

# **Critical Reasoning Test Battery**

(Item Banked)

**Psytech SA**  
understanding people

**South African User Guide and  
Research Reference**

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# CRTBi User Guide

This user guide is for South African users, and will be updated regularly as new research evidence becomes available. Studies will be added to the various sections as they are completed. The date when it was last updated appears on every study.

## The CRTBi

Critical Reasoning is an ability that is central to all roles that require the incumbent to make logical decisions based on complex information. The CRTBi (Critical Reasoning Test Battery – item banked) is an item banked assessment that has been designed to assess critical reasoning ability and is available for unsupervised administration via Psytech International’s online testing platform. The CRTBi comprises two sub-tests which measure verbal and numerical critical reasoning. These can be administered either individually or together.

The CRTBi is similar in difficulty level to the CRTB2 battery, however the CRTBi is intended to be administered unsupervised (i.e., controlled mode). Unsupervised administration of classical psychometric tests (not item-banked) increases the risk of practice effects and respondents helping one another to obtain higher scores. The CRTBi is widely used by Psytech International’s partners and users internationally.

<b>What the CRTBi measures</b>	<p>The <b>Verbal Critical Reasoning</b> subtest measures the ability to understand and accurately draw logical conclusions and inferences from complex reports. Consequently, it forms a key assessment for managerial and professional roles which require accurate interpretation of written reports and rational decision making.</p> <p>The <b>Numerical Critical Reasoning</b> subtest measures the ability to understand and critically evaluate a wide range of numerical data and draw logical conclusions from this. Consequently, it forms a key assessment for managerial and professional roles which require the ability to understand financial, numerical and statistical information.</p>
<b>Who can the CRTBi identify</b>	<p>The CRTBi can identify people who:</p> <ul style="list-style-type: none"><li>• Weigh up evidence logically</li><li>• Take ill informed decisions</li><li>• Identify trends in data</li><li>• Fail to grasp numerical concepts</li></ul>

	<ul style="list-style-type: none"> <li>• Isolate the key points in an argument</li> <li>• Overlook core information</li> <li>• Understand complex arguments</li> <li>• Struggle to grasp complex arguments</li> <li>• Assimilate all the evidence</li> <li>• Fail to appreciate all the evidence</li> <li>• Quickly comprehend statistical and financial information</li> <li>• Are confused by statistical and financial data</li> <li>• Process information quickly</li> <li>• Are slow to process information</li> <li>• Make well-informed business decisions</li> <li>• Have poor business judgement</li> <li>• Solve problems effectively</li> <li>• Are unable to find solutions to problems</li> </ul>
<b>Intended use of the CRTBi battery</b>	Business managers and graduate-level staff for selection and recruitment, identification for promotion and training.
<b>Administration</b>	Online – supervised and unsupervised assessment
<b>Timing</b>	45 minutes excluding administration time
<b>Scoring and Reporting</b>	Online
<b>Reports</b>	Standard report Feedback report Group results summary spreadsheet
<b>Cost</b>	2 credits per scored assessment

**Important notes:**

- Although the CRTBi measures the same constructs as the CRTB2, they are not scale equivalent assessments. “Scalar equivalence means that the measurement scale is identical across versions of the assessment” (Van de Vijver, 2011). This means that you cannot expect the same result for a respondent on both subtests, the assessments, they are not the same.
- Note that there is no pencil and paper equivalent test battery to the CRTBi. Users must take this into account when planning assessment projects.

## Classification Status of The CRTBi

The HPCSA still publishes a list of classified tests. However, the HPCSA no longer certifies tests. Thus, there is no review process under the auspices of the HPCSA. The function of classification is to limit who may use the test. It no longer indicates that a test has been reviewed for metric quality. There is no fee to be paid and it takes a short while. This CRTBi manual will be submitted to the HPCSA to be classified. Assessment Standards South Africa (ASSA) offers a voluntary review process, and the CRTBi will be submitted to ASSA for review.

## Conditions of Use and Professional Responsibilities

The CRTBi must be used under the control of an HPCSA registered Psychologist, Psychometrist (Independent Practice), or Registered Counsellor (Independent Practice).

## Purchasing CRTBi Materials and Scoring Services

The CRTBi is only available online due to the nature of the test: it is item-banked. Scoring and reporting is done online on Psytech International's online testing platform. Psytech South Africa offers training on the use of the platform; attendance is required for users to fully benefit from what the platform has to offer and to ensure with the understanding of the platform, that assessments are utilised ethically.

## Constructing of Test Batteries

Only an HPCSA registered Psychologist, Psychometrist (Independent Practice) or a Registered Counsellor (Independent Practice) may decide which tests or questionnaires to use for a particular purpose. Psychometrists registered for supervised practice or other role players such as HR Practitioners or line managers may not act independently of the registered psychology professional, and may not overrule their decisions in this regard. Unregistered persons by law are not permitted to perform any psychological act.

## Registration Requirements

- The tests may be administered by a HPCSA registered Psychologist, Psychometrist (Supervised Practice), Psychometrist (Independent Practice), Registered Counsellor (Independent Practice) or Psychotechnician.
- Psychometrists (Supervised Practice) have to be supervised by a Psychologist or Psychometrist (Independent Practice).

The CRTBi can only be administered online, supervised or unsupervised. While the test can be done unsupervised, the identity of the respondent needs to be verified. It is still best

practice to administer tests under supervised conditions, as the respondent needs to be able to get help if there are technical problems during the test administration.

### The International Test Commission on Test Administration

The International Test Commission (ITC) have devised guidelines for good practice in testing.

#### “Give due regard to technological issues in Computer-based (CBT) and Internet Testing”

Tests users need to be aware of the software and hardware that are required in order to run the assessment. Ensure that the device you are using is capable of running the assessment. Confirm with the respondent that they have a device capable of running the assessment. Stay up-to-date with new technology.

#### “Take account of the robustness of the CBT/Internet test”

Test Users need to ensure that there are processes in place should a respondent need assistance. Bearing in mind that unsupervised assessments give the respondent the choice of when to complete the assessment, this might be outside of office hours. The user needs to know how to attain technical support should this be necessary. Test users are to inform test publishers of problems that occur.

#### “Consider human factors issues in the presentation of material via computer or the Internet”

Test Users need to be familiar with the presentation of the questions in the assessment, where the instructions will be found, and how instructions can be accessed during the assessment. As well as familiarizing oneself with how the items are presented, and how the respondent is required to respond. Psytech SA advises clients to complete the assessments they plan to use themselves, in order to understand what the respondent will experience.

#### “Consider reasonable adjustments to the technical features of the test for candidates with disabilities”

When assessing someone with disabilities, the test user needs ensure that the assessment features facilitate the respondent's needs. If the assessment is not suitable, one should consider using an alternative assessment procedure. The ITC mentions making test modifications as a means of addressing the needs of disabled clients. This is not a viable option for the CRTBi. The test may self-adjust for certain disabilities up to a point, but the

recommendation remains valid. There is still a need for individual face-to-face assessments for persons with serious disabilities.

### “Provide help, information, and practice items within the CBT/Internet test”

Test users must ensure that they understand the how to access technical support when needed, and be familiar with the system. Ensure the respondent is competent in using an online method of assessment.

The CRTBi has practice items in the beginning of each subtest, as with Psytech’s other ability assessments. Should the candidate need additional practice items, please direct respondents to the appropriate practice items for the assessment they will be taking. The practice items should be done prior to starting the assessment. These can be found on the Psytech website ([www.psytech.co.za](http://www.psytech.co.za)) under the assessment tab. For this purpose, please use the CRTB2 practice items available on Psytech South Africa’s website:

[www.psytech.co.za](http://www.psytech.co.za).

Where appropriate and possible, collect data on the respondent’s reactions towards assessment and provide feedback to test developers to help them ensure a more positive experience for test-takers. This also assists with fairness studies.

### Scoring of the CRTBi

The CRTBi is scored online, and reports are available immediately. As with Psytech’s other ability assessments, results are represented in stanines. The South African norms available for the CRTBi are listed in this user guide, along with the biographical information and descriptive statistics for each norm.

### Reporting on the CRTBi

The choice of which computerised report to use should be made by:

- A HPCSA registered Psychologist, Psychometrist (Independent Practice) or a Registered Counsellor (Independent Practice).

Psychometrists (Supervised Practice) and Psychotechnicians should consult with a Psychologist or Psychometrist (Independent Practice) about the most suitable report to use.

## Feedback on CRTBi Reports

Feedback on the CRTBi reports may be done by an HPCSA registered Psychologists, Psychometrists (Independent Practice) or Registered Counsellors (Independent Practice). Psychometrists registered for supervised practice may give feedback on the CRTBi within clearly circumscribed guidelines laid down by a Psychologist or Psychometrist (Independent Practice), and provided proper supervision, with regular consultation, is maintained. We recommend using the descriptors: below average, average, and above average when giving a respondent feedback. Below average: stanine 1 – 3, average: stanine 4 – 6, above average: 7 - 9.

## A History of the CRTBi in South Africa

In March 2020, South Africa went into a countrywide lockdown due to the Covid-19 virus that had caused an international pandemic. Due to these unusual circumstances, Psytech SA felt it was of critical importance to protect not only our professional practitioners, but also the candidates to be assessed against the risk of infection with a deadly disease. With this in mind, Psytech SA added the CRTBi to the (then) GeneSys online platform in order to assist with the prevailing circumstances. The assessment was widely used during this time.

The CRTBi had been used internationally for several years prior to the pandemic. Psytech SA did not release it then because of requirements for test certification and the difficulty of collecting evidence on a test that was not yet classified. These requirements have now fallen away and tests are classified only in terms of what they measure.

## The Effect of Employment Equity in Recruitment and Selection Practices on Test Statistics

One of the legacies of apartheid is that South Africa is a country characterized by imbalances of distribution of opportunities and resources which permeates all spheres of society. The differences are mostly felt in the educational and occupational environments and they still shape the wellbeing and future of the previously oppressed Black majority. One of the mechanisms put in place is Broad-based Economic Empowerment (BEE) aimed at correcting the imbalances of the pasts by giving the Black majority an opportunity to advance and develop. However, the inferior quality of education and other factors that resulted from institutionalized discrimination makes it difficult for most Black candidates to meet the requirements. This extends to their ability to perform above the cut-off point on psychometric tests necessary for joining, promotions and attending high profile courses. The situation is aggravated by the bad reputation of psychometric tests in SA, making it difficult for some

leaders to accept the result. Some perceive them as tools to frustrate processes such as AA, consequently suggesting the exclusion of psychometric tests in any selection processes.

A very common strategy when recruiting candidates in a manner that aims to compensate for previous systemic disadvantage of some population groups, is as follows:

- Seriously consider every applicant from a formerly disadvantaged background who may possibly meet the requirements of the position.
- Only consider applicants from formerly advantaged backgrounds once a quota of formerly disadvantaged individuals has been met, or when the supply of suitable disadvantaged applicants has been exhausted.

Assessing candidates with psychometric tests incurs a cost for the employer, and employers usually try to minimize costs. Thus, testing normally occurs fairly late in the selection process. Frequently candidates are evaluated on application forms, CVs and interviews before they are tested. Often this means that the candidates from formerly advantaged backgrounds, who are tested, have been more rigorously pre-screened than the candidates from formerly disadvantaged backgrounds. This serves to aggravate the reported group differences on the tests, and can make a test appear more biased than it otherwise would be.

Users are advised to bear this in mind when evaluating the reported figures in this manual. Test users are also welcome to approach Psytech SA when large recruitment projects are being undertaken, so that the project can be planned in such a way as to render less distorted information about the tests. If necessary and justifiable in the interest of research, Psytech SA is willing to subsidize such projects.

### Some Cautionary Notes

- No subtest of the CRTBi should be used on its own as a selection instrument. The tests should always form part of an assessment battery that includes other measures, and preferably some non-test information as well.
- It is strongly recommended that a validation/integration interview should follow any assessment by means of tests or questionnaires. The interviewer should use this opportunity to put the test results into perspective relative to the respondent's background and the purpose of the assessment.

- Users should pay attention to the reliability and validity data available relating to the population group on which they intend to use the questionnaire.
- Users should use norm groups that are appropriate for the person being assessed, also bearing in mind the demands of the situation for which the person is being assessed.

## Computer-Assisted Reports

Psytech tests and questionnaires are all supported by computer-assisted reports. Some of the tests have a range of computer-assisted reports, allowing instant interpretation of the test results from a variety of perspectives. For the CRTBi, a standard report and a feedback report are available, either as a battery of individually for each subtest. In addition, a results summary spreadsheet is available to generate which is particularly useful as a summarized version of the individual candidates scores, or scores of a group of candidates that have completed the CRTBi. Neither the summary spreadsheet nor the standard report are to be shared with non-professionals. Computerized reports can also be created for specific batteries of measures, integrating the results of ability tests with personality and perhaps interests.

### How Do the Computer-Generated Reports Work?

The reports represent an expert system, drawing on numerous built-in relationships between patterns of scores and human behaviour. It would normally take a user many years of experience to gain the knowledge and insight that are contained in this reporting system.

### What Are the Advantages of Computer-Generated Reports?

Computer-generated reports ensure that the complete pattern of scores is interpreted every time. No score or combination of scores is overlooked. Everyone is treated in exactly the same way, irrespective of whether the person interpreting the results is having an 'off day' or is pressed for time. This helps to ensure fairness and consistency. Moreover, computer-generated reports save a lot of time, freeing the professional up to add value in the interview, integration of results from other sources and feedback processes.

### Are Computer-Assisted Reports Open to Abuse?

Like any powerful tool, computer-assisted reports can be misused. They should not be used to substitute for professional expertise, but rather to supplement and support it.



One must remember that these reports are generic - the standard reports do not know anything about the requirements of the positions that the respondent may have applied for. They are also completely unaware of the respondent's background and personal circumstances. They can usually not stand on their own, but must be used as one source of information in the assessment process, and be integrated with other information. This integration and interpretation is highly skilled professional work, and it should not be left to persons who have not had the required training.

In some situations, handing out unaltered computer-generated reports to respondents or line managers without any counselling or explanation, could be considered abuse of these reports. We recommend that the technical appendix in a report, which gives a graphic summary of raw scores and profiles, not be given to untrained persons. The Code of Conduct stipulates that the explanation of assessment results needs to be done using 'language that is reasonably and understandable to the client assessed or to another legally authorised person on behalf of the client.'

Integration platforms combine tests from different providers, which helps to speed up the report writing process. It should be noted however, that these systems do not take context into account, nor do they consider the individual needs of respondents. Therefore, as a psychology professional, it is necessary to ensure that these elements are considered and included in the final report. As well as triangulation. Triangulation is the process of combining different sources of information to evaluate a construct, such as psychological assessments, CVs, interviews, scholastic results, etc.

## Classical Test Theory

Classical Test Theory (CTT), *also known as true score theory*, has dominated the assessment industry for some time. It is a psychometric theory that predicts the outcomes of an assessments, such as ability level. CTT involves the following foundation:

$$\text{Observed score} = \text{True Score} + \text{random error}$$

A respondent's observed score (the score they attain) is equal to the sum of the true score (the score free from error) and an error score. The true score in CTT is one that would be obtained if there were no errors in measurement. However, this was borne from the critical

acknowledgement that assessments contain error. Error is the term used to compensate for extraneous factors to the construct of interest. In this case the construct of interest is ability.

### Assumptions of Classical Test Theory

Classical Test theory makes the following assumptions about measurement error:

- 1) The expected random error is zero,
- 2) The correlation between the true score and the random error is zero,
- 3) The correlation between the random error and of one variable and the true score of another variable is zero,
- 4) The correlation between errors on distinct measurements is zero.

(Carmines & Woods, 2005)

#### **Some notes on CTT:**

- Scores are test and item dependent. All items included in the test need to be administered.
- Norms are sample dependent; this means that a sample representative of the population needs to be obtained and used.
- Reliability is sometimes calculated at a test level across the trait spectrum. Users should consider this when looking at the metric properties of an assessment, i.e., look at the scale-level reliability where necessary.
- Standard error of measurement (SEM) is consistent across an entire population, regardless of the raw test score. SEM is a statistical estimate of the amount of random error in the assessment of results or scores.
- An increase in test length will increase the reliability. Therefore, a longer test is likely to appear more reliable. Some believe that longer multiple-choice tests tend to be more reliable because more items automatically reduce the error of measurement. Indeed, a sufficient number of items must be included to cover the content areas tested; however, there are other factors that contribute to how efficiently a test measures and separates candidate ability.
- CTT is norm based. This means the statistics are dependent on the representation of the population. This is why Psytech SA encourages our test users to use the largest, latest and most inclusive norm.
- True scores are assumed to be measured at interval level, and normally distributed. However, in practice tests tend to measure on an interval level. As such SEM should always be considered and it should not be assumed that the test is able to measure small differences between people precisely.

# Administration Instructions

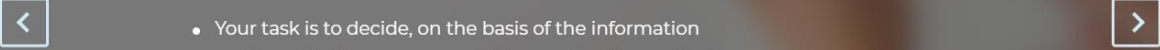
Respondents are not permitted to use calculators; they may use rough paper for working out. The assessment does not require complex mathematical calculations. When necessary, provide candidates with practise examples.

## Verbal subtest administration instructions

Instructions

In this test you have to draw inferences from short passages of text.

- You will be presented with a passage of text followed by a number of statements.
- Your task is to decide, on the basis of the information contained in the passage, whether each statement is true, false or cannot be inferred from the passage.
- Your decision should be based only on the information contained in the passage and not on your own knowledge or opinions.



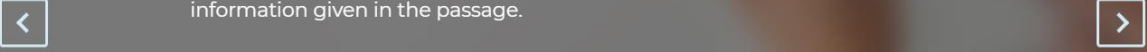
Instructions

For each statement you will be asked which of the following three categories correctly describes whether the statement can be inferred from the passage.

TRUE: This means that the statement directly follows from the facts provided within the passage. That is to say, the statement can be logically inferred from the information given in the passage.

CANNOT DETERMINE: This means that there is not enough information provided within the text to infer whether the statement is either true or false.

FALSE: This means that it is possible to infer from the information provided within the passage that the statement is definitely not true.



## Instructions

### 1. Select or change your answers

By using the mouse or the corresponding number of keys on the keyboard:



### 2. Press Enter to confirm an answer

This will automatically move you to the next question



### 3. Move backwards and forwards

Using the arrows keys



## Instructions

Before you start let's try an example of the type of question you will be asked, in order to make sure that you understand the test.

Press **[Enter]** to continue.

Example  
1/3

While the number of commercial radio stations has doubled over the last ten years further growth is limited as no new radio frequencies are now available. While a few popular radio stations are making substantial profits most, however, are running at a loss. This is mostly due to poor audience figures limiting the amount that can be charged for advertising space. In this context, it is expected that some radio stations may go bankrupt within the next few years.

**It is likely that the recent rapid expansion in the number of commercial radio stations will continue.**



The correct response to Example 1 is False. It is explicitly stated within the text that further growth in the number of radio stations is limited due to there being no new radio frequencies available.

True

Cannot  
Determine

False

1

2


3

Example  
2/3

MARKETING WEEKLY

While the number of commercial radio stations has doubled over the last ten years further growth is limited as no new radio frequencies are now available. While a few popular radio stations are making substantial profits most, however, are running at a loss. This is mostly due to poor audience figures limiting the amount that can be charged for advertising space. In this context, it is expected that some radio stations may go bankrupt within the next few years.

**Audience figures affect a radio station's profitability.**

 The correct response to Example 2 is True. It is explicitly stated that audience figures affect advertising revenue, thus affecting profitability.

True

Cannot  
Determine

False

1


2

3

Example  
3/3

further growth is limited as no new radio frequencies are now available. While a few popular radio stations are making substantial profits most, however, are running at a loss. This is mostly due to poor audience figures limiting the amount that can be charged for advertising space. In this context, it is expected that some radio stations may go bankrupt within the next few years.

**Commercial radio stations are likely to increase their profitability over the next few years.**

 The correct response to Example 3 is Cannot Determine. It is impossible to infer, from the information provided in the text, whether radio stations in general will become more profitable. Whilst it is noted some stations may go bankrupt, it is not possible to infer from this that audience figures (and as a result advertising revenue) will increase for the remaining radio stations.

True

Cannot  
Determine

False

1


2

3

Instructions

REMEMBER

- Time is short, so when you begin the timed test work as quickly and as accurately as you can. The time you have left will be displayed in the top right hand corner of the screen.
- If you want to change an answer, highlight your new choice of answer and press [Enter] to record it.
- If you finish before the time runs out, you will be given the chance to review and change your answers.
- If you need to review the instructions while you are completing the test, click [Help] on the screen. The clock continues to count down while you are reviewing the instructions.




## Numerical subtest administration instructions

Instructions

In this test you will have to draw inferences from numerical information which is presented in tabular form.

- You will be presented with a numerical table and asked a number of questions about this information.
- You will then have to select the correct answer from one of six possible choices.
- One and only one answer is correct in each case.



## Instructions

### 1. Select or change your answers

By using the mouse or the corresponding number of keys on the keyboard:



### 2. Press Enter to confirm an answer

This will automatically move you to the next question



### 3. Move backwards and forwards

Using the arrows keys



## Instructions

Before you start let's try some examples of the type of question you will be asked, in order to make sure that you understand how to do the test.

Press **[Enter]** to continue.

Example  
1/3

Men						Women					
% of Men, within each Age Group, citing each of the listed Characteristics as the most important feature of a car.						% of Women, within each Age Group, citing each of the listed Characteristics as the most important feature of a car.					
Characteristic	20-29	30-39	40-49	50-59	60-69	Characteristic	20-29	30-39	40-49	50-59	60-69
Performance	52	32	38	32	26	Performance	18	12	8	10	5
Economy	3	16	18	20	27	Economy	17	24	29	28	32
Reliability	20	28	18	22	38	Reliability	34	32	24	27	35
Safety	5	15	13	22	5	Safety	18	30	32	31	27
Design	20	5	13	6	4	Design	13	2	7	4	1

For Women, which is the least important feature of a car?

Performance	Economy	Reliability	Safety	Design	cannot say
1	2	3	4	5	6

Example  
2/3

Men						Women					
% of Men, within each Age Group, citing each of the listed Characteristics as the most important feature of a car.						% of Women, within each Age Group, citing each of the listed Characteristics as the most important feature of a car.					
Characteristic	20-29	30-39	40-49	50-59	60-69	Characteristic	20-29	30-39	40-49	50-59	60-69
Performance	52	32	38	32	26	Performance	18	12	8	10	5
Economy	3	16	18	20	27	Economy	17	24	29	28	32
Reliability	20	28	18	22	38	Reliability	34	32	24	27	35
Safety	5	15	13	22	5	Safety	18	30	32	31	27
Design	20	5	13	6	4	Design	13	2	7	4	1

For men over the age of 39 what is the most important feature of the car?

Performance	Economy	Reliability	Safety	Design	cannot say
1	2	3	4	5	6

Example  
3/3

Men						Women					
% of Men, within each Age Group, citing each of the listed Characteristics as the most important feature of a car.						% of Women, within each Age Group, citing each of the listed Characteristics as the most important feature of a car.					
Characteristic	20-29	30-39	40-49	50-59	60-69	Characteristic	20-29	30-39	40-49	50-59	60-69
Performance	52	32	38	32	26	Performance	18	12	8	10	5
Economy	3	16	18	20	27	Economy	17	24	29	28	32
Reliability	20	28	18	22	38	Reliability	34	32	24	27	35
Safety	5	15	13	22	5	Safety	18	30	32	31	27
Design	20	5	13	6	4	Design	13	2	7	4	1

For men under the age of 30 how many times more important is performance than safety?

**!** The correct answer to this question is 10.4 (Number 5). Of all males below 30, 5% identified safety and 52% identified performance as the most important feature of a car. 52% is just above 10 times that of 5%.

5.1	9.8	11	5	10.4	Cannot Say
1	2	3	4	5	6

Instructions

REMEMBER

- Time is short, so when you begin the timed test work as quickly and as accurately as you can. The time you have left will be displayed in the top right hand corner of the screen.
- If you want to change an answer, highlight your new choice of answer and press [Enter] to record it.
- If you finish before the time runs out, you will be given the chance to review and change your answers.
- If you need to review the instructions while you are completing the test, click [Help] on the screen. The clock continues to count down while you are reviewing the instructions.



## Instructions

- In total there are 5 tables of information and 30 questions. You have 30 minutes in which to answer the questions.
- If you are unsure about how to complete this test, ask the administrator now.



Press **[Enter]** to start the timed test.

# CRTBi South African Norm Data

## Index of South African Norm Groups for The Critical Reasoning Test Battery – item-banked (CRTBi)

Description	Study number
CRTBi Norms SA Aggregate Population 2021	N1
CRTBi Norms SA English Language Group 2021	N2
CRTBi Norms SA Afrikaans Language Group 2021	N3
CRTBi Norms SA Indigenous Language Group 2021	N4

# Critical Reasoning Test Battery – item-banked (CRTBi) – Norm Group 1, South Africans, Aggregate Population, Updated 2021

## Sample Composition

The sample consisted of South Africans tested by Psytech South Africa and collaborators from June 2015 to March 2021. Since not all respondents completed all the subtests of the CRTBi, biographical characteristics are reported separately for the different subtests.

### Critical Numerical Reasoning Test: Biographical Composition

Category	Frequency table: Sex			
	Count	Cumulative Count	Percent	Cumulative Percent
M	623	623	57.20845	57.2084
F	465	1088	42.69972	99.9082
U	1	1089	0.09183	100.0000
Missing	0	1089	0.00000	100.0000

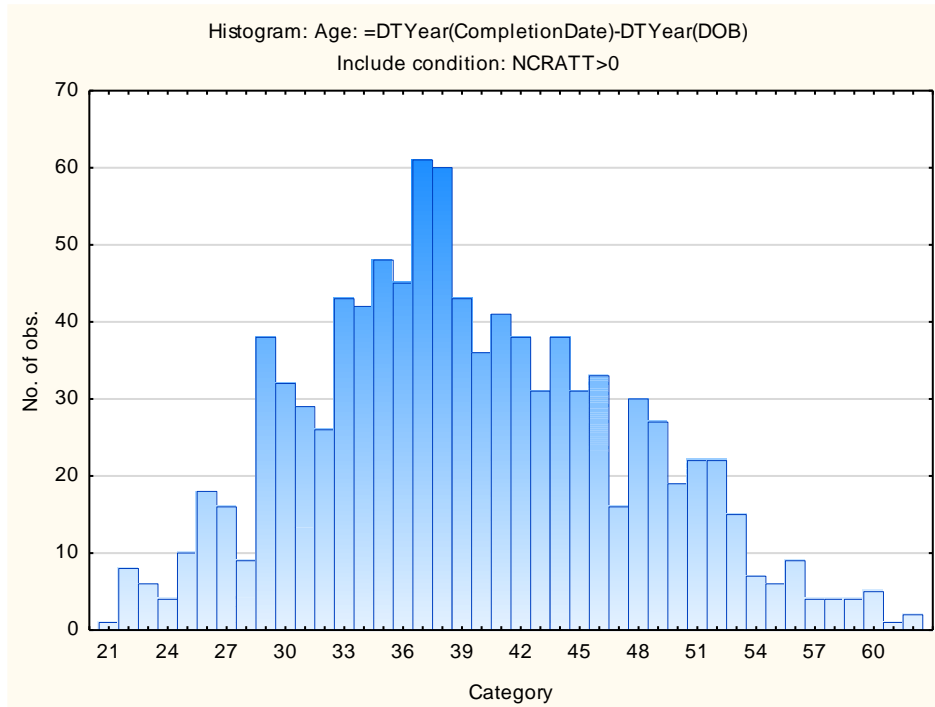
Category	Frequency table: Education			
	Count	Cumulative Count	Percent	Cumulative Percent
Grade 12	28	28	2.57117	2.5712
Post Graduate	460	488	42.24059	44.8118
Tertiary	446	934	40.95500	85.7668
Tertiary Cert / Trade	87	1021	7.98898	93.7557
Missing	68	1089	6.24426	100.0000

Category	Frequency table: Race			
	Count	Cumulative Count	Percent	Cumulative Percent
European	180	180	16.52893	16.5289
Coloured	61	241	5.60147	22.1304
African	553	794	50.78053	72.9109
Indian	76	870	6.97888	79.8898
Asian	8	878	0.73462	80.6244
Missing	211	1089	19.37557	100.0000

Category	Frequency table: Language			
	Count	Cumulative Count	Percent	Cumulative Percent
English	609	609	55.92287	55.9229
Afrikaans	117	726	10.74380	66.6667
Setswana	41	767	3.76492	70.4316
isiXhosa	31	798	2.84665	73.2782
Sepedi	16	814	1.46924	74.7475
Sesotho	19	833	1.74472	76.4922
siSwati	4	837	0.36731	76.8595
isiZulu	39	876	3.58127	80.4408
Xitsonga	6	882	0.55096	80.9917
isiNdebele	5	887	0.45914	81.4509
Tshivenda	9	896	0.82645	82.2773
Missing	193	1089	17.72268	100.0000

Category	Frequency table: Language Group			
	Count	Cumulative Count	Percent	Cumulative Percent
English	609	609	55.92287	55.9229
Afrikaans	117	726	10.74380	66.6667
Indigenous	170	896	15.61065	82.2773
Missing	193	1089	17.72268	100.0000

Variable	Descriptive Statistics: Age				N	No.cases Missing
	Mean	Std.Dev	Minimum	Maximum		
Age	39.32755	8.070037	21.00000	62.00000	980	109



## Critical Verbal Reasoning Test: Biographical Composition

Category	Frequency table: Sex			
	Count	Cumulative Count	Percent	Cumulative Percent
M	624	624	57.19523	57.1952
F	466	1090	42.71311	99.9083
U	1	1091	0.09166	100.0000
Missing	0	1091	0.00000	100.0000

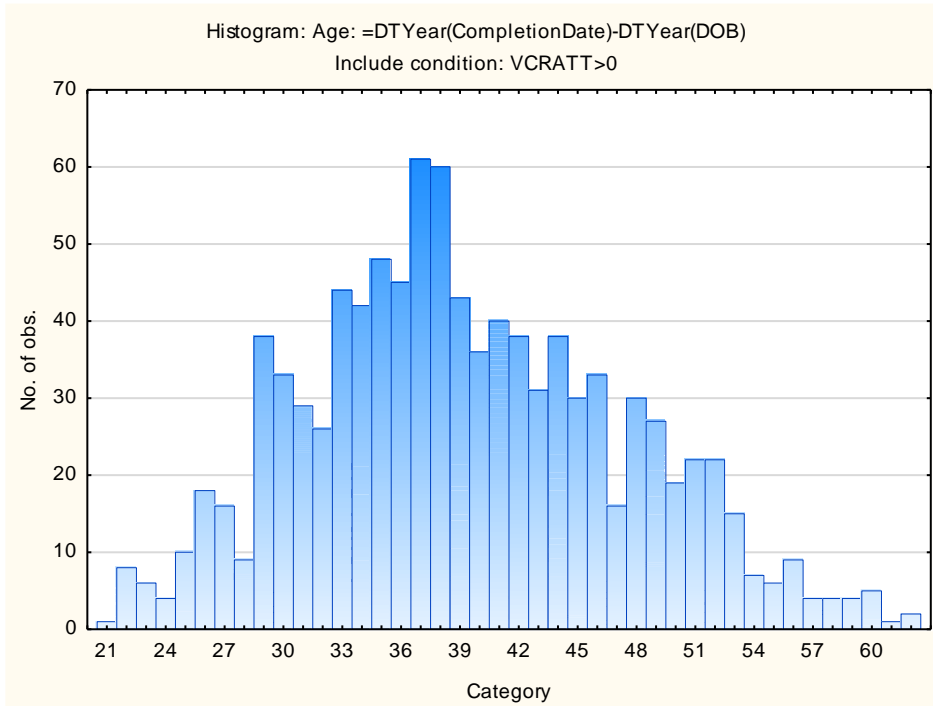
Category	Frequency table: Education			
	Count	Cumulative Count	Percent	Cumulative Percent
Grade 12	28	28	2.56645	2.5665
Post Graduate	460	488	42.16315	44.7296
Tertiary	447	935	40.97159	85.7012
Tertiary Cert / Trade	87	1022	7.97434	93.6755
Missing	69	1091	6.32447	100.0000

Category	Frequency table: Race			
	Count	Cumulative Count	Percent	Cumulative Percent
European	180	180	16.49863	16.4986
Coloured	61	241	5.59120	22.0898
African	553	794	50.68744	72.7773
Indian	77	871	7.05775	79.8350
Asian	8	879	0.73327	80.5683
Missing	212	1091	19.43171	100.0000

Category	Frequency table: Language			
	Count	Cumulative Count	Percent	Cumulative Percent
English	609	609	55.82035	55.8203
Afrikaans	117	726	10.72411	66.5445
Setswana	41	767	3.75802	70.3025
isiXhosa	31	798	2.84143	73.1439
Sepedi	16	814	1.46654	74.6104
Sesotho	19	833	1.74152	76.3520
siSwati	4	837	0.36664	76.7186
isiZulu	40	877	3.66636	80.3850
Xitsonga	6	883	0.54995	80.9349
isiNdebele	5	888	0.45830	81.3932
Tshivenda	9	897	0.82493	82.2181
Missing	194	1091	17.78185	100.0000

Category	Frequency table: Language Group			
	Count	Cumulative Count	Percent	Cumulative Percent
English	609	609	55.82035	55.8203
Afrikaans	117	726	10.72411	66.5445
Indigenous	171	897	15.67369	82.2181
Missing	194	1091	17.78185	100.0000

Variable	Descriptive Statistics: Age					
	Mean	Std.Dev	Minimum	Maximum	N	No.cases Missing
Age	39.30408	8.075827	21.00000	62.00000	980	111

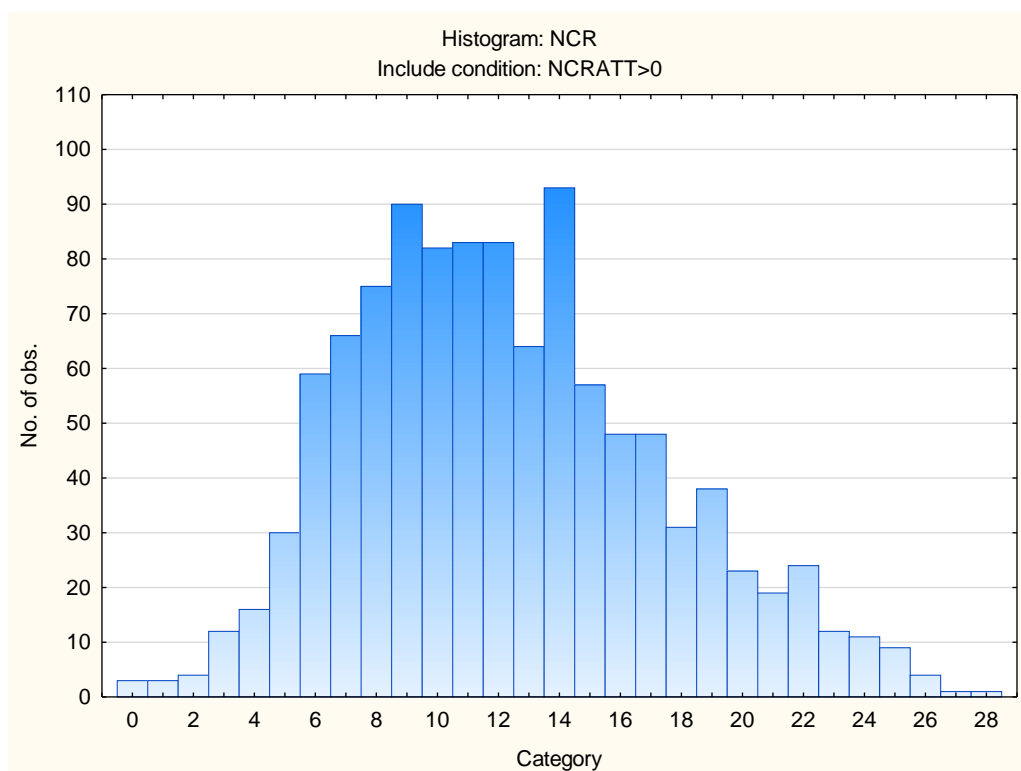




# Descriptive Statistics and Frequency Distributions on Critical Reasoning Test Battery Subtests

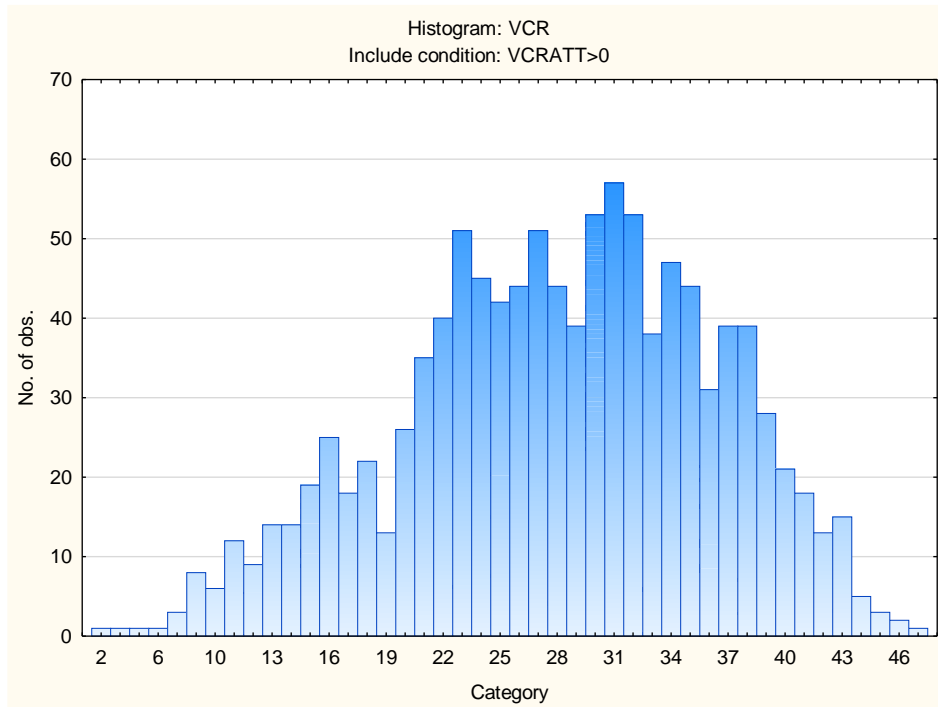
## Critical Numerical Reasoning Test

Variable	Descriptive Statistics					
	Mean	Std.Dev	Minimum	Maximum	N	No.cases Missing
NCR	12.28650	5.063441	0.00	28.00000	1089	0



## Critical Verbal Reasoning Test

Variable	Descriptive Statistics: Age					
	Mean	Std.Dev	Minimum	Maximum	N	No.cases Missing
VCR	28.03300	8.227321	2.000000	47.000000	1091	0



## Stanine table

Scales	Stanine Groups								
	S9_1	S9_2	S9_3	S9_4	S9_5	S9_6	S9_7	S9_8	S9_9
Critical Numerical Reasoning	2-13	14-17	18-21	22-25	26-30	31-34	35-38	39-42	43-47
Critical Verbal Reasoning	0-3	4-5	6-8	9-11	12-13	14-16	17-18	19-21	22-28

# Critical Reasoning Test Battery – item-banked (CRTBi) – Norm Group 2 South Africans, English Language Group, Updated 2021

## Sample Composition

The sample consisted of South Africans tested by Psytech South Africa and collaborators from June 2015 to March 2021. Since not all respondents completed all the subtests of the CRTBi, biographical characteristics are reported separately for the different subtests.

## Critical Numerical Reasoning Test: Biographical Composition

Category	Frequency table: Sex			
	Count	Cumulative Count	Percent	Cumulative Percent
M	338	338	55.50082	55.5008
F	271	609	44.49918	100.0000
Missing	0	609	0.00000	100.0000

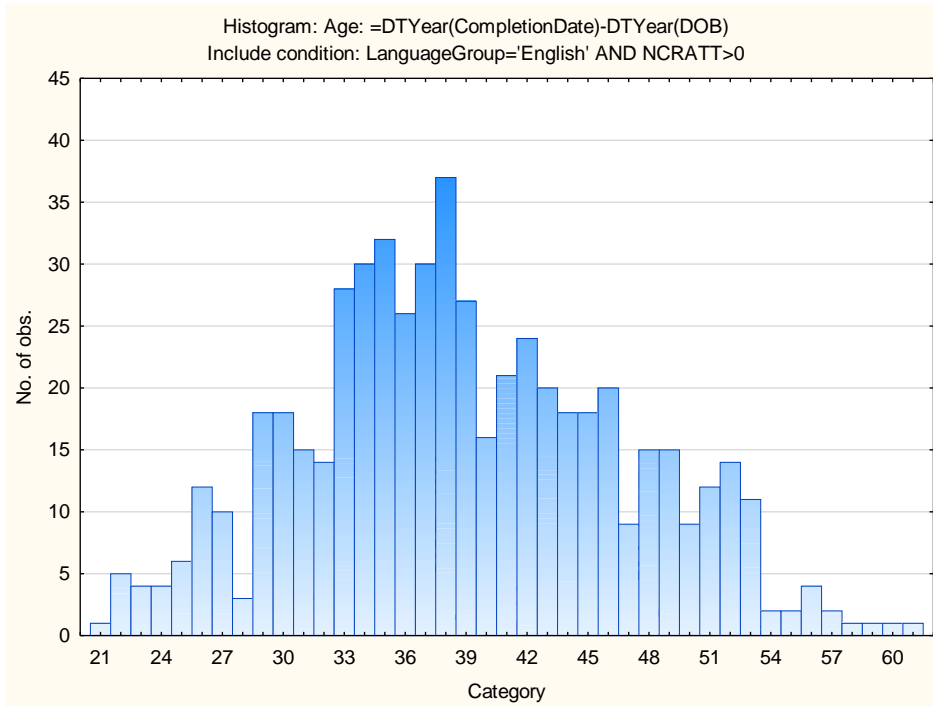
Category	Frequency table: Education			
	Count	Cumulative Count	Percent	Cumulative Percent
Grade 12	18	18	2.95567	2.9557
Post Graduate	266	284	43.67816	46.6338
Tertiary	265	549	43.51396	90.1478
Tertiary Cert / Trade	55	604	9.03120	99.1790
Missing	5	609	0.82102	100.0000

Category	Frequency table: Race			
	Count	Cumulative Count	Percent	Cumulative Percent
European	72	72	11.82266	11.8227
Coloured	56	128	9.19540	21.0181
African	328	456	53.85878	74.8768
Indian	76	532	12.47947	87.3563
Asian	7	539	1.14943	88.5057
Missing	70	609	11.49425	100.0000

Category	Frequency table: Language			
	Count	Cumulative Count	Percent	Cumulative Percent
English	609	609	100.0000	100.0000
Missing	0	609	0.0000	100.0000

Category	Frequency table: Language Group			
	Count	Cumulative Count	Percent	Cumulative Percent
English	609	609	100.0000	100.0000
Missing	0	609	0.0000	100.0000

Variable	Descriptive Statistics: Age					
	Mean	Std.Dev	Minimum	Maximum	N	No.cases Missing
Age	38.87590	7.832991	21.00000	61.00000	556	53



### Critical Verbal Reasoning Test: Biographical Composition

Category	Frequency table: Sex			
	Count	Cumulative Count	Percent	Cumulative Percent
M	338	338	55.50082	55.5008
F	271	609	44.49918	100.0000
Missing	0	609	0.00000	100.0000

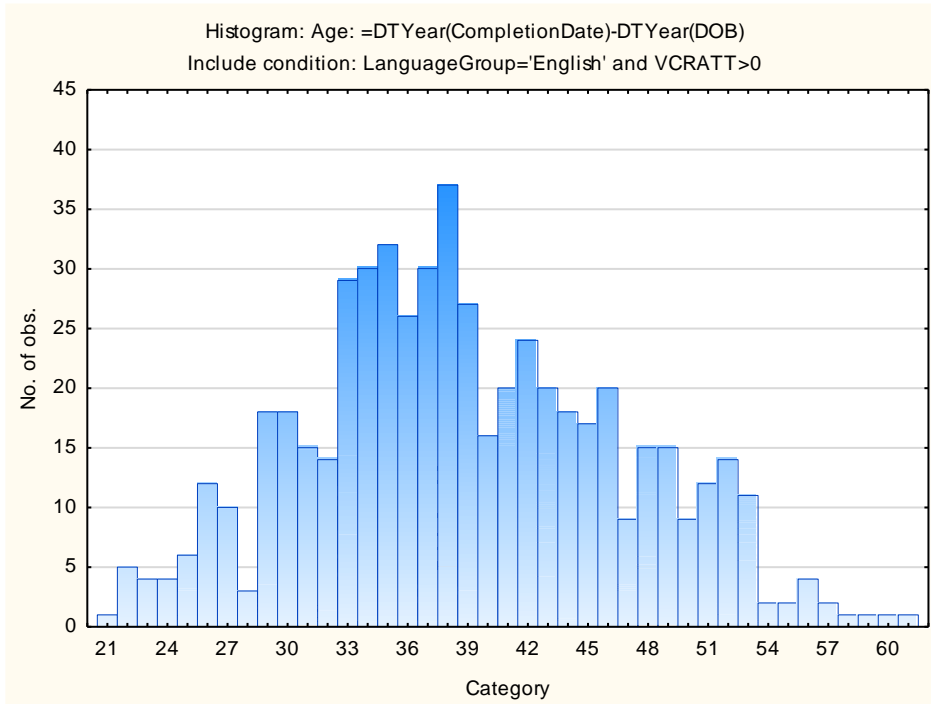
Category	Frequency table: Education			
	Count	Cumulative Count	Percent	Cumulative Percent
Grade 12	18	18	2.95567	2.9557
Post Graduate	265	283	43.51396	46.4696
Tertiary	266	549	43.67816	90.1478
Tertiary Cert / Trade	55	604	9.03120	99.1790
Missing	5	609	0.82102	100.0000

Category	Frequency table: Race			
	Count	Cumulative Count	Percent	Cumulative Percent
European	72	72	11.82266	11.8227
Coloured	56	128	9.19540	21.0181
African	327	455	53.69458	74.7126
Indian	77	532	12.64368	87.3563
Asian	7	539	1.14943	88.5057
Missing	70	609	11.49425	100.0000

Category	Frequency table: Language			
	Count	Cumulative Count	Percent	Cumulative Percent
English	609	609	100.0000	100.0000
Missing	0	609	0.0000	100.0000

Category	Frequency table: Language Group			
	Count	Cumulative Count	Percent	Cumulative Percent
English	609	609	100.0000	100.0000
Missing	0	609	0.0000	100.0000

Variable	Descriptive Statistics: Age					
	Mean	Std.Dev	Minimum	Maximum	N	No. cases Missing
Age	38.85045	7.839153	21.00000	61.00000	555	54

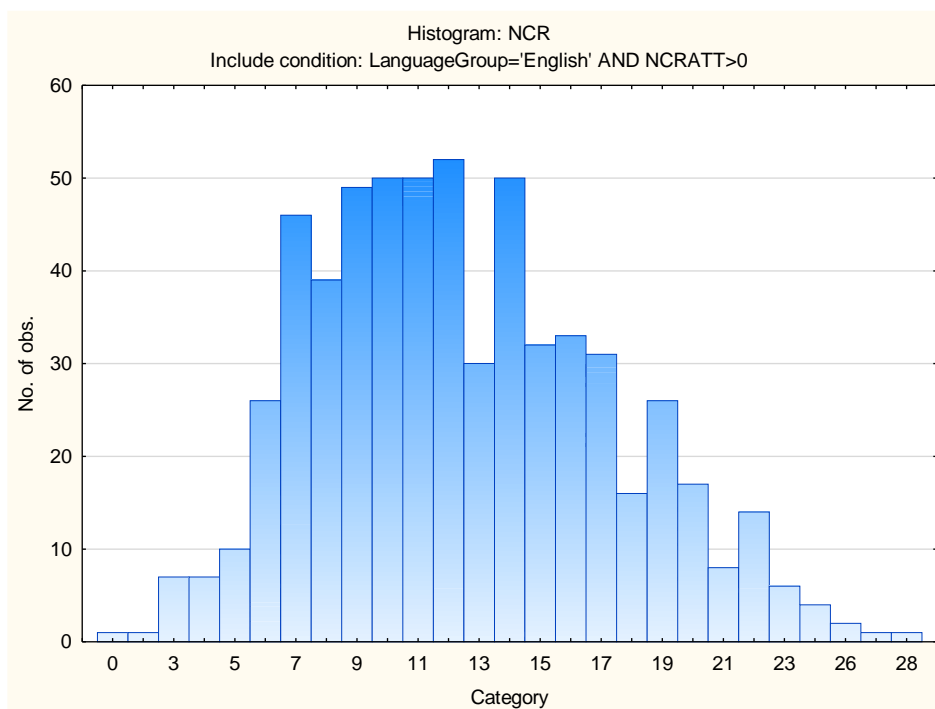




## Descriptive Statistics and Frequency Distributions on Critical Reasoning Test Battery – Item-Banked Subtests

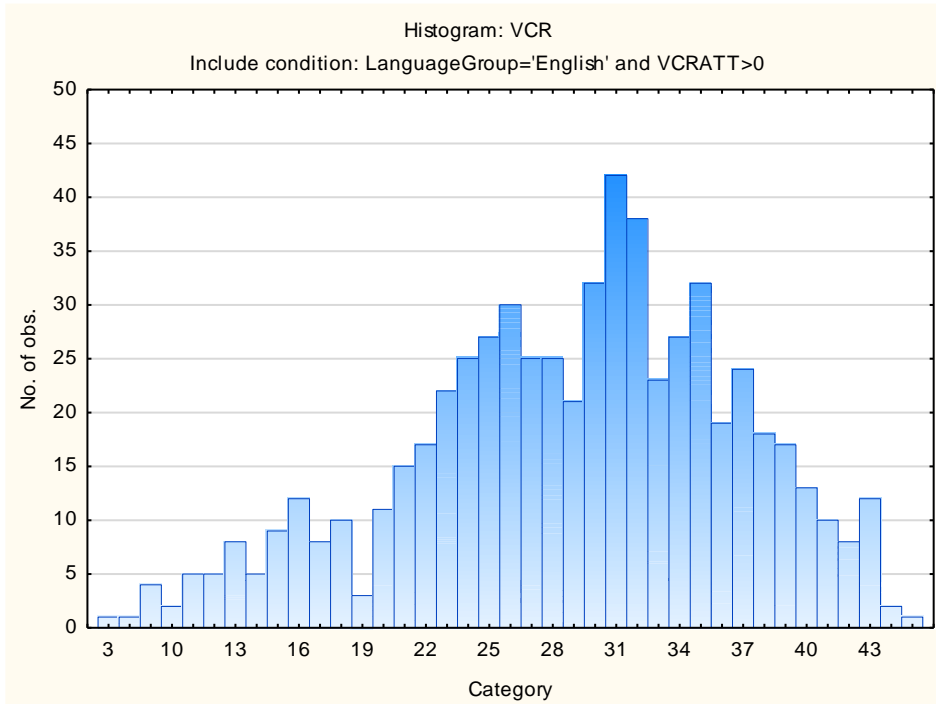
### Critical Numerical Reasoning Test

Variable	Descriptive Statistics					
	Mean	Std.Dev	Minimum	Maximum	N	No. cases Missing
NCR	12.43514	4.822113	0.00	28.00000	609	0



### Critical Verbal Reasoning Test

Variable	Descriptive Statistics					
	Mean	Std.Dev	Minimum	Maximum	N	No. cases Missing
VCR	28.93760	7.814211	3.000000	47.00000	609	0



## Stanine table

Scales	Stanine Groups								
	S9_1	S9_2	S9_3	S9_4	S9_5	S9_6	S9_7	S9_8	S9_9
Critical Verbal Reasoning	3-15	16-19	20-23	24-26	27-30	31-34	35-38	39-42	43-47
Critical Numerical Reasoning	0-3	4-6	7-8	9-11	12-13	14-16	17-18	19-20	21-28

# Critical Reasoning Test Battery – Item-Banked (CRTBi) – Norm Group 3

## South Africans, Afrikaans Language Group, Updated 2021

### Sample Composition

The sample consisted of South Africans tested by Psytech South Africa and collaborators from June 2015 to March 2021. Since not all respondents completed all the subtests of the CRTBi, biographical characteristics are reported separately for the different subtests.

### Critical Numerical Reasoning Test: Biographical Composition

Category	Frequency table: Sex			
	Count	Cumulative Count	Percent	Cumulative Percent
M	65	65	55.55556	55.5556
F	52	117	44.44444	100.0000
Missing	0	117	0.00000	100.0000

Category	Frequency table: Education			
	Count	Cumulative Count	Percent	Cumulative Percent
Grade 12	6	6	5.12821	5.1282
Post Graduate	37	43	31.62393	36.7521
Tertiary	60	103	51.28205	88.0342
Tertiary Cert / Trade	12	115	10.25641	98.2906
Missing	2	117	1.70940	100.0000

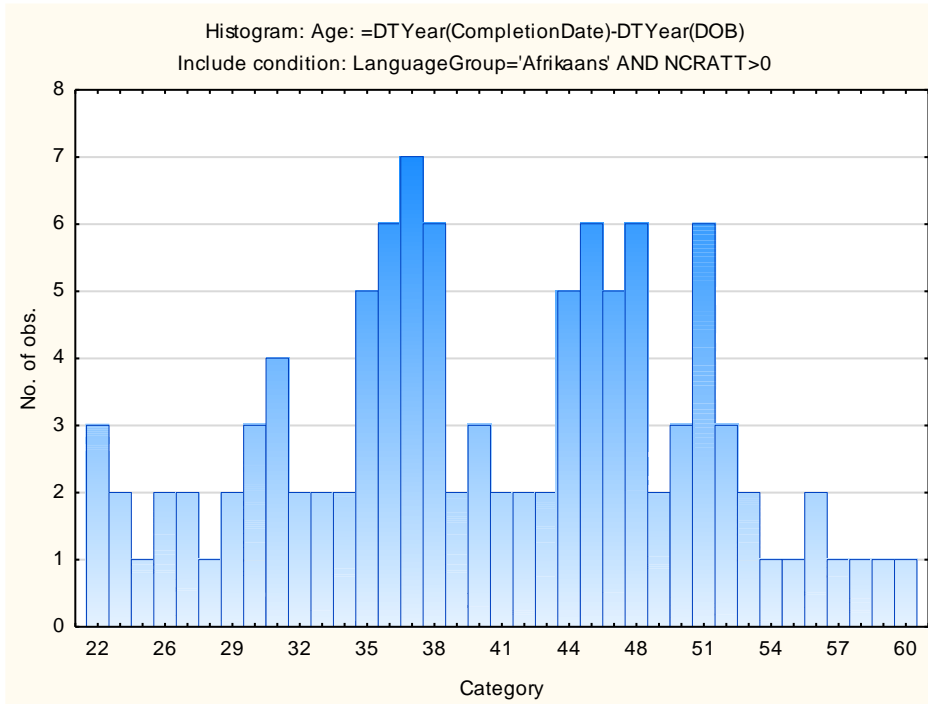
Category	Frequency table: Race			
	Count	Cumulative Count	Percent	Cumulative Percent
European	105	105	89.74359	89.7436

Category	Frequency table: Race			
	Count	Cumulative Count	Percent	Cumulative Percent
Coloured	4	109	3.41880	93.1624
African	5	114	4.27350	97.4359
Missing	3	117	2.56410	100.0000

Category	Frequency table: Language			
	Count	Cumulative Count	Percent	Cumulative Percent
Afrikaans	117	117	100.0000	100.0000
Missing	0	117	0.0000	100.0000

Category	Frequency table: Language Group			
	Count	Cumulative Count	Percent	Cumulative Percent
Afrikaans	117	117	100.0000	100.0000
Missing	0	117	0.0000	100.0000

Variable	Descriptive Statistics: Age					
	Mean	Std.Dev	Minimum	Maximum	N	No. cases Missing
Age	40.63551	9.299414	22.00000	60.00000	107	10



### Critical Verbal Reasoning Test: Biographical Composition

Category	Frequency table: Sex			
	Count	Cumulative Count	Percent	Cumulative Percent
M	65	65	55.55556	55.5556
F	52	117	44.44444	100.0000
Missing	0	117	0.00000	100.0000

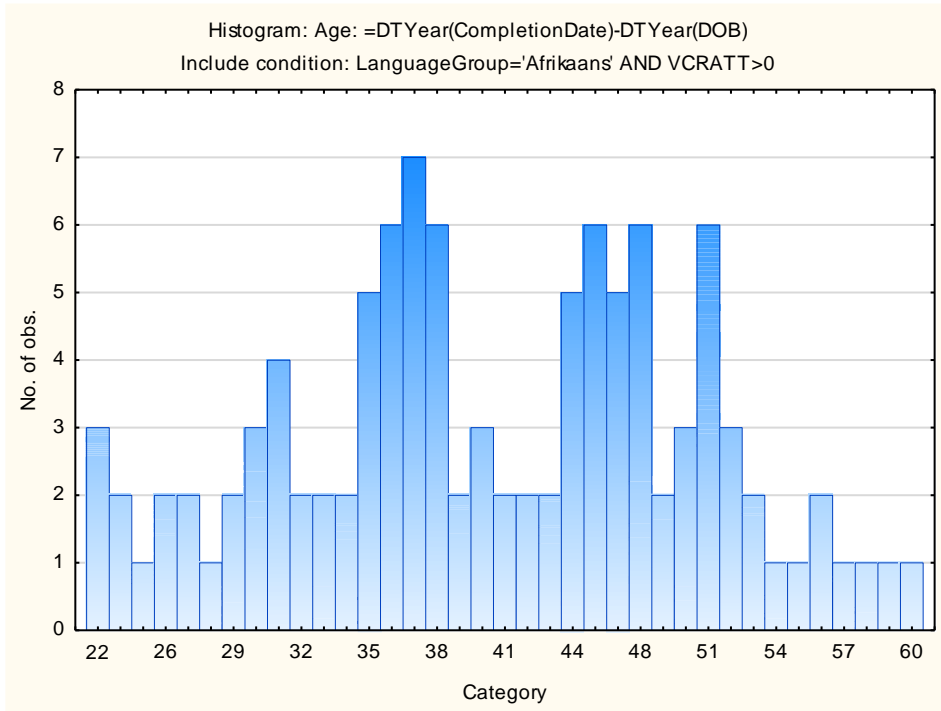
Category	Frequency table: Education			
	Count	Cumulative Count	Percent	Cumulative Percent
Grade 12	6	6	5.12821	5.1282
Post Graduate	37	43	31.62393	36.7521
Tertiary	60	103	51.28205	88.0342
Tertiary Cert / Trade	12	115	10.25641	98.2906
Missing	2	117	1.70940	100.0000

Category	Frequency table: Race			
	Count	Cumulative Count	Percent	Cumulative Percent
European	105	105	89.74359	89.7436
Coloured	4	109	3.41880	93.1624
African	5	114	4.27350	97.4359
Missing	3	117	2.56410	100.0000

Category	Frequency table: Language			
	Count	Cumulative Count	Percent	Cumulative Percent
Afrikaans	117	117	100.0000	100.0000
Missing	0	117	0.0000	100.0000

Category	Frequency table: Language Group			
	Count	Cumulative Count	Percent	Cumulative Percent
Afrikaans	117	117	100.0000	100.0000
Missing	0	117	0.0000	100.0000

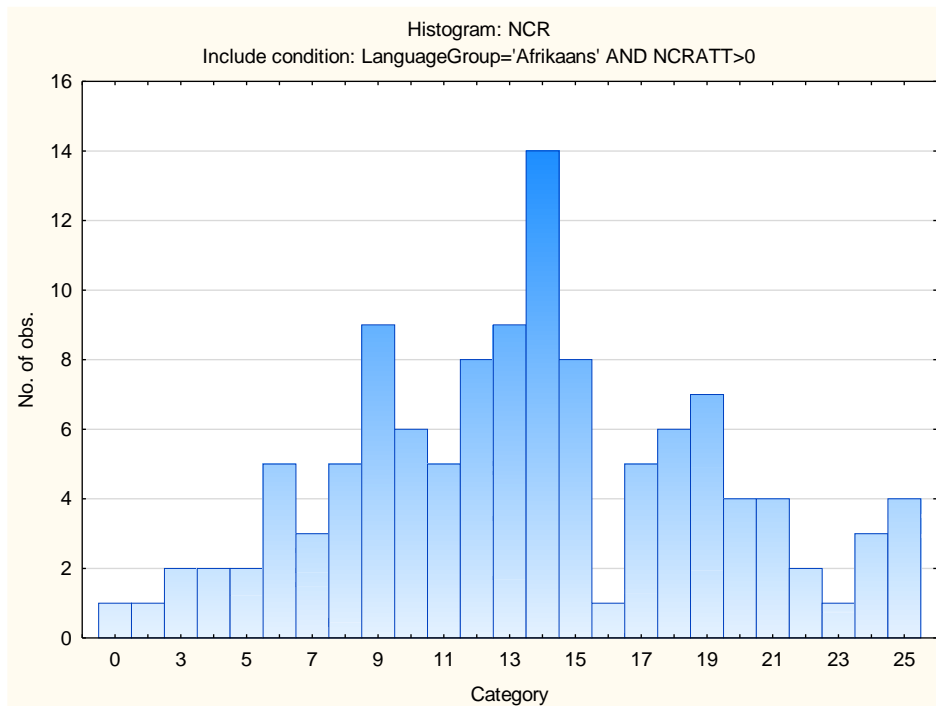
Variable	Descriptive Statistics: Age					
	Mean	Std.Dev	Minimum	Maximum	N	No. cases Missing
Age:	40.63551	9.299414	22.00000	60.00000	107	10



## Descriptive Statistics and Frequency Distributions on Critical Reasoning Test Battery – Item-Banked Subtests

### Critical Numerical Reasoning Test

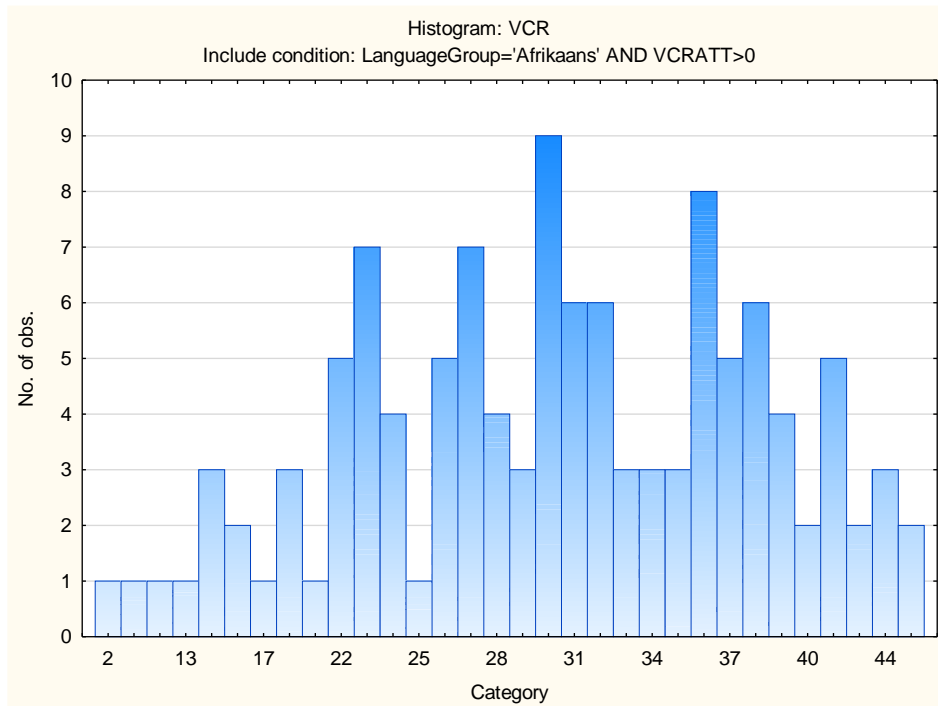
Variable	Descriptive Statistics					
	Mean	Std.Dev	Minimum	Maximum	N	No. cases Missing
NCR	13.56410	5.599237	0.00	25.00000	117	0



### Critical Verbal Reasoning Test

Variable	Descriptive Statistics					
	Mean	Std.Dev	Minimum	Maximum	N	No. cases Missing
VCR	30.07692	8.361605	2.000000	45.00000	117	0





## Stanine table

Scales	Stanine Groups								
	S9_1	S9_2	S9_3	S9_4	S9_5	S9_6	S9_7	S9_8	S9_9
Critical Verbal Reasoning	2-15	16-19	20-23	24-27	28-32	33-36	37-40	41-44	45-45
Critical Numerical Reasoning	0-3	4-6	7-9	10-12	13-14	15-17	18-20	21-23	24-25

# Critical Reasoning Test Battery – Item-Banked (CRTBi) – Norm Group 4 South Africans, Indigenous Language Group, Updated 2021

## Sample Composition

The sample consisted of South Africans tested by Psytech South Africa and collaborators from June 2015 to March 2021. Since not all respondents completed all the subtests of the CRTBi, biographical characteristics are reported separately for the different subtests.

## Critical Numerical Reasoning Test: Biographical Composition

Category	Frequency table: Sex			
	Count	Cumulative Count	Percent	Cumulative Percent
M	99	99	57.89474	57.8947
F	72	171	42.10526	100.0000
Missing	0	171	0.00000	100.0000

Category	Frequency table: Education			
	Count	Cumulative Count	Percent	Cumulative Percent
Grade 12	1	1	0.58480	0.5848
Post Graduate	79	80	46.19883	46.7836
Tertiary	71	151	41.52047	88.3041
Tertiary Cert / Trade	19	170	11.11111	99.4152
Missing	1	171	0.58480	100.0000

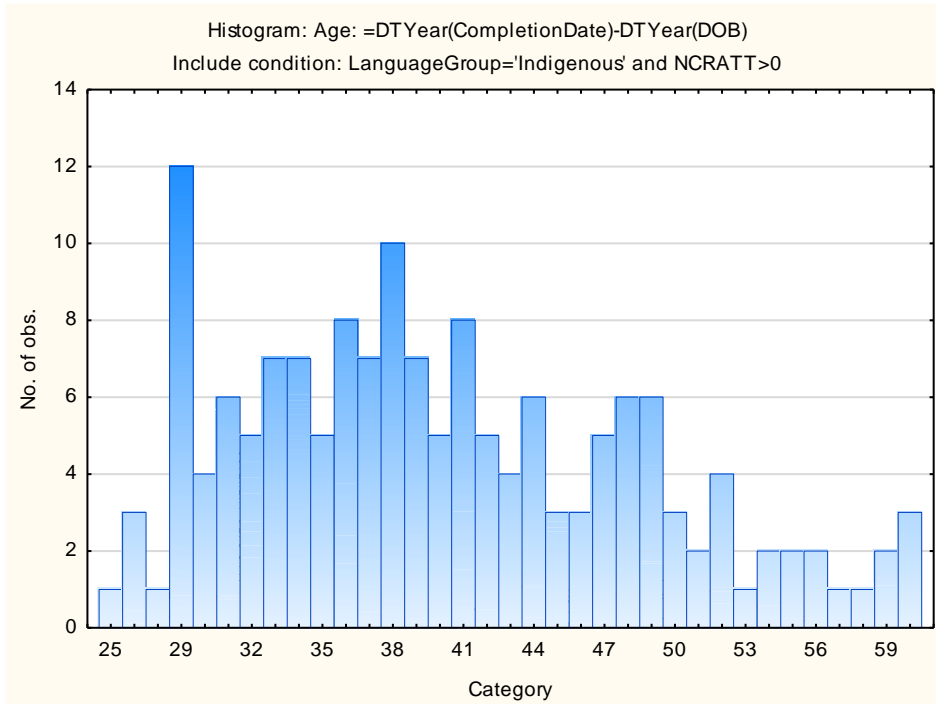
Category	Frequency table: Race			
	Count	Cumulative Count	Percent	Cumulative Percent
African	162	162	94.73684	94.7368
Missing	9	171	5.26316	100.0000

Category	Frequency table: Language			
	Count	Cumulative Count	Percent	Cumulative Percent
Setswana	41	41	24.11765	24.1176
isiXhosa	31	72	18.23529	42.3529
Sepedi	16	88	9.41176	51.7647
Sesotho	19	107	11.17647	62.9412
siSwati	4	111	2.35294	65.2941
isiZulu	39	150	22.94118	88.2353
Xitsonga	6	156	3.52941	91.7647
isiNdebele	5	161	2.94118	94.7059
Tshivenda	9	170	5.29412	100.0000
Missing	0	170	0.00000	100.0000

Category	Frequency table: Language Group			
	Count	Cumulative Count	Percent	Cumulative Percent
Indigenous	170	170	100.0000	100.0000
Missing	0	170	0.0000	100.0000

Category	Frequency table: Sex			
	Count	Cumulative Count	Percent	Cumulative Percent
M	98	98	57.64706	57.6471
F	72	170	42.35294	100.0000
Missing	0	170	0.00000	100.0000

Variable	Descriptive Statistics: Age					
	Mean	Std.Dev	Minimum	Maximum	N	No. cases Missing
Age	40.18471	8.473807	25.00000	60.00000	157	13



### Critical Verbal Reasoning Test: Biographical Composition

Category	Frequency table: Sex			
	Count	Cumulative Count	Percent	Cumulative Percent
M	99	99	57.89474	57.8947
F	72	171	42.10526	100.0000
Missing	0	171	0.00000	100.0000

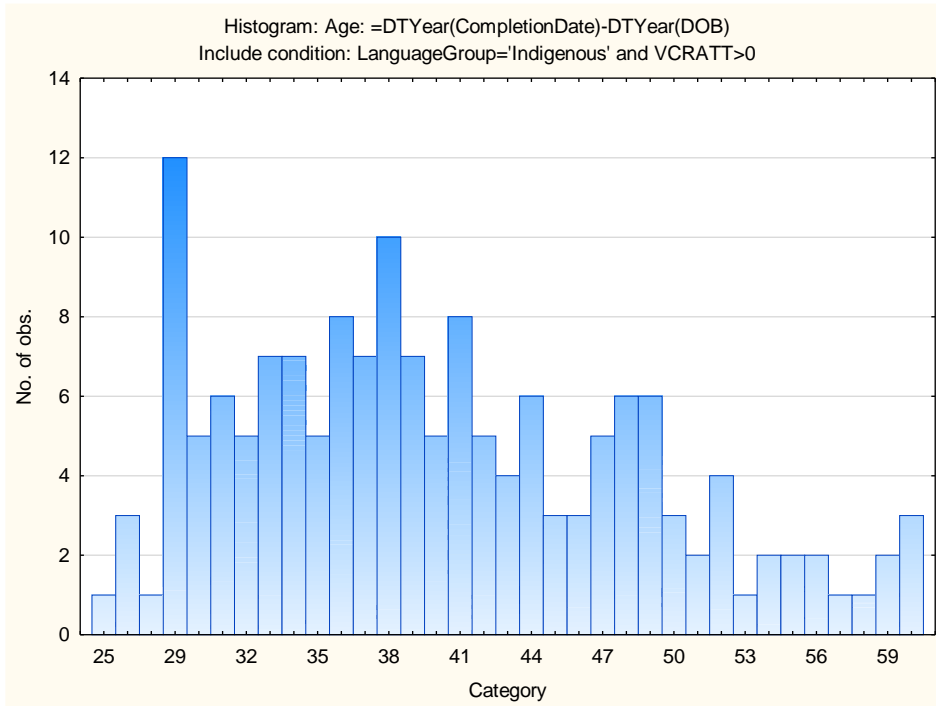
Category	Frequency table: Education			
	Count	Cumulative Count	Percent	Cumulative Percent
Grade 12	1	1	0.58480	0.5848
Post Graduate	79	80	46.19883	46.7836
Tertiary	71	151	41.52047	88.3041
Tertiary Cert / Trade	19	170	11.11111	99.4152
Missing	1	171	0.58480	100.0000

Category	Frequency table: Race			
	Count	Cumulative Count	Percent	Cumulative Percent
African	162	162	94.73684	94.7368
Missing	9	171	5.26316	100.0000

Category	Frequency table: Language			
	Count	Cumulative Count	Percent	Cumulative Percent
Setswana	41	41	23.97661	23.9766
isiXhosa	31	72	18.12865	42.1053
Sepedi	16	88	9.35673	51.4620
Sesotho	19	107	11.11111	62.5731
siSwati	4	111	2.33918	64.9123
isiZulu	40	151	23.39181	88.3041
Xitsonga	6	157	3.50877	91.8129
isiNdebele	5	162	2.92398	94.7368
Tshivenda	9	171	5.26316	100.0000
Missing	0	171	0.00000	100.0000

Category	Frequency table: Language Group			
	Count	Cumulative Count	Percent	Cumulative Percent
Indigenous	171	171	100.0000	100.0000
Missing	0	171	0.0000	100.0000

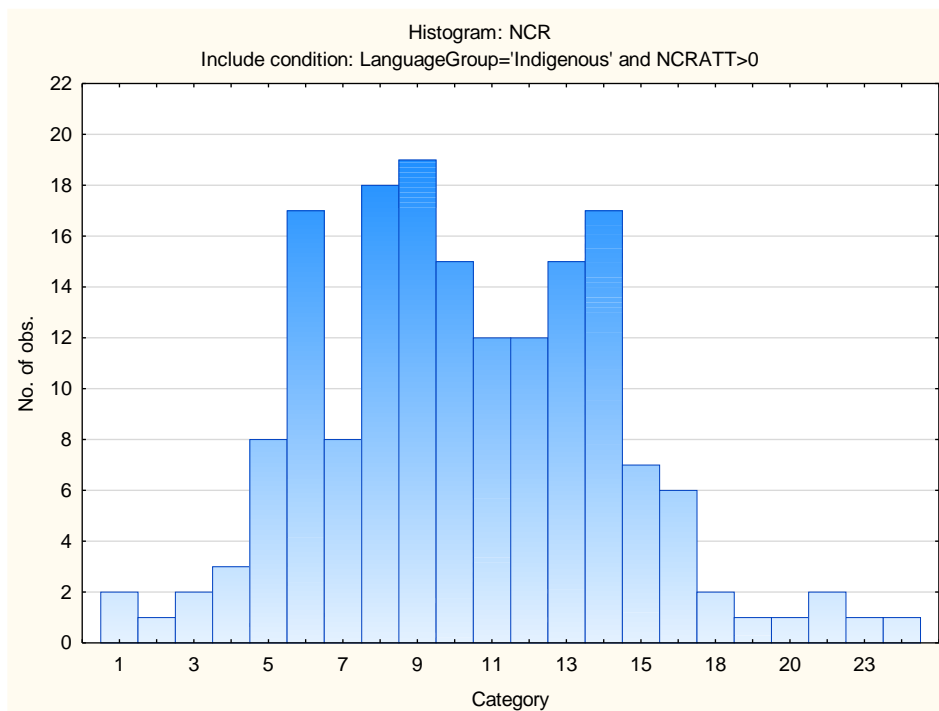
Variable	Descriptive Statistics: Age					
	Mean	Std.Dev	Minimum	Maximum	N	No. cases Missing
Age	40.12025	8.485550	25.00000	60.00000	158	13



## Descriptive Statistics and Frequency Distributions on Critical Reasoning Test Battery – Item-Banked Subtests

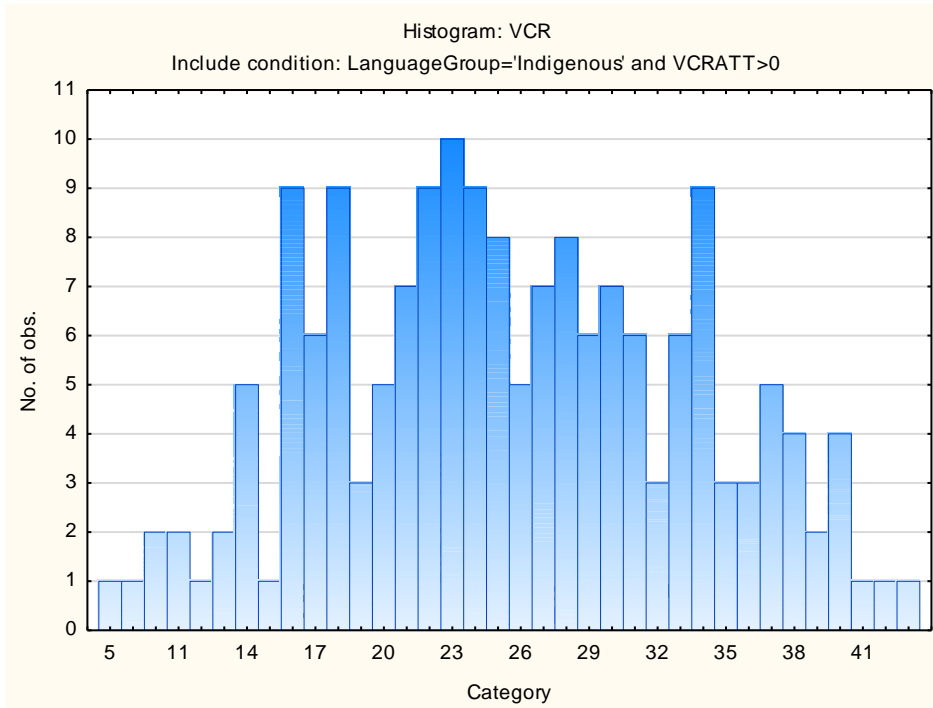
### Critical Numerical Reasoning Test

Variable	Descriptive Statistics					
	Mean	Std.Dev	Minimum	Maximum	N	No. cases Missing
NCR	10.34706	4.085277	1.000000	24.00000	170	0



### Critical Verbal Reasoning Test

Variable	Descriptive Statistics					
	Mean	Std.Dev	Minimum	Maximum	N	No. cases Missing
VCR	25.51462	7.953066	5.000000	44.00000	171	0



## Stanine table

Scales	Stanine Groups								
	S9_1	S9_2	S9_3	S9_4	S9_5	S9_6	S9_7	S9_8	S9_9
Critical Numerical Reasoning	5-11	12-15	16-19	20-23	24-27	28-31	32-35	36-39	40-44
Critical Verbal Reasoning	1-3	4-5	6-7	8-9	10-11	12-13	14-15	16-17	18-24



# Index of Reliability Studies Done on The Critical Reasoning Test Battery – Item-Banked (CRTBi)

<b>Description</b>	<b>Study number</b>
SA Aggregate Population 2021	R1
SA English Language Group 2021	R2
SA Afrikaans Language Group 2021	R3
SA Indigenous Language Group 2021	R4

# Critical Reasoning Test Battery – item-banked (CRTBi)- Reliability Group 1 South Africans, Aggregate Population, Updated 2021

## Sample Composition

The sample consisted of South Africans tested by Psytech South Africa and collaborators from June 2015 to March 2021. Since not all respondents completed all the subtests of the CRTBi, biographical characteristics are reported separately for the different subtests.

## Critical Numerical Reasoning Test: Biographical Composition

Category	Frequency table: Sex			
	Count	Cumulative Count	Percent	Cumulative Percent
M	623	623	57.20845	57.2084
F	465	1088	42.69972	99.9082
U	1	1089	0.09183	100.0000
Missing	0	1089	0.00000	100.0000

Category	Frequency table: Education			
	Count	Cumulative Count	Percent	Cumulative Percent
Grade 12	28	28	2.57117	2.5712
Post Graduate	460	488	42.24059	44.8118
Tertiary	446	934	40.95500	85.7668
Tertiary Cert / Trade	87	1021	7.98898	93.7557
Missing	68	1089	6.24426	100.0000

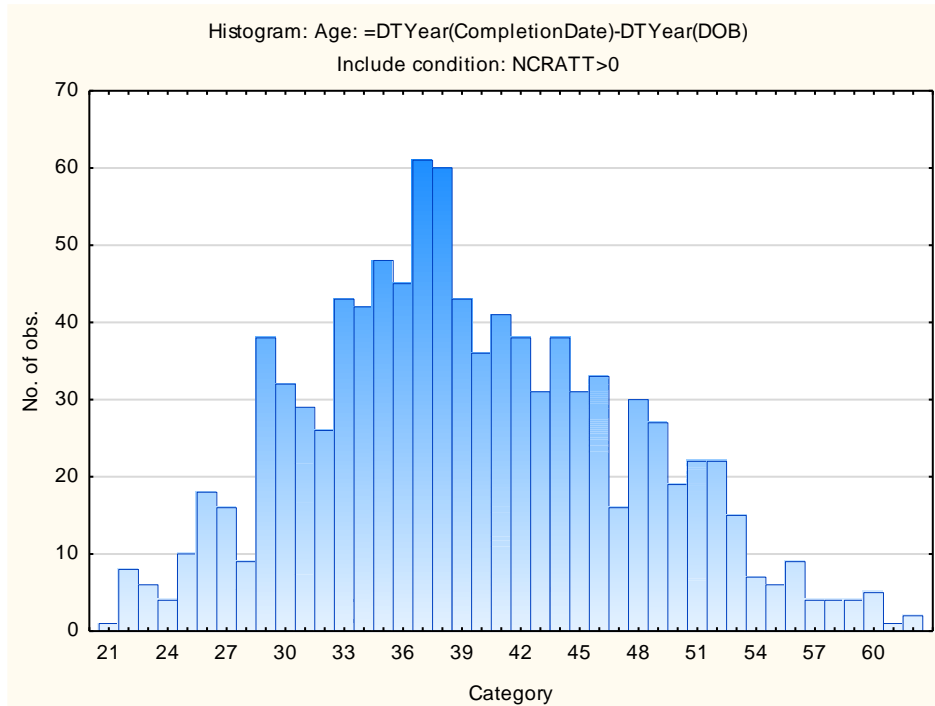
Category	Frequency table: Race			
	Count	Cumulative Count	Percent	Cumulative Percent
European	180	180	16.52893	16.5289

Category	Frequency table: Race			
	Count	Cumulative Count	Percent	Cumulative Percent
Coloured	61	241	5.60147	22.1304
African	553	794	50.78053	72.9109
Indian	76	870	6.97888	79.8898
Asian	8	878	0.73462	80.6244
Missing	211	1089	19.37557	100.0000

Category	Frequency table: Language			
	Count	Cumulative Count	Percent	Cumulative Percent
English	609	609	55.92287	55.9229
Afrikaans	117	726	10.74380	66.6667
Setswana	41	767	3.76492	70.4316
isiXhosa	31	798	2.84665	73.2782
Sepedi	16	814	1.46924	74.7475
Sesotho	19	833	1.74472	76.4922
siSwati	4	837	0.36731	76.8595
isiZulu	39	876	3.58127	80.4408
Xitsonga	6	882	0.55096	80.9917
isiNdebele	5	887	0.45914	81.4509
Tshivenda	9	896	0.82645	82.2773
Missing	193	1089	17.72268	100.0000

Category	Frequency table: Language Group			
	Count	Cumulative Count	Percent	Cumulative Percent
English	609	609	55.92287	55.9229
Afrikaans	117	726	10.74380	66.6667
Indigenous	170	896	15.61065	82.2773
Missing	193	1089	17.72268	100.0000

Variable	Descriptive Statistics: Age					N	No. cases Missing
	Mean	Std.Dev	Minimum	Maximum			
Age	39.32755	8.070037	21.00000	62.00000		980	109



## Critical Verbal Reasoning Test: Biographical Composition

Category	Frequency table: Sex			
	Count	Cumulative Count	Percent	Cumulative Percent
M	624	624	57.19523	57.1952
F	466	1090	42.71311	99.9083
U	1	1091	0.09166	100.0000
Missing	0	1091	0.00000	100.0000

Category	Frequency table: Education			
	Count	Cumulative Count	Percent	Cumulative Percent
Grade 12	28	28	2.56645	2.5665
Post Graduate	460	488	42.16315	44.7296
Tertiary	447	935	40.97159	85.7012

Category	Frequency table: Education			
	Count	Cumulative Count	Percent	Cumulative Percent
Tertiary Cert / Trade	87	1022	7.97434	93.6755
Missing	69	1091	6.32447	100.0000

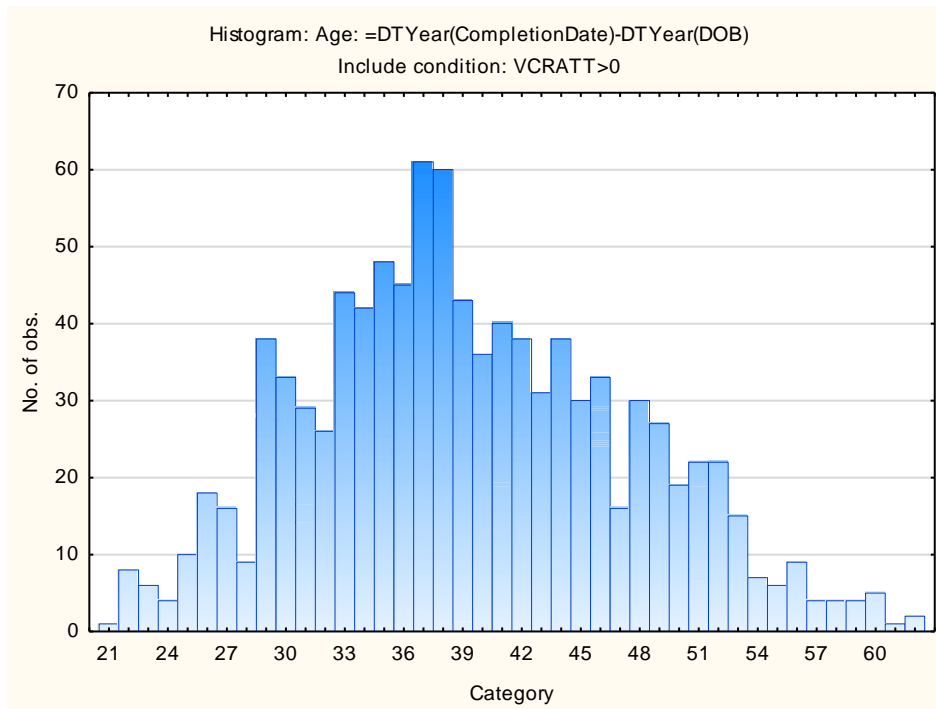
Category	Frequency table: Race			
	Count	Cumulative Count	Percent	Cumulative Percent
European	180	180	16.49863	16.4986
Coloured	61	241	5.59120	22.0898
African	553	794	50.68744	72.7773
Indian	77	871	7.05775	79.8350
Asian	8	879	0.73327	80.5683
Missing	212	1091	19.43171	100.0000

Category	Frequency table: Language			
	Count	Cumulative Count	Percent	Cumulative Percent
English	609	609	55.82035	55.8203
Afrikaans	117	726	10.72411	66.5445
Setswana	41	767	3.75802	70.3025
isiXhosa	31	798	2.84143	73.1439
Sepedi	16	814	1.46654	74.6104
Sesotho	19	833	1.74152	76.3520
siSwati	4	837	0.36664	76.7186
isiZulu	40	877	3.66636	80.3850
Xitsonga	6	883	0.54995	80.9349
isiNdebele	5	888	0.45830	81.3932
Tshivenda	9	897	0.82493	82.2181
Missing	194	1091	17.78185	100.0000

Category	Frequency table: Language Group			
	Count	Cumulative Count	Percent	Cumulative Percent
English	609	609	55.82035	55.8203

Category	Frequency table: Language Group			
	Count	Cumulative Count	Percent	Cumulative Percent
Afrikaans	117	726	10.72411	66.5445
Indigenous	171	897	15.67369	82.2181
Missing	194	1091	17.78185	100.0000

Variable	Descriptive Statistics: Age					
	Mean	Std.Dev	Minimum	Maximum	N	No. cases Missing
Age	39.30408	8.075827	21.00000	62.00000	980	111



## Internal Consistency Reliabilities for the Critical Reasoning Test Battery - item-banked Subtests

<b>Subtest</b>	<b>Cronbach Coefficient Alpha</b>
Critical Numerical Reasoning Test	0,76
Critical Verbal Reasoning Test	0,86

# Critical Reasoning Test Battery – Item-Banked (CRTBi)- Reliability Group 2 South Africans, English Language Group, Updated 2021

## Sample Composition

The sample consisted of South Africans tested by Psytech South Africa and collaborators from June 2015 to March 2021. Since not all respondents completed all the subtests of the CRTBi, biographical characteristics are reported separately for the different subtests.

## Critical Numerical Reasoning Test: Biographical Composition

Category	Frequency table: Sex			
	Count	Cumulative Count	Percent	Cumulative Percent
M	338	338	55.50082	55.5008
F	271	609	44.49918	100.0000
Missing	0	609	0.00000	100.0000

Category	Frequency table: Education			
	Count	Cumulative Count	Percent	Cumulative Percent
Grade 12	18	18	2.95567	2.9557
Post Graduate	266	284	43.67816	46.6338
Tertiary	265	549	43.51396	90.1478
Tertiary Cert / Trade	55	604	9.03120	99.1790
Missing	5	609	0.82102	100.0000

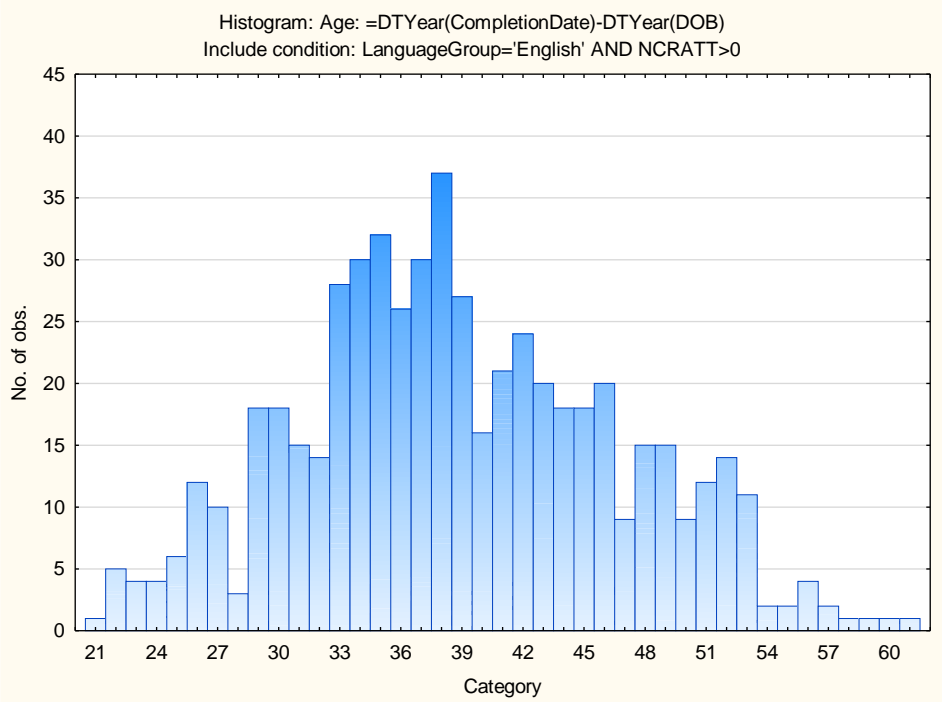


Category	Frequency table: Race			
	Count	Cumulative Count	Percent	Cumulative Percent
European	72	72	11.82266	11.8227
Coloured	56	128	9.19540	21.0181
African	328	456	53.85878	74.8768
Indian	76	532	12.47947	87.3563
Asian	7	539	1.14943	88.5057
Missing	70	609	11.49425	100.0000

Category	Frequency table: Language			
	Count	Cumulative Count	Percent	Cumulative Percent
English	609	609	100.0000	100.0000
Missing	0	609	0.0000	100.0000

Category	Frequency table: Language Group			
	Count	Cumulative Count	Percent	Cumulative Percent
English	609	609	100.0000	100.0000
Missing	0	609	0.0000	100.0000

Variable	Descriptive Statistics: Age					
	Mean	Std.Dev	Minimum	Maximum	N	No. cases Missing
Age	38.87590	7.832991	21.00000	61.00000	556	53



## Critical Verbal Reasoning Test: Biographical Composition

Category	Frequency table: Education			
	Count	Cumulative Count	Percent	Cumulative Percent
Grade 12	18	18	2.95567	2.9557
Post Graduate	265	283	43.51396	46.4696
Tertiary	266	549	43.67816	90.1478
Tertiary Cert / Trade	55	604	9.03120	99.1790
Missing	5	609	0.82102	100.0000

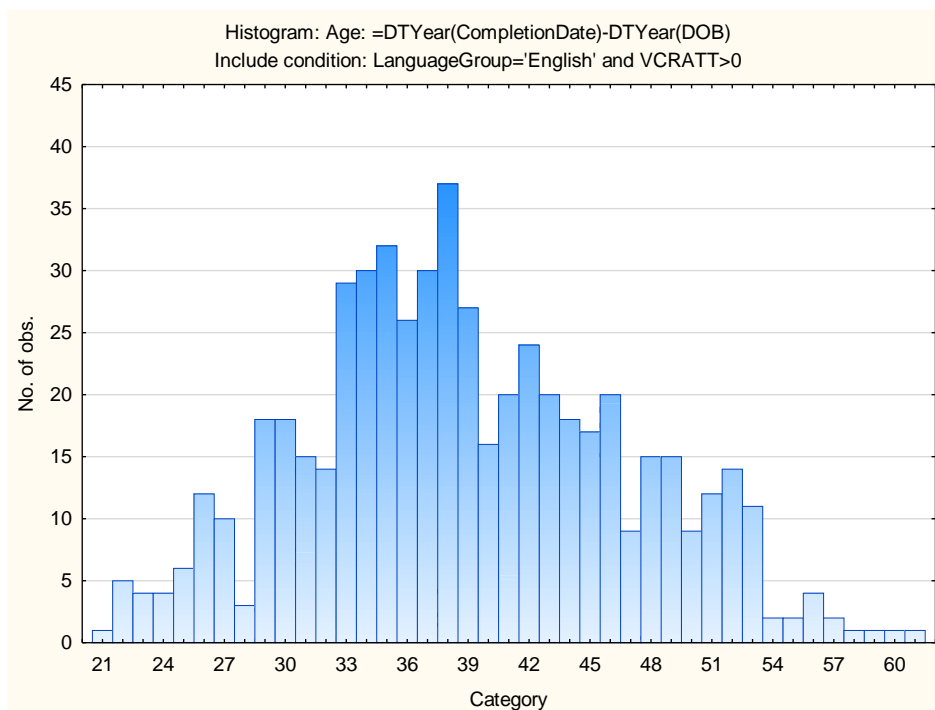
Category	Frequency table: Race			
	Count	Cumulative Count	Percent	Cumulative Percent
European	72	72	11.82266	11.8227
Coloured	56	128	9.19540	21.0181
African	327	455	53.69458	74.7126
Indian	77	532	12.64368	87.3563
Asian	7	539	1.14943	88.5057
Missing	70	609	11.49425	100.0000

Category	Frequency table: Language			
	Count	Cumulative Count	Percent	Cumulative Percent
English	609	609	100.0000	100.0000
Missing	0	609	0.0000	100.0000

Category	Frequency table: Language Group			
	Count	Cumulative Count	Percent	Cumulative Percent
English	609	609	100.0000	100.0000
Missing	0	609	0.0000	100.0000

Category	Frequency table: Sex			
	Count	Cumulative Count	Percent	Cumulative Percent
M	338	338	55.50082	55.5008
F	271	609	44.49918	100.0000
Missing	0	609	0.00000	100.0000

Variable	Descriptive Statistics: Age					
	Mean	Std.Dev	Minimum	Maximum	N	No. cases Missing
Age	38.85045	7.839153	21.00000	61.00000	555	54



# Internal Consistency Reliabilities for the Critical Reasoning Test Battery – Item-Banked Subtests

<b>Subtest</b>	<b>Cronbach Coefficient Alpha</b>
Critical Numerical Reasoning Test	0,74
Critical Verbal Reasoning Test	0,85

# Critical Reasoning Test Battery – Item-Banked (CRTBi) – Reliability Group 3 South Africans, Afrikaans Language Group, Updated 2021

## Sample Composition

The sample consisted of South Africans tested by Psytech South Africa and collaborators from June 2015 to March 2021. Since not all respondents completed all the subtests of the CRTBi, biographical characteristics are reported separately for the different subtests.

## Critical Numerical Reasoning Test: Biographical Composition

Category	Frequency table: Sex			
	Count	Cumulative Count	Percent	Cumulative Percent
M	65	65	55.55556	55.5556
F	52	117	44.44444	100.0000
Missing	0	117	0.00000	100.0000

Category	Frequency table: Education			
	Count	Cumulative Count	Percent	Cumulative Percent
Grade 12	6	6	5.12821	5.1282
Post Graduate	37	43	31.62393	36.7521
Tertiary	60	103	51.28205	88.0342
Tertiary Cert / Trade	12	115	10.25641	98.2906
Missing	2	117	1.70940	100.0000

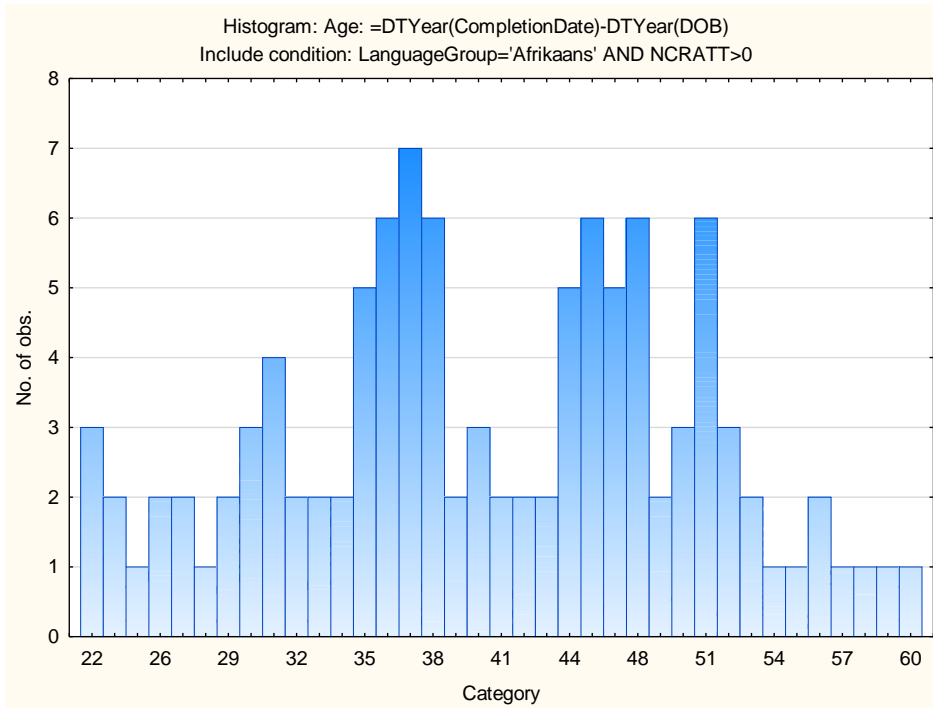
Category	Frequency table: Race			
	Count	Cumulative Count	Percent	Cumulative Percent
European	105	105	89.74359	89.7436
Coloured	4	109	3.41880	93.1624

Category	Frequency table: Race			
	Count	Cumulative Count	Percent	Cumulative Percent
African	5	114	4.27350	97.4359
Missing	3	117	2.56410	100.0000

Category	Frequency table: Language			
	Count	Cumulative Count	Percent	Cumulative Percent
Afrikaans	117	117	100.0000	100.0000
Missing	0	117	0.0000	100.0000

Category	Frequency table: Language Group			
	Count	Cumulative Count	Percent	Cumulative Percent
Afrikaans	117	117	100.0000	100.0000
Missing	0	117	0.0000	100.0000

Variable	Descriptive Statistics					
	Mean	Std.Dev	Minimum	Maximum	N	No. cases Missing
Age	40.63551	9.299414	22.00000	60.00000	107	10





## Critical Verbal Reasoning Test: Biographical Composition

Category	Frequency table: Sex			
	Count	Cumulative Count	Percent	Cumulative Percent
M	65	65	55.55556	55.5556
F	52	117	44.44444	100.0000
Missing	0	117	0.00000	100.0000

Category	Frequency table: Education			
	Count	Cumulative Count	Percent	Cumulative Percent
Grade 12	6	6	5.12821	5.1282
Post Graduate	37	43	31.62393	36.7521
Tertiary	60	103	51.28205	88.0342
Tertiary Cert / Trade	12	115	10.25641	98.2906
Missing	2	117	1.70940	100.0000

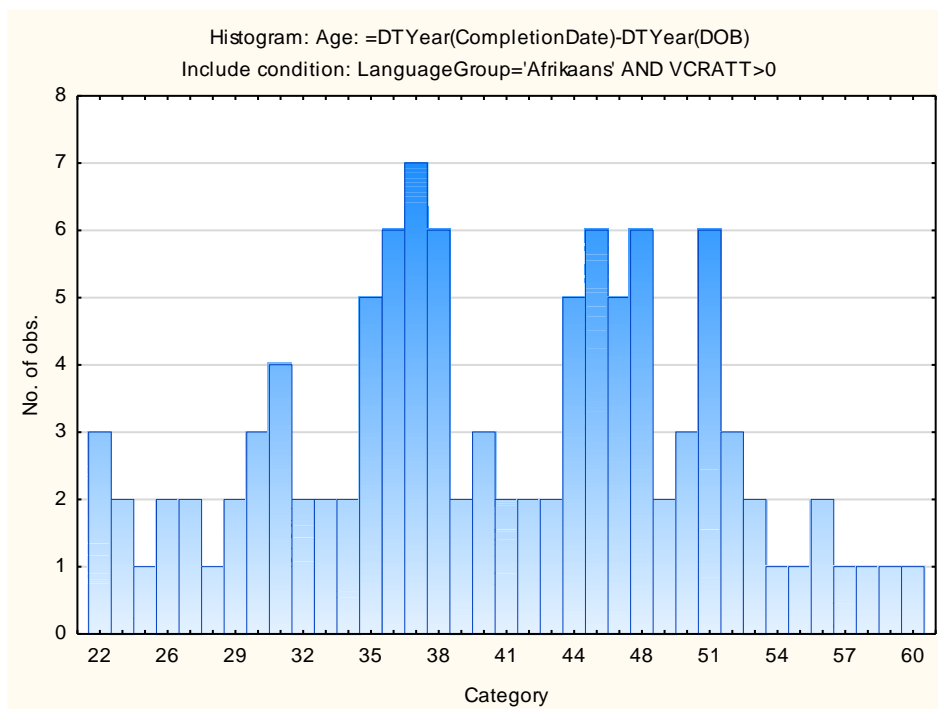
Category	Frequency table: Race			
	Count	Cumulative Count	Percent	Cumulative Percent
European	105	105	89.74359	89.7436
Coloured	4	109	3.41880	93.1624
African	5	114	4.27350	97.4359
Missing	3	117	2.56410	100.0000

Category	Frequency table: Language			
	Count	Cumulative Count	Percent	Cumulative Percent
Afrikaans	117	117	100.0000	100.0000
Missing	0	117	0.0000	100.0000

Category	Frequency table: Language Group			
	Count	Cumulative Count	Percent	Cumulative Percent
Afrikaans	117	117	100.0000	100.0000

Category	Frequency table: Language Group			
	Count	Cumulative Count	Percent	Cumulative Percent
Missing	0	117	0.0000	100.0000

Variable	Descriptive Statistics					
	Mean	Std.Dev	Minimum	Maximum	N	No. cases Missing
Age	40.63551	9.299414	22.00000	60.00000	107	10



## Internal Consistency Reliabilities for the Critical Reasoning Test Battery – Item-Banked Subtests

<b>Subtest</b>	<b>Cronbach Coefficient Alpha</b>
Critical Numerical Reasoning Test	0,810902
Critical Verbal Reasoning Test	0,875090

# Critical Reasoning Test Battery – Item-Banked (CRTBi) – Reliability Group 4 South Africans, Indigenous Language Group, Updated 2021

## Sample Composition

The sample consisted of South Africans tested by Psytech South Africa and collaborators from June 2015 to March 2021. Since not all respondents completed all the subtests of the CRTBi, biographical characteristics are reported separately for the different subtests.

## Critical Numerical Reasoning Test: Biographical Composition

Category	Frequency table: Sex			
	Count	Cumulative Count	Percent	Cumulative Percent
M	99	99	57.89474	57.8947
F	72	171	42.10526	100.0000
Missing	0	171	0.00000	100.0000

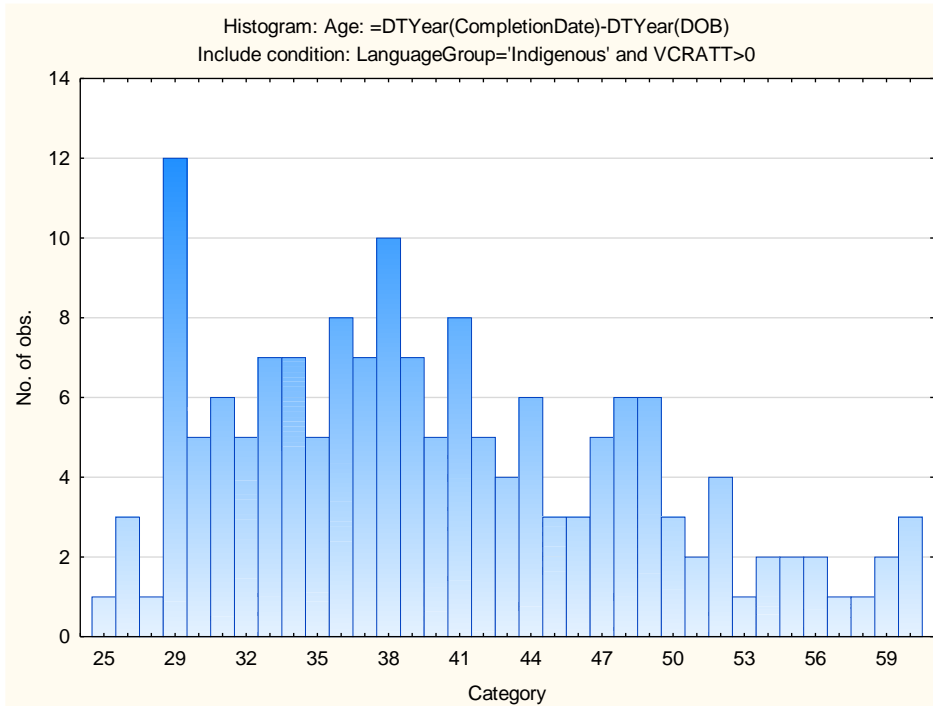
Category	Frequency table: Education			
	Count	Cumulative Count	Percent	Cumulative Percent
Grade 12	1	1	0.58480	0.5848
Post Graduate	79	80	46.19883	46.7836
Tertiary	71	151	41.52047	88.3041
Tertiary Cert / Trade	19	170	11.11111	99.4152
Missing	1	171	0.58480	100.0000

Category	Frequency table: Race			
	Count	Cumulative Count	Percent	Cumulative Percent
African	162	162	94.73684	94.7368
Missing	9	171	5.26316	100.0000

Category	Frequency table: Language			
	Count	Cumulative Count	Percent	Cumulative Percent
Setswana	41	41	23.97661	23.9766
isiXhosa	31	72	18.12865	42.1053
Sepedi	16	88	9.35673	51.4620
Sesotho	19	107	11.11111	62.5731
siSwati	4	111	2.33918	64.9123
isiZulu	40	151	23.39181	88.3041
Xitsonga	6	157	3.50877	91.8129
isiNdebele	5	162	2.92398	94.7368
Tshivenda	9	171	5.26316	100.0000
Missing	0	171	0.00000	100.0000

Category	Frequency table: Language Group			
	Count	Cumulative Count	Percent	Cumulative Percent
Indigenous	171	171	100.0000	100.0000
Missing	0	171	0.0000	100.0000

Variable	Descriptive Statistics					
	Mean	Std.Dev	Minimum	Maximum	N	No. cases Missing
Age	40.12025	8.485550	25.00000	60.00000	158	13



### Critical Verbal Reasoning Test: Biographical Composition

Category	Frequency table: Sex			
	Count	Cumulative Count	Percent	Cumulative Percent
M	98	98	57.64706	57.6471
F	72	170	42.35294	100.0000
Missing	0	170	0.00000	100.0000

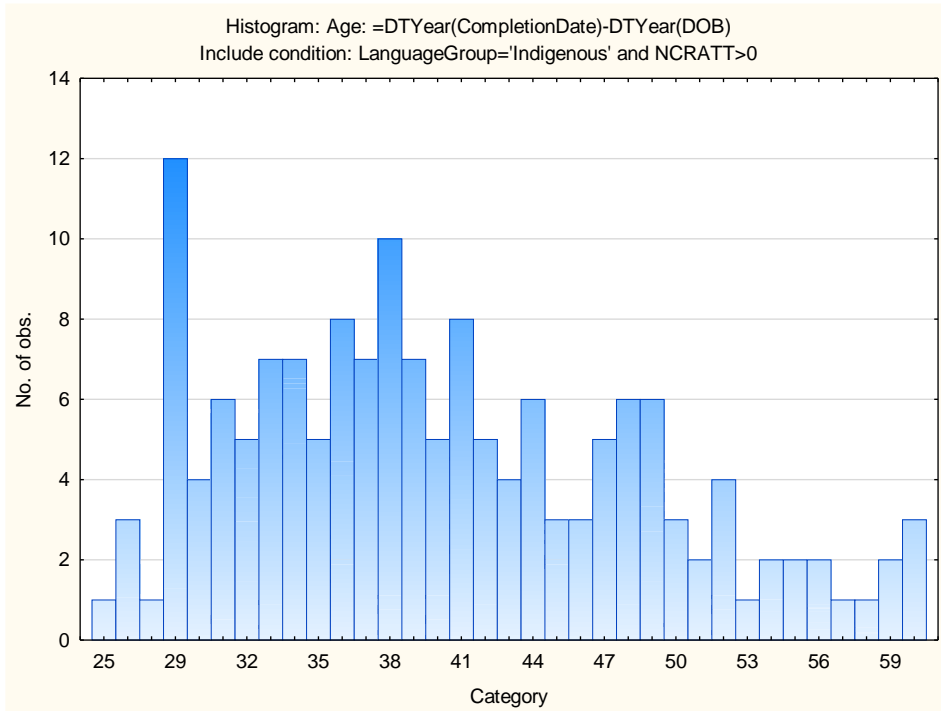
Category	Frequency table: Education			
	Count	Cumulative Count	Percent	Cumulative Percent
Grade 12	1	1	0.58824	0.5882
Post Graduate	78	79	45.88235	46.4706
Tertiary	71	150	41.76471	88.2353
Tertiary Cert / Trade	19	169	11.17647	99.4118
Missing	1	170	0.58824	100.0000

Category	Frequency table: Race			
	Count	Cumulative Count	Percent	Cumulative Percent
African	161	161	94.70588	94.7059
Missing	9	170	5.29412	100.0000

Category	Frequency table: Language			
	Count	Cumulative Count	Percent	Cumulative Percent
Setswana	41	41	24.11765	24.1176
isiXhosa	31	72	18.23529	42.3529
Sepedi	16	88	9.41176	51.7647
Sesotho	19	107	11.17647	62.9412
siSwati	4	111	2.35294	65.2941
isiZulu	39	150	22.94118	88.2353
Xitsonga	6	156	3.52941	91.7647
isiNdebele	5	161	2.94118	94.7059
Tshivenda	9	170	5.29412	100.0000
Missing	0	170	0.00000	100.0000

Category	Frequency table: Language Group			
	Count	Cumulative Count	Percent	Cumulative Percent
Indigenous	170	170	100.0000	100.0000
Missing	0	170	0.0000	100.0000

Variable	Descriptive Statistics					
	Mean	Std.Dev	Minimum	Maximum	N	No. cases Missing
Age	40.18471	8.473807	25.00000	60.00000	157	13



### Internal Consistency Reliabilities for the Critical Reasoning Test Battery - Item-Banked Subtests

Subtest	Cronbach Coefficient Alpha
Critical Numerical Reasoning Test	0,651813
Critical Verbal Reasoning Test	0,851489

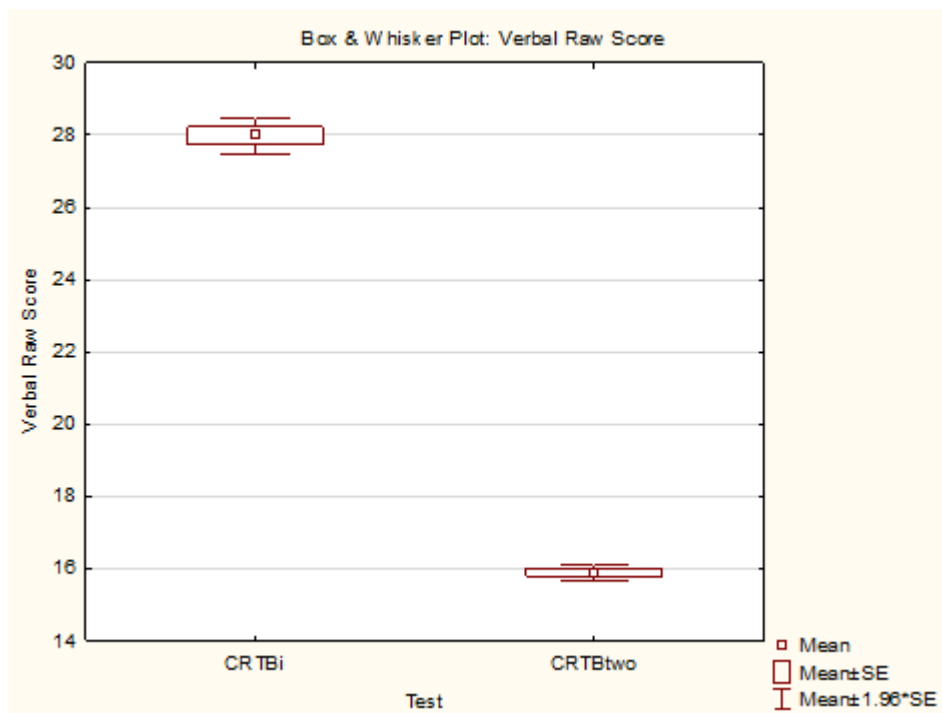


# T-Test Results – CRTBi and CRTB2

## CRTBi and CRTB2 Verbal T-test

Variable	T-tests; Grouping: Test (Dataset for Verbal)						
	Group 1: CRTBi						
	Group 2: CRTBtwo						
	Mean CRTBi	Mean CRTBtwo	t-value	df	p	Valid N CRTBi	Valid N CRTBtwo
Verbal Raw Score	27.98170	15.88373	47.47050	5787	0.00	1093	4696

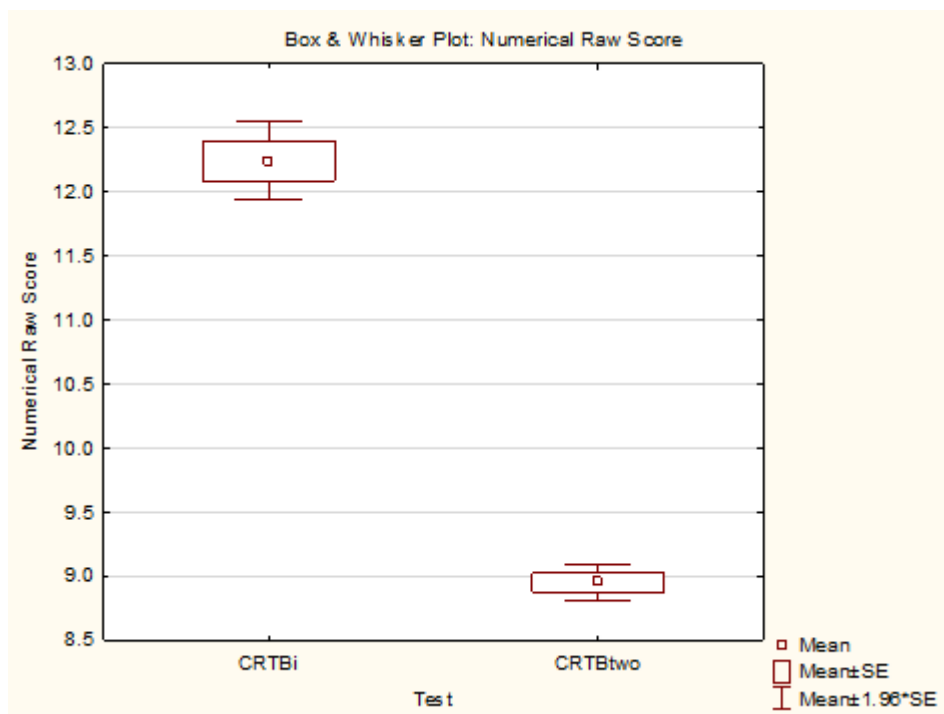
Variable	T-tests; Grouping: Test (Dataset for Verbal)			
	Group 1: CRTBi			
	Group 2: CRTBtwo			
	Std.Dev. CRTBi	Std.Dev. CRTBtwo	F-ratio Variances	p Variances
Verbal Raw Score	8.306714	7.411595	1.256132	0.000001



## CRTBi and CRTB2 Numerical t-test

Variable	T-tests; Grouping: Test (Dataset for Numerical)						
	Group 1: CRTBi		Group 2: CRTBtwo				
	Mean CRTBi	Mean CRTBtwo	t-value	df	p	Valid N CRTBi	Valid N CRTBtwo
Numerical Raw Score	12.24154	8.950609	19.23665	5768	0.00	1093	4677

Variable	T-tests; Grouping: Test (Dataset for Numerical)			
	Group 1: CRTBi		Group 2: CRTBtwo	
	Std.Dev. CRTBi	Std.Dev. CRTBtwo	F-ratio Variances	p Variances
Numerical Raw Score	5.108371	5.088263	1.007919	0.860357

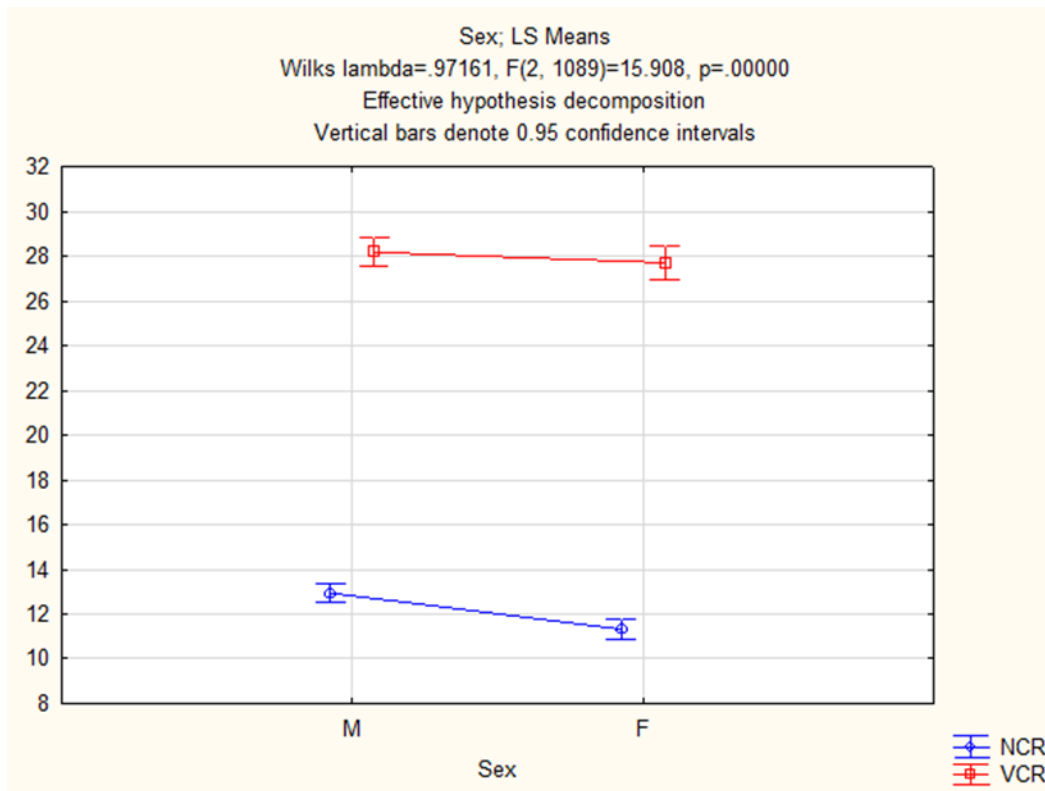


# ANOVAs and Power Analyses - CRTBi

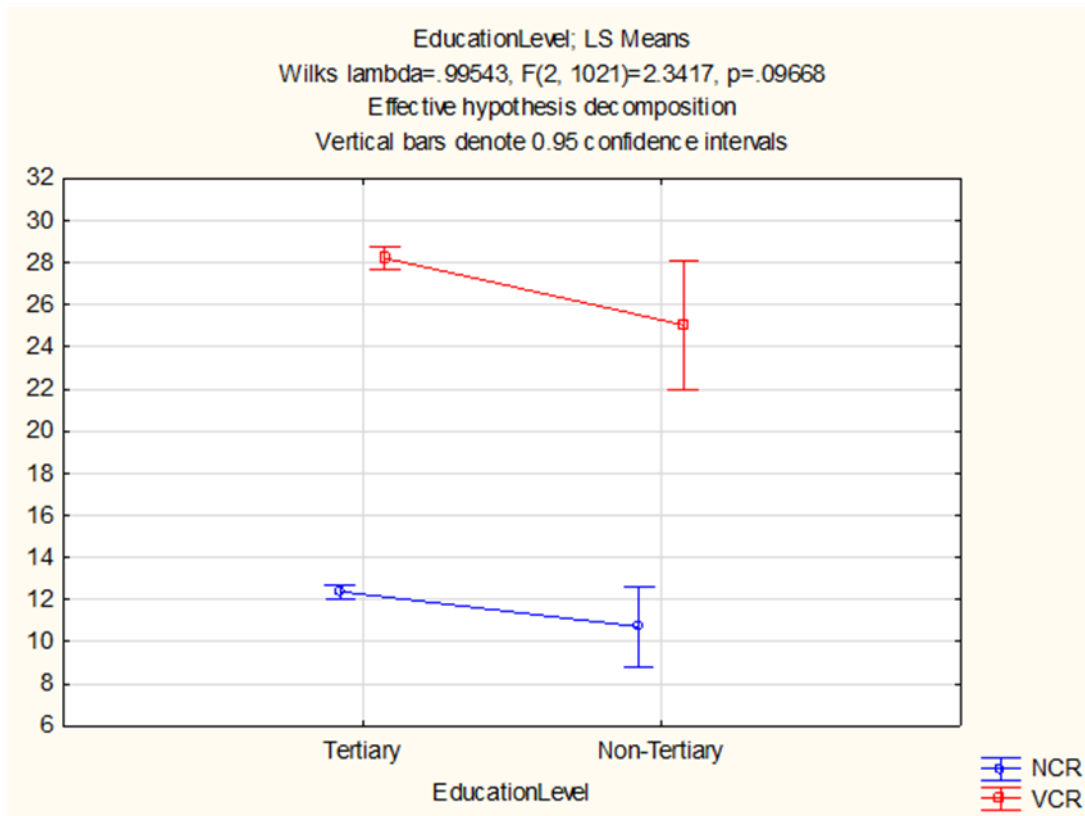
## Sample Composition

This sample consists of 1093 respondents who have completed the Critical Reasoning Test Battery- item-banked from April 2014 to March 2021.

## Sex

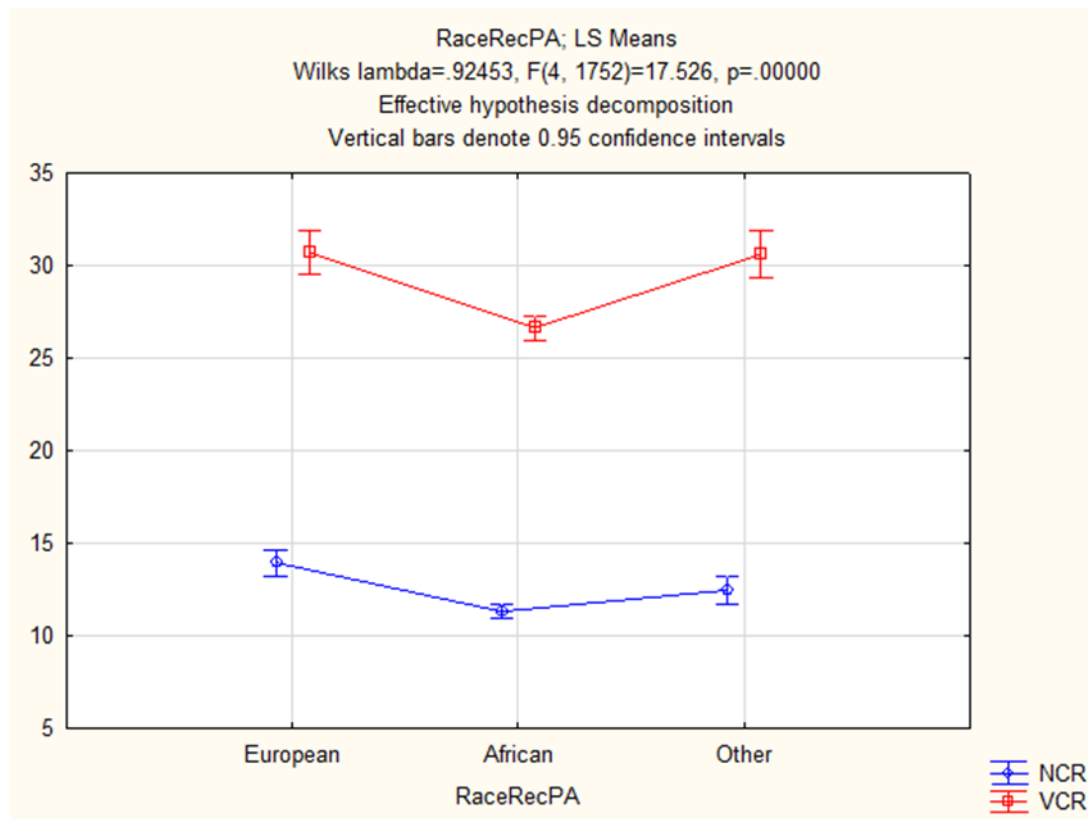


## Education Level

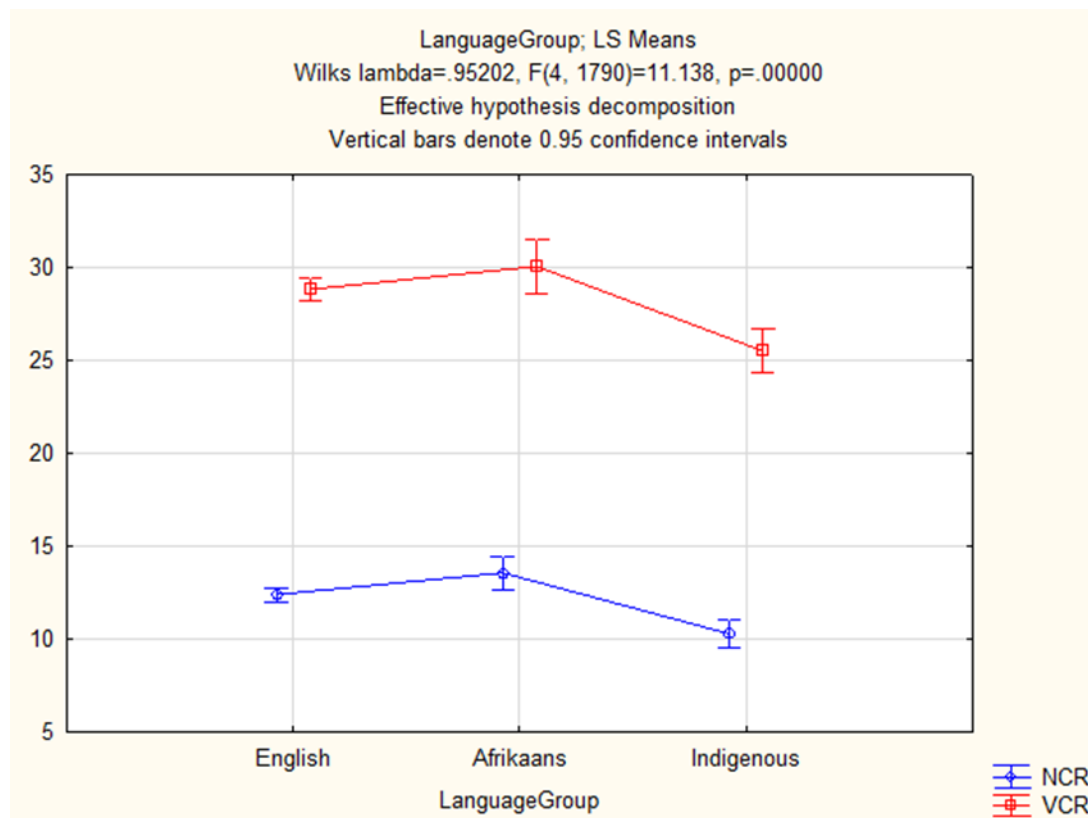


Note: The Non-Tertiary education group has a sample size of 28. This is because the CRTBi is aimed at graduate level staff.

## Race



## Language Group



## Power Analyses

### Why use Power Analysis?

Power Analysis is a statistical concept that estimates a good sample size for a study, effect size, or level of significance or statistical power. All four variables are linked with each other and changing one variable impacts the rest of the variables. Power Analysis is the process of estimating one of the 4 variables given values for the 3 variables.

Power analysis depends on four related variables:

- 1) **Effect size:** The more prominent effect the data carries, the lesser the random error
- 2) **Sample size:** larger sample size helps detects smaller effects
- 3) **Level of Significance:**  $\alpha$
- 4) **Statistical Power**

Although commonly used to calculate the appropriate sample size for a study, it has here been used to calculate effect size.

**Effect size** is a statistical concept that measures the strength of the relationship between two variables on a numeric scale. For instance, if we have data on the height of men and women and we notice that, on average, men are taller than women, the difference between the height of men and the height of women is known as the effect size. The greater the effect size, the greater the height difference between men and women will be (Statistics Solutions, 2021).

Power Analyses for the CRTBi were calculated using a pooled SD. Three different analyses were used, Cohen's d, Glasses Delta and Hedges' G. Cohen's d and Glasses Delta, which assume equal sample sizes. Hedge's G is an alternative as it provides a measure of effect size according to the relevant size of the sample. The results for all three are posted below. Power analyses are done in order to determine the practical significance of the differences between groups. When analyses are run on large sample sizes, it is common to observe statistically significant differences due to the large number of responses. Whether these differences translate into actually differences observed is determine by a power analysis: this is known as effect size.

When interpreting the coefficient, the general guideline is as follows:

- small (0.2)
- medium (0.5)

- large (0.8)

Only a large coefficient has an impact, smaller differences do not identify differences that would make an impact in real-life situations. Therefore, below 0,8 the difference between groups does not carry a practical implication.

When looking at the below, it can be seen that there are no significant differences between the groups. This indicates that the test can be used on different groups in South Africa.

## Sex

Variable	Descriptive Statistics: Sex='M'					
	Mean	Std.Dev	Minimum	Maximum	N	No. cases Missing
NCR	12.93760	5.187597	0.00	28.00000	625	0
VCR	28.18720	8.319838	0.00	47.00000	625	0

Variable	Descriptive Statistics: Sex='F'					
	Mean	Std.Dev	Minimum	Maximum	N	No. cases Missing
NCR	11.31906	4.855301	0.00	27.00000	467	0
VCR	27.71520	8.297205	0.00	45.00000	467	0

### Numerical

$$\text{Cohen's } d = (11.31906 - 12.9376) / 5.024197 = 0.322149$$

$$\text{Glass's } \delta = (11.31906 - 12.9376) / 5.1875975 = 0.312002$$

$$\text{Hedges' } g = (11.31906 - 12.9376) / 5.04821 = 0.320617$$

### Verbal

$$\text{Cohen's } d = (27.7152 - 28.1872) / 8.308529 = 0.056809$$

$$\text{Glass's } \delta = (27.7152 - 28.1872) / 8.319838 = 0.056732$$

$$\text{Hedges' } g = (27.7152 - 28.1872) / 8.310169 = 0.056798$$

## Education Level

Variable	Descriptive Statistics: Education Level='Tertiary'					
	Mean	Std.Dev	Minimum	Maximum	N	No. cases Missing
NCR	12.37550	5.089112	0.00	28.00000	996	0
VCR	28.21486	8.243409	0.00	47.00000	996	0

Variable	Descriptive Statistics: Education Level='non-Tertiary'					
	Mean	Std.Dev	Minimum	Maximum	N	No. cases Missing
NCR	10.71429	4.609629	5.00000	22.00000	28	0
VCR	25.03571	9.199364	10.00000	40.00000	28	0

### Numerical

Cohen's  $d = (10.71429 - 12.3755)/4.855293 = 0.342144$

Glass's  $\delta = (10.71429 - 12.3755)/5.089112 = 0.326424$

Hedges'  $g = (10.71429 - 12.3755)/5.077027 = 0.327201$

### Verbal

Cohen's  $d = (25.03571 - 28.21486)/8.734475 = 0.363977$

Glass's  $\delta = (25.03571 - 28.21486)/8.243409 = 0.38566$

Hedges'  $g = (25.03571 - 28.21486)/8.270085 = 0.384416$

## English First Language or Second Language

Variable	Descriptive Statistics: English First Language					
	Mean	Std.Dev	Minimum	Maximum	N	No. cases Missing
NCR	12.39444	4.866402	0.00	28.00000	611	0
VCR	28.84288	7.974849	0.00	47.00000	611	0

Variable	Descriptive Statistics: English Second Language					
	Mean	Std.Dev	Minimum	Maximum	N	No. cases Missing
NCR	11.61806	5.046814	0.00000	25.00000	288	0
VCR	27.36806	8.412076	2.00000	45.00000	288	0



### Numerical

Cohen's  $d = (11.61806 - 12.39444)/4.957429 = 0.156609$

Glass's  $\delta = (11.61806 - 12.39444)/4.866402 = 0.159539$

Hedges'  $g = (11.61806 - 12.39444)/4.924845 = 0.157646$

### Verbal

Cohen's  $d = (27.36806 - 28.84288)/8.196378 = 0.179936$

Glass's  $\delta = (27.36806 - 28.84288)/7.974849 = 0.184934$

Hedges'  $g = (27.36806 - 28.84288)/8.117305 = 0.181688$

### Race

Due to small sample sizes, Indian, Asian, and Coloured respondents were grouped together to form the group 'Other'.

Variable	Descriptive Statistics: Race = European					
	Mean	Std.Dev	Minimum	Maximum	N	No. cases Missing
NCR	13.95556	5.403105	0.000000	27.00000	180	0
VCR	30.71667	8.292337	2.000000	47.00000	180	0

Variable	Descriptive Statistics: Race = African					
	Mean	Std.Dev	Minimum	Maximum	N	No. cases Missing
NCR	11.31227	4.584938	0.00	26.00000	554	0
VCR	26.65343	7.843111	0.00	45.00000	554	0

Variable	Descriptive Statistics: Race = Other					
	Mean	Std.Dev	Minimum	Maximum	N	No. cases Missing
NCR	12.45890	5.035223	0.00000	28.00000	146	0
VCR	30.62329	7.096517	10.00000	46.00000	146	0

## European and African

### Numerical

$$\text{Cohen's } d = (11.31227 - 13.95556)/5.010748 = 0.527524$$

$$\text{Glass's } \delta = (11.31227 - 13.95556)/5.403105 = 0.489217$$

$$\text{Hedges' } g = (11.31227 - 13.95556)/4.797919 = 0.550925$$

### Verbal

$$\text{Cohen's } d = (26.65343 - 30.71667)/8.07085 = 0.503446$$

$$\text{Glass's } \delta = (26.65343 - 30.71667)/8.292337 = 0.489999$$

$$\text{Hedges' } g = (26.65343 - 30.71667)/7.955306 = 0.510758$$

## European and Other

### Numerical

$$\text{Cohen's } d = (12.4589 - 13.95556)/5.222404 = 0.286584$$

$$\text{Glass's } \delta = (12.4589 - 13.95556)/5.403105 = 0.277$$

$$\text{Hedges' } g = (12.4589 - 13.95556)/5.241659 = 0.285532$$

### Verbal

$$\text{Cohen's } d = (30.62329 - 30.71667)/7.717623 = 0.0121$$

$$\text{Glass's } \delta = (30.62329 - 30.71667)/8.292337 = 0.011261$$

$$\text{Hedges' } g = (30.62329 - 30.71667)/7.779926 = 0.012003$$

**The power analyses show that there are no practically significant differences between the groups.**

# Executive Summary

The CRTBi is similar in difficulty to the CRTB2, but is suitable for remote administration as it is an item-banked test. The T-Tests show a statistically significant difference between the difficulty levels of the two tests. As such, we ran power analyses to determine whether or not this difference is practically significant, as statistical significance can be affected by sample size. The power analyses show that there is no practically significant differences between the two tests in terms of difficulty. It is important to remember that the tests should *not* be considered equivalent. As such, respondents who have done the different versions should not be directly compared with each other.

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