	○ skree	○ ukuthetha	0
6	**convince**	**oortuig**	**ukweyisela**	
	○ persuade	○ oorreed	○ ukuphembelela	2
	○ conclude	○ gevolgtrekking	○ ukubonisana ngento	1
	○ tempt	○ versoek	○ ukuqhubela phambili	1
	○ win	○ oorwin	○ ukuqiqa	0
	○ vindicate	○ verdedig	○ ukubona	0
7	**excellence**	**uitnemendheid**	**ukugqwesa**	
	○ brilliance	○ briljant	○ ukuphumelela ngaphambili	2
	○ greatness	○ grootheid	○ ukwenza kakuhle kakhulu	1
	○ sufficiency	○ genoegsaamheid	○ ukwenza ngokufanelekileyo	1
	○ performance	○ werkverrigting	○ ukulunga	0
	○ difference	○ verskil	○ ukuphumelela	0
8	**recurrent**	**terugkerend**	**-phindaphindayo**	
	○ repetitive	○ herhalend	○ ukwenza izidlandlo ezininzi	2
	○ frequent	○ frekwent	○ ukwenza kwakhona	1
	○ regular	○ gereeld	○ ukumana ukhumbula	1
	○ respected	○ gerespekteerd	○ ukukhumbula	0
	○ recent	○ onlangs	○ iinkumbulo	0
9	**impetuous**	**oorhastig**	**-dyuduzayo**	
	○ impulsive	○ impulsief	○ ukwenza into ngokungxama	2
	○ imprudent	○ onverstandig	○ ukwenza ngaphandle kokucinga	1
	○ uncontrolled	○ onbeheersd	○ ukwenza into ngokungathali	1
	○ considered	○ orweeg	○ ukonqena	0
	○ disciplined	○ gedissiplineerd	○ ukukhathala	0
10	**deliberation**	**deliberasie**	**ukucamngca**	
	○ consideration	○ oorweging	○ ukucingisisa nzulu	2
	○ carefulness	○ versigtigheid	○ ukucinga kakhulu	1
	○ thinking	○ dink	○ ukucinga ngento	1
	○ freedom	○ Vryheid	○ ukuqwalasela	0
	○ communication	○ kommunikasie	○ ukuphonononga	0
11	**effort**	**poging**	**umzamo**	
	○ attempt	○ probeerslag	○ ukuzabalaza	2
	○ achievement	○ prestasie	○ ukwenza amatiletile	1
	○ result	○ resultaat	○ ukwenza	1
	○ victory	○ oorwinning	○ umsebenzi	0
	○ competence	○ bevoegheid	○ ukutsala nzima	0
12	**tumult**	**rumoer**	**isidubedube**	
	○ commotion	○ oproer	○ umbhodamo	2
	○ trouble	○ moeilikheid	○ isiphithiphithi	1
	○ chaos	○ chaos	○ isigxumgxum	1
	○ tantrum	○ vloermoer	○ abantu abaninzi	0
	○ temper	○ humeur	○ ingxolo eninzi	0

Appendix G
Multilingual Vocabulary Test (pen-and-paper version) – Scoring Rubric (English)

Multilingual Vocabulary Test (MVT) 12-Items – Preliminary Scoring Rubric				
This preliminary scoring rubric serves as a guideline of how to evaluate responses. In general, the more abstract and comprehensive a response, the higher the score should be.				
Item			**Score**	**Response**
1	E: **horse**		**0**	Animal, big animal, strong animal
	A: **perd**		**1**	Mammal, used for riding
	X: **ihashe**		**2**	Hoofed riding animal
2	E: **picture**		**0**	Something you take, with your phone
	A: **prent**		**1**	Drawing, photo, documentation
	X: **umfanekiso**		**2**	Can be painting/photographed, a captured moment
3	E: **train**		**0**	Transports people, takes people to work
	A: **trein**		**1**	Railway, public transport, vehicle
	X: **uloliwe**		**2**	Public transport on railways
4	E: **announce**		**0**	Tell people, say something to someone
	A: **aankondig**		**1**	Put out a notice, report
	X: **ukwazisa**		**2**	Proclaim, make known
5	E: **suggest**		**0**	Argue, tell your opinion
	A: **voorstel**		**1**	Put forward an idea, show
	X: **ukucebisa**		**2**	Propose, imply, insinuate
6	E: **convince**		**0**	Say, prove sth., argue
	A: **oortuig**		**1**	Make s.o. do sth., win over
	X: **ukweyisela**		**2**	Persuade, induce, sway s.o.
7	E: **excellence**		**0**	Good, nice, great work
	A: **uitnemendheid**		**1**	Accomplishment, achievement,
	X: **ukugqwesa**		**2**	Outstanding performance, brilliance, superiority
8	E: **recurrent**		**0**	Happening, once-off, now and then, always there
	A: **terugkerend**		**1**	Ongoing, keeps coming back
	X: **-phindaphindayo**		**2**	Repetitive, returning, reiterative,

