

Exploring the factors of the English Comprehension Test

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Abstract

The empirically designed English Comprehension Test was initially developed as a means of assessing individual's English comprehension skills. The test development of the English Comprehension Test led to the piloting of two test versions of the English Comprehension Test, namely, version 1.2 and version 1.3. The purpose of this study was to statistically explore the factors emerging from the two test versions of the English Comprehension Test. This study is the initial step towards establishing the construct validity, which forms part of the validation of the English Comprehension Test. This quantitative study involved an exploratory inspection of the factors of the English Comprehension Test, with the use of factor analyses. It also employed two factor extraction methods (Principal Component Analysis and Principal Axis Factoring) for comparison. These two factor extraction methods used for the exploratory factor analyses revealed a dominant factor for both test versions of the English Comprehension Test, thereby endorsing an argument for unidimensionality of the English Comprehension Test. The similarities between the results for the two test versions confirmed the existence of an inherent structure for the English Comprehension Test, despite the differences between the two test versions. The labelling of the factors of the test also suggests that the English Comprehension Test could be an assessment of cognitive (verbal) aptitude. A major limitation of this study is the restriction of range and lack of generalizability. The contribution made by this study will enhance psychometric validation

studies in South Africa as well as increasing literature on South African test construction for multicultural and multilingual individuals.

Keywords: Comprehension, factor analysis, Principal Axis Factoring, Principal Component Analysis, psychometrics, test development

When assisting in selections for posts within an organizational setting, it was observed that many candidates were unsuccessful due to difficulties with comprehending the English language in the cognitive psychometric tests they completed. The predominate use of Western-developed psychometric tests in organizational settings increases the need for an assessment tool that specifically caters to the South African context, as Western-developed tests were not created for a multilingual and cultural environment such as South Africa. When considering that tests in organisational settings are often used for decision making purposes, the position of power that these tests hold is emphasized and thus the need to investigate tests is crucial in South Africa (Mahoney & MacSwan, 2005; Van de Vijver & Tanzer, 2004). This, however, also creates much need for local psychometric test development that may produce more culturally appropriate tests and lessen the need for Western developed tests to be used in decision making processes in organisational settings. In addition to this, the need for candidates to comprehend the English language is essential to all posts within an organizational environment because it is the primary language used throughout organizations in South Africa.

The English Comprehension Test (ECT) was created to measure English comprehension that would screen for individuals that may have difficulty with comprehending English because it would also affect their performance on English cognitive assessments. The empirical construction of the ECT was influenced by assessing other

language comprehension tests and relevant literature (Gernsbacher, 1990; Pretorius, 2002; Oberholzer, 2005; Van den broek & Gustafson, 1999) to assess the construct of English Comprehension. The operationalizing of the English Comprehension construct within the ECT was therefore comprised of elements such as reading comprehension, inferences, reasoning ability, vocabulary and general English language.

The development of the ECT began with the creation of items by the researcher to correspond to a comprehension piece, an article written in an organisational magazine. Language skills such as antonyms and synonyms were assessed. All of the items in the ECT are multiple-choice questions, with the exception of four written responses. The written responses are sentence construction items that consist of jumbled words which require reordering into logical sentences. The scoring method of these multiple-choice items and written responses are dichotomous. The face validity of the ECT was reviewed by individuals with Master Degrees in Psychology. Consequently, an initial pilot study was conducted to assess whether the items were understood and the language used within the test was clear. Subsequently, the ECT version 1.2 (39 items) was created for research purposes and administered until a suitable sample size was reached (597). The initial analyses conducted on the ECT version 1.2 indicated that the test showed potential but certain changes needed to be made (Arendse, 2011). A new test version (ECT version 1.3) was developed to obtain more data that could be compared to the initial test version (ECT version 1.2) for research purposes and refinement of the construct. The administration remained the same for the ECT version 1.3 (42 items), but the number of instructions on the

test booklet were increased. The comprehension and language sections of the test were demarcated more clearly to avoid confusion. The problematic items were edited and removed and 5 new items (plurals, e.g. foot/feet) were added. The 45-minute time limit (ECT 1.2) was removed, because performance on the test could be attributed to functioning under pressure and this would affect the validity and reliability of the test. The time period in which the last person completed the test was documented for the ECT 1.3. Once the ECT is validated, the intention is that it may be used for organisational screening of candidates as well as in educational settings as an initial screening. Since the ECT is still in development, the scores should be interpreted carefully with higher scores implying more and lower scores implying less of the constructs.

Since the items of the ECT were empirically created, the conceptual investigation of the test using exploratory factor analysis is fundamental to developing the ECT further. This study was therefore the first formal assessment of the test and the construct being measured by the ECT. The operationalisation of the construct was therefore also explored by means of a factor analysis. Given that the majority of the items are similar across the first two test versions, the exploration of a common factor structure also prompted this investigation. Once a common factor structure is established, further studies on the factors and items are required to ensure the appropriateness of the test for a multicultural society such as South Africa (Foxcroft, 2004). This study is therefore the necessary step towards ascertaining the factor structure and the constructs underlying the ECT.

Research Purpose and Objectives

The rationale for exploring the ECT using exploratory factor analysis was to assess what factors emerged across the two test versions. Although the test versions (ECT version 1.2 and version 1.3) were administered differently, most of the items are identical across the two test versions. Factor analysis allows the structure of the data to be explored by reducing the items into factors (Field, 2017). The two test versions of the ECT were compared conceptually to establish whether the factor structure was common across the two versions and whether the ECT 1.3 was an improved test version. Furthermore, the exploration of the factors measured by the ECT will contribute to the existing instrument development as well as the construct underlying the ECT.

The study can be considered unique as it utilized two factor extraction techniques across the two test versions. The results obtained from these two factor extraction techniques were compared in terms of what emerged from the analyses. These two methods of interest were Principal Components Analysis (PCA) and Principal Axis Factoring (PAF). The literature consulted indicated that these two extraction methods are the most commonly used (Williams, Onsman & Brown, 2010; Yong & Pearce, 2013) when conducting factor analyses. PCA is not considered to be an exploratory factor analysis method but a method which reduces the data to smaller units. PCA is different to factor analysis in that it usually assumes no relationship exists between the variables (Field, 2017). PCA is however suggested when there is no preceding knowledge of the scales being explored. PAF is regarded as a method of exploratory factor analysis and can be used when the data is not

normally distributed (Yong & Pearce, 2013). Williams, Onsman & Brown (2010) highlighted that PCA can be performed prior to conducting a PAF. This is suggested to establish better solutions.

The research question for the study was how many factors were present in the ECT.

The objective of the study was as follows:

- Objective 1: To explore and compare the factors emerging from the ECT using two factor extraction techniques.

In this study on the factors of the ECT, the exploration of possible factors that could emerge from an English Comprehension test needed to be discussed. This would guide the interpretation of the factors of the ECT. For this reason, relevant literature was consulted and framed the manner in which the factors were understood. It should however be noted that although the ECT consists of comprehension and language elements, it is not considered to be an assessment of language proficiency. It is rather considered to be a psychological measure because the inclusion of comprehension links it to a cognitive ability (Gernsbacher, 1990; Van den broek & Gustafson, 1999) which falls within the domain of psychology (Sijtsma, 2012). Consequently, the factors of the ECT requires a combination of cognitive and language elements as the test essentially measures aptitude.

The relationship between comprehension and cognitive abilities lies mostly in the fact that inferences and understanding text involves abilities that require cognitive

engagement. Language is therefore the vehicle by which this engagement occurs (Gernsbacher, 1990; Van den broek & Gustafson, 1999). An important element of language included in the ECT is that of vocabulary. Vocabulary is however also inherently part of comprehension and any text using language, as it is that basis by which one understands words. With this in mind, it is no surprise that issues relating to vocabulary has often been attributed to difficulty with texts. Moreover, vocabulary has a strong relationship with reading comprehension and has been identified as a factor that attributes to success in reading (Ma & Lin, 2015; Ormrod, 2008).

Reading relates to both vocabulary knowledge and the use of inferences from text (Pretorius, 2002; Salehi, 2011). In a study on the factor structure of a reading comprehension test conducted by Salehi (2011) it was revealed that some of the factors that were identified from the factor analyses, were namely: factors relating to reasoning ability, vocabulary and a factor involved in drawing conclusions which roughly relates to deduction. These issues emerging from other research might be issues which need to be considered in the current study. Research also indicates that there is a definite cognitive ability, such as general reasoning skill, present in comprehension tests which may imply that it is also present in the ECT. Thus, the ECT might include psychological elements. This is significant for the ECT as it contains a reading passage and thus vocabulary and comprehension (inferences, deductions and reasoning) elements will be inherent in the test.

In addition to this, the awareness of English second language individuals completing the test requires one to be cognisant of the fact that these individuals may struggle more if

their vocabulary is limited as this will impair their ability to effectively read and comprehend the text (Ma & Lin, 2015; McDonald & Van Eeden, 2014).

Broom and Jewson (2013) conducted a study where South African learners were assessed on their reading proficiency. The researchers utilized a 'Western' developed test (the Stanford Diagnostic Reading Test) within a South African context. Their results indicated that the learners had trouble with reading comprehension. Their difficulty with the reading text affected their understanding of the text which limited their learning. The findings revealed that the quality of education that the African learners were exposed to impacted on their performance on measures. The interpretation of the findings suggested that African learners' poor performance on reading comprehension and vocabulary assessment was not only attributed to poor education but to several other factors such as social economic status, familiarity with English and reading materials, familiarity with comprehension and multiple choice tests, and general cognitive and academic ability (Broom & Jewson, 2013). These factors are imperative as they can affect any psychometric assessment done in South Africa (McDonald & Van Eeden, 2014; Van der Vijver & Rothmann, 2004). The issue of familiarity with the English language is important as South Africa is a multilingual country and the sample of the ECT consists of predominately English second language speakers. This study also has similar objectives to the current study, as it emphasizes the importance of creating local assessment tools to cater to our diverse population which is both multi-lingual and multi-cultural. Once the ECT is refined

and validated, it may limit the necessity to use language comprehension tests from other contexts and countries.

Method

Factor analysis assists in evaluating scales and instruments in psychology (Williams, Onsman & Brown, 2010). There is no statistical hypothesis stated for the analyses conducted as this study is exploratory. There is however a conceptual hypothesis for this study, as it is expected that the ECT contains cognitive elements, as found in several studies and the literature. The heuristic hypothesis identified from the literature does not translate into a statistical hypothesis, but it does guide the factor analysis and the interpretation thereof. Since the data has already been collected, the data for the ECT version 1.2 can be considered secondary data, while the ECT version 1.3 comprises the primary data. Secondary Data Analysis (SDA) can be described as the re-analysis of data.

Participants

The sample consisted of 597 individuals (Version 1.2) and 881 individuals (Version 1.3) respectively. Both samples had different proportions of males (66% for ECT version 1.2 and 75% for ECT version 1.3) and females (27% for ECT version 1.2 and 24% for ECT version 1.3). For the ECT version 1.2, their age groups ranged from 18 to 52 years old (mean age of 22 years) and for ECT version 1.3, their age ranged from 18 to 42 years old (mean age of 21 years). The racial distribution of the individuals for the ECT version 1.2

were African (n = 428), White (n = 71), Coloured (n = 44), and Asian/Indian (n = 10). The racial distribution of individuals for the ECT version 1.3 were African (n = 682), White (n = 135), Coloured (n = 50) and Asian/Indian (n = 11). These individuals represented all 9 provinces. All 11 official languages were present for both samples. There was thus an overlap between the demographics across the two test versions.

Since the ECT has two versions and was administered differently (specifically with respect to the time limit imposed), the samples were explored separately and not combined. The appropriate sample size required for factor analysis is 15 cases for each item (Williams, Onsman & Brown, 2010), which indicates that both samples are acceptable.

Instrument

The ECT was developed as an individual test which measures an individual's English language ability and comprehension skills. The ECT contains a comprehension section which consists of multiple choice questions. The language section contains multiple-choice questions and a written-answer section. The ECT version 1.2 and version 1.3 contain the same item content, but differ in terms of the addition of new items (items pertaining to plurals were added) for the ECT version 1.3. The test is dichotomously scored; hence there is only one correct answer from the answer options given. In table 1 and 2, are examples of items in the two test versions (ECT version 1.2 and 1.3).

Table 1: Example of a test question (True and False) in the ECT version 1.2

Which statement is TRUE according to the information given in the passage?

- A. The passengers got out of the aircraft because they wanted to see the back of the aircraft during refuelling.
 - B. The passengers got out of the aircraft because they wanted to stand by the flight line during refuelling.
 - C. The passengers got out of the aircraft because they could not be in the aircraft during refuelling.
 - D. The passengers got out of the aircraft because they felt odd and nervous during refuelling.
-

Table 2: Example of a test question (Plurals) in the ECT version 1.3

Choose the CORRECT FORM OF THE WORD in the following sentences.

1. The army (**A. man, B. men**) were very tired after their war battle exercise in Pretoria.
 2. The pilots were flying across the midlands when they saw (**A. people, B. person**) waving to
-

This test has been used on individuals from different linguistic and cultural backgrounds in South Africa. Since the ECT is still in development and only used for research purposes, the age groups that the ECT has been piloted on, ranges from 18 to 52 years. The ECT version 1.2 has 39 items and a time limit of 45 minutes was imposed. The ECT version 1.3 has 42 items and no time limit was imposed. The psychometric properties of the ECT will be explored in a PhD study through the University of Pretoria.

Procedure

The sampling method used for both the primary and secondary data was convenience sampling, in that the candidates in the study were all attending selections, thus making them accessible for the piloting of the ECT. All candidates were therefore either grade 12 learners or had already completed their grade 12. The data collection occurred in 2010 for the ECT version 1.2 and in 2011 for the ECT version 1.3.

The administration for these test sessions involved test orientation and assisting individuals with the completion of the biographical section of the answer sheet. The consent for individuals to participate in the research was done before the selection commenced. They were informed of the inclusion of the ECT and asked to consent for research purposes. After individuals had completed all the cognitive tests in the selection battery, they would break for lunch and thereafter complete the ECT. The reasoning behind this was that the research should not affect their performance in other tests on which they will be recommended for selection purposes.

Ethics Considerations

When the primary and secondary data was collected, the following ethical procedures were followed: firstly, confidentiality, because the information gathered contained sensitive and identifying information of the candidates, this will be kept private. Secondly, informed consent, as individuals participating in the research were informed that it was for research purposes and they were not obligated to participate and all their

information would be confidential. Ethical approval for the larger study was obtained from the University of Pretoria and the data will be stored at the University of Pretoria for 15 years.

Data Analysis

The data analysis for this study consisted of exploratory factor analysis, which assisted in investigating the factors of the ECT 1.2 and 1.3. These two data sets were analysed separately to conceptually compare the factor structures that emerged and to establish whether the ECT 1.3 was an improved test version. Pair-wise deletion was used for missing data, because this allows all available data to be retained for analyses. Since the researcher believed that the factors were related, Promax rotation was used which is a common Oblique rotation method (Tabachnick & Fidell, 2013). The indices that were used in the EFA were as follows: correlation matrixes, Kaiser-Meyer-Olkin (KMO), and the Bartlett's Test for Sphericity. The correlation matrixes were used to assess the assumption of multicollinearity ($> .00001$) and did not indicate that the inter-correlations were too high (Field, 2017). The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was above .50 (Yong & Pearce, 2013) and indicated that the sample size was adequate for factor analysis. The Bartlett's Test for sphericity needed to be significant ($p = .00$), to indicate the appropriateness of factor analysis for the data (Williams, Onsman & Brown, 2010).

The criteria for choosing the number of factors to retain were based on the Kaiser criterion and the Scree-plot (Field, 2017; Williams, Onsman & Brown, 2010). The Kaiser

criterion states that factors which contain eigenvalues greater than 1 should be retained (Field, 2017; Williams, Onsman & Brown, 2010). The factor loadings give an indication of the relative contributions that items make to a factor. In this study, the regression coefficients were interpreted in the factor pattern matrix (Field, 2017; Yong & Pearce, 2013). The final factor structure was based on the number of factors identified from consulting the Scree-plot and total variance explained. Once the number of factors were identified, the analysis was re-run.

According to Yong & Pearce (2013), the covariance matrix should be used when items belong to the same scale and there should be a minimum of three variables loading on each factor for it to be considered an acceptable factor (Tabachnick & Fidell, 2013). The component correlation matrix was observed for correlations between factors. The small to large correlations were interpreted as factors that are interrelated and not independent (Field, 2017).

Results

The ECT version 1.2: The descriptive statistics on the data indicated the following: a minimum score of 8, maximum score of 38 and a mean of 23. The values of skewness, -.125 and kurtosis, -.284 indicates that the data is negatively skewed and has a flat distribution (Field, 2017). The tests for normality (observed in Table 3), namely