Multilingual Vocabulary Test (MVT) 12-Items – Preliminary Scoring Rubric (continued)				
Item			**Score**	**Response**
9	E: **impetuous**		**0**	Doing sth. quickly, fast
	A: **oorhastig**		**1**	Hasty, reckless, w/o thinking, hurry
	X: **-dyuduzayo**		**2**	Impulsive, impromptu, spur-of-the-moment
10	E: **deliberation**		**0**	Thinking, willingness
	A: **deliberasie**		**1**	Thinking deeply, discussing, consultation
	X: **ukucamngca**		**2**	Rumination, reflection
11	E: **effort**		**0**	Energy, power, making/doing sth.
	A: **poging**		**1**	Try, hard work
	X: **umzamo**		**2**	Attempt, achievement, accomplishment
12	E: **tumult**		**0**	Turmoil, confusion
	A: **rumoer**		**1**	Loud event, happening
	X: **isidubedube**		**2**	Commotion, chaotic and loud group of people

Appendix H

Ethical Approval

UNIVERSITY OF CAPE TOWN

Department of Psychology

University of Cape Town Rondebosch 7701 South Africa
Telephone (021) 650 3417
Fax No. (021) 650 4104

09 June 2017

Julian Siebert
Department of Psychology
University of Cape Town
Rondebosch 7701

Dear Julian

I am pleased to inform you that ethical clearance has been given by an Ethics Review Committee of the Faculty of Humanities for your study, *Developing a Linguistically Fair IQ Screening Tool Appropriate to the Multilingual Reality of South Africa.* The reference number is PSY2017 -020.

I wish you all the best for your study.

Yours sincerely

University of Cape Town
ΨPSYCHOLOGY DEPARTMENT
Upper Campus
Rondebosch

Lauren Wild (PhD)
Associate Professor
Chair: Ethics Review Committee

Appendix I

Consent Form: Study 1 (As Presented in the Online Survey)

Consent to Participate in a Research Study

ACSENT Laboratory

University of Cape Town

You are invited to take part in a study which tests the usefulness of a new intelligence test using more than one language. I am doing this study for a degree in the Department of Psychology at the University of Cape Town. Before you agree to take part, please carefully read this page, and email the researcher about any questions you might have.

Why am I doing this study?

I would like to test how useful the newly developed Multilingual Vocabulary Test (MVT) is as a quick way of testing someone's intelligence. I do this by comparing how well people who speak more than one language do on this test, to how well they do in test that use only one languages. I do this, because I would like to make sure that people who speak more than one language can be tested using all the languages they know.

What will I ask you to do?

Part 1 (online): After you agree to take part, I will ask you to fill out two brief questionnaires asking you about some details about you, your life, and your languages. *Part 2 (in the lab):* Then, I, or one of my assistants, will test how well you speak English and Afrikaans/isiXhosa. Following that, I will ask you to do three short intelligence tests. In those tests, you will have to show how well you can complete patterns, and how well you can explain the meaning of words to me. The entire study will take about 90 minutes.

Are there any risks or benefits to you?

Filling in this online survey is no more dangerous than doing anything else on your computer. You will not get a reward for taking part in the study, but you will help to work toward a fairer way of measuring the intelligence of people who speak multiple languages.

What are your rights when taking part in the study?

You take part in this study, because you want to do so. You are not forced to take part. If you would like to stop filling in the survey before the end, you can do that anytime. You will not have to say why you stopped, and you will not be punished. I will keep your answers safe, and nobody will find out what answers you gave, even I will not be able to know. I will only use your answers to see how well the MVT, the new test, works.

Informed Consent

I, _____, have read and understood what is written on this page, and by signing here, I agree to take part in this study.

Participant's signature: _____ *Date:* _____

Researcher's signature: _____ *Date:* _____

Should you have any further questions or concerns, please feel free to contact me, Julian M. Siebert, at SBRJLU003@myuct.ac.za, or my supervisor, Dr. Kevin Thomas, at kevin.thomas@uct.ac.za. If you feel that you were not treated well, you can complain to Ms Rosalind Adams: 021 650 3417 or rosalind.adams@uct.ac.za

Appendix J

Consent Form: Study 1 (As Presented in the Laboratory Session)

Consent to Participate in a Research Study

ACSENT Laboratory

University of Cape Town

Thank you for making time to participate in this study. The study tests the usefulness of a new intelligence test using more than one language. I do this study for a degree in the Department of Psychology at the University of Cape Town. Before you agree to take part, please carefully read this page, and email the researcher about any questions you might have.

Why am I doing this study?

I would like to test how useful the newly developed Multilingual Vocabulary Test (MVT) is as a quick way of testing someone's intelligence. I do this by comparing how well people who speak more than one language do on this test, to how well they do in test that use only one languages. I do this, because I would like to make sure that people who speak more than one language can be tested using all the languages they know.

What will I ask you to do?

After you agree to take part, I, or one of my assistants, will test how well you speak English and Afrikaans/isiXhosa. Then, I will ask you to do three short intelligence tests. In those tests, you will have to show how well you can complete patterns, and how well you can explain the meaning of words to me. Then, I will ask you to fill out two brief questionnaires asking you about some details about you, your life, and your languages. The entire study will take about 60-80 minutes.

Are there any risks or benefits to you?

Filling in this online survey is no more dangerous than doing anything else on your computer. You will not get a reward for taking part in the study, but you will help to work toward a fairer way of measuring the intelligence of people who speak multiple languages.

What are your rights when taking part in the study?

You take part in this study, because you want to do so. You are not forced to take part. If you would like to stop filling in the survey before the end, you can do that anytime. You will not have to say why you stopped, and you will not be punished. I will keep your answers safe, and nobody will find out what answers you gave, even I will not be able to know. I will only use your answers to see how well the MVT, the new test, works.

Informed Consent

I, _____, have read and understood what is written on this page, and by signing here, I agree to take part in this study.

Participant's signature: _____ *Date:* _____

Researcher's signature: _____ *Date:* _____

Should you have any further questions or concerns, please feel free to contact me, Julian M. Siebert, at SBRJLU003@myuct.ac.za, or my supervisor, Dr. Kevin Thomas, at kevin.thomas@uct.ac.za. If you feel that you were not treated well, you can complain to Ms Rosalind Adams: 021 650 3417 or rosalind.adams@uct.ac.za

Appendix K
Open-ended Questions Used to Obtain Test Takers' Feedback

1. How did you like the MVT?

2. How was your testing experience?

3. What aspects did you like about it?

4. What aspects did you not like about it?

5. How did you feel it compared to the English-only measure (12-Item SA-WASI Vocabulary subtest)?

Appendix L

Debriefing Form: Study 1

Debriefing Form

ACSENT Laboratory

University of Cape Town

Developing a Linguistically Fair IQ Screening Tool Appropriate to the Multilingual Reality of South Africa

Dear participant,

Thank you for your participation in this study. The aim of this research project is to develop a linguistically fair screening tool for intelligence.

In order to do that, I need to compare people's performance on the new measure, the Multilingual Vocabulary Test (MVT), to established intelligence tests. The data you provided by completing the various tests will be used assess how well the measure predicts intelligence, and to show what other factors influenced how well you did. Examples of such factors are your sex, your level of education, your socioeconomic status, and your language history. Therefore, you were asked to complete a short sociodemographic and linguistic profile questionnaire; this allows for an analysis of the various factors.

Be reminded of the fact that your responses will be treated anonymously, and confidentially; this means that nobody, not even I, can find out what responses you gave on any of the tests or questionnaires you completed.

Please feel free to ask any further questions you might have right now, or email them to me, Julian M. Siebert, at SBRJUL003@myuct.ac.za. If you feel that I have not treated you well, or if you would like to complain about the study, please contact the UCT Department of Psychology: Ms Rosalind Adams, rosalind.adams@uct.ac.za.

Appendix M

Recruitment Email: Study 2

From: *Julian M. Siebert, <SBRJUL003@myuct.ac.za>*
Subject: *Get 2 SRPP points in an exciting cross-cultural neuropsychology study*

Dear Students,

You are invited to take part in an exciting research study in the field of cross-cultural neuropsychology.

My name is Julian Siebert and, as part of my psychology honours project, I am conducting a study on multilingual intelligence testing. The study's aim is to develop and validate a linguistically fair intelligence screening tool for the multilingual population of South Africa's Western Cape province.
The study comprises the short intelligence screening tool to be evaluated (the MVT), and two short questionnaires about sociodemographic and linguistic information. All of the above will be administered via an online questionnaire. Should you have any further questions, please contact me at SBRJUL003@myuct.ac.za.

Your time and effort are greatly appreciated—you are helping to make intelligence screening more linguistically fair for everyone!

Please click on this link below to start the survey: https://www.surveymonkey.com/r/MVTatUCT

The information you share will remain confidential and anonymous, and the completion of the questionnaire is voluntary, and you may withdraw out of the survey at any point.

Kind regards,
Julian M Siebert - Researcher

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 N

Revised Multilingual Vocabulary Test (digital version)

Multilingual Vocabulary Test (MVT)
12-Items

Please provide the closest meaning of the word below.
Kies asseblief die naaste betekening van die word onder.
Khetha elona intsingiselo echanekileyo ehambelana nalamagama.

horse	**perd**	**ihashe**
□ riding animal	□ rybare dier	□ silwanyana esikhwelwayo
□ farm animal	□ plaas dier	□ isilwanyana sasekhaya
□ hoofed animal	□ gehoefde dier	□ isilwanyana esikhabayo
□ big animal	□ groot dier	□ isilwanyana esikhulu
□ strong animal	□ sterk dier	□ isilwanyana esinamandla

On-screen representation resembles the above. An item list is provided below.

d-MVT Items and Response Options (Study 2)

Item	English	Afrikaans	isiXhosa	Score
1	**horse**	**perd**	**ihashe**	
	○ riding animal	○ riding animal	○ isilwanyana esikhwelwayo	2
	○ farm animal	○ plaas dier	○ isilwanyana sasekhaya	1
	○ hoofed animal	○ gehoefde dier	○ isilwanyana esikhabayo	1
	○ big animal	○ groot dier	○ isilwanyana esikhulu	0
	○ strong animal	○ sterk dier	○ isilwanyana esinamandla	0
2	**picture**	**prent**	**umfanekiso**	
	○ painting	○ skildery	○ ifoto	2
	○ artwork	○ kunswerk	○ umzobo	1
	○ still	○ stillewe	○ omboniso	1
	○ caption	○ opskrif	○ isazobe	0
	○ show	○ skou	○ umabonwakude	0
3	**train**	**trein**	**uloliwe**	
	○ locomotive	○ lokomotief	○ inqwelo enamakhareji	2
	○ carriage	○ wa	○ igutsi	1
	○ railway	○ spoorlyn	○ ingqwelo ende	1
	○ vehicle	○ motor	○ ingqwelo	0
	○ transport	○ vervoer	○ imoto	0
4	**announce**	**aankondig**	**ukwazisa**	
	○ proclaim	○ verkondig	○ ukudumisa umba	2
	○ make known	○ bekend maak	○ ukuvakalisa	1
	○ state	○ verklaar	○ ukusasaza iindaba	1
	○ communicate	○ kommunikeer	○ ukuthetha	0
	○ talk	○ praat	○ ukucacisa	0

5	**suggest**	**voorstel**	**ukucebisa**	
	○ propose	○ aanbeveel	○ ukuveza iimbono	2
	○ argue	○ argumenteer	○ ukubonisa	1
	○ imply	○ impliseer	○ ukunceda umntu	1
	○ say	○ sê	○ ukuyalela	0
	○ scream	○ skree	○ ukuthetha	0
6	**convince**	**oortuig**	**ukweyisela**	
	○ persuade	○ oorreed	○ ukuphembelela	2
	○ influence	○ beïnvloed	○ ukubonisana ngento	1
	○ win over	○ oorwin	○ ukuba nomthelela	1
	○ win	○ win	○ ukoyisa	0
	○ vindicate	○ verdedig	○ ukubona	0
7	**excellence**	**uitnemendheid**	**ukugqwesa**	
	○ brilliance	○ briljant	○ ukuphumelela emagqabini	2
	○ greatness	○ grootheid	○ ukwenza kakuhle kakhulu	1
	○ distinction	○ onderskeiding	○ ukuntshatshela	1
	○ sufficiency	○ genoegsaamheid	○ ukwenza ngokufanelekileyo	0
	○ difference	○ verskil	○ ukuphumelela	0
8	**recurrent**	**terugkerend**	**-phindaphindayo**	
	○ repetitive	○ herhalend	○ ukwenza izidlandlo ezininzi	2
	○ frequent	○ frekwent	○ ukwenza kwakhona	1
	○ regular	○ gereeld	○ ukumana ukhumbula	1
	○ respected	○ gerespekteerd	○ ukukhumbula	0
	○ recent	○ onlangs	○ iinkumbulo	0
9	**impetuous**	**oorhastig**	**-dyuduzayo**	
	○ impulsive	○ impulsief	○ ukwenza into ngokungxama	2
	○ imprudent	○ onverstandig	○ ukwenza ngaphandle kokucinga	1
	○ uncontrolled	○ onbeheersd	○ ukwenza into ngokungathali	1
	○ considered	○ orweeg	○ ukonqena	0
	○ disciplined	○ gedissiplineerd	○ ukukhathala	0
10	**deliberation**	**deliberasie**	**ukucamngca**	
	○ rumination	○ herkauwing	○ ukucingisisa nzulu	2
	○ consideration	○ oorweging	○ Ukuthathela ingqalelo	1
	○ thinking	○ dink	○ ukucinga ngento	1
	○ willingness	○ gewilligheid	○ Ukwenza ngabomi	0
	○ carefulness	○ versigtigheid	○ Ukucinga kakhulu	0
11	**effort**	**poging**	**umzamo**	
	○ attempt	○ probeerslag	○ ukuzabalaza	2
	○ try	○ aanpak	○ ilenge	1
	○ achievement	○ prestasie	○ ukwenza amatiletile	1
	○ venture	○ onderneming	○ ukwenza into	0
	○ competence	○ bevoegheid	○ ukutsala nzima	0
12	**tumult**	**rumoer**	**isidubedube**	
	○ commotion	○ oproer	○ ingxubevange	2
	○ trouble	○ moeilikheid	○ isiphithiphithi	1
	○ chaos	○ chaos	○ isigxumgxum	1
	○ tantrum	○ vloermoer	○ abantu abaninzi	0
	○ temper	○ humeur	○ ingxolo eninzi	0

Appendix O

Consent Form: Study 2

Consent to Participate in a Research Study

ACSENT Laboratory

University of Cape Town

Thank you for making time to participate in this study. The study tests the usefulness of a new intelligence test using more than one language. I do this study for a degree in the Department of Psychology at the University of Cape Town. Before you agree to take part, please carefully read this page, and email the researcher about any questions you might have.

Why am I doing this study?

I would like to test how useful the newly developed Multilingual Vocabulary Test (MVT) is as a quick way of testing someone's intelligence. I do this by comparing how well people who speak more than one language do on this test, to how well they do in test that use only one languages. I do this, because I would like to make sure that people who speak more than one language can be tested using all the languages they know.

What will I ask you to do?

After you agree to take part, I will ask you to complete a short multiple-choice test asking you to answer 12 questions about the meaning of some words. Then, you will be asked to fill out two brief questionnaires asking you about some details about you, your life, and your languages.

Are there any risks or benefits to you?

Filling in this online survey is no more dangerous than doing anything else on your computer. You will not get a reward for taking part in the study, but you will help to work toward a fairer way of measuring the intelligence of people who speak multiple languages.

What are your rights when taking part in the study?

You take part in this study, because you want to do so. You are not forced to take part. If you would like to stop filling in the survey before the end, you can do that anytime. You will not have to say why you stopped, and you will not be punished. I will keep your answers safe, and nobody will find out what answers you gave, even I will not be able to know. I will only use your answers to see how well the MVT, the new test, works.

Should you have any further questions or concerns, please feel free to contact me, Julian M. Siebert, at SBRJLU003@myuct.ac.za, or my supervisor, Dr. Kevin Thomas, at kevin.thomas@uct.ac.za. If you feel that you were not treated well, you can complain to Ms Rosalind Adams: 021 650 3417 or rosalind.adams@uct.ac.za

PLAGIARISM DECLARATION

PLAGIARISM

This means that you present substantial portions or elements of another's work, ideas or data as your own, even if the original author is cited occasionally. A signed photocopy or other copy of the Declaration below must accompany every piece of work that you hand in.

DECLARATION

1. I know that Plagiarism is wrong. Plagiarism is to use another's work and pretend that it is one's own.

2. I have used the American Psychological Association formatting for citation and referencing. Each significant contribution to, and quotation in, this project from the work or works, of other people has been attributed, cited and referenced.

3. This project is my own work.

4. I have not allowed, and will not allow anyone to copy my work with the intention of passing it off as his or her own work.

NAME: **Julian Maximilian Siebert**

STUDENT NUMBER: **SBRJUL003**

DATE: **16 November 2017**

SIGNATURE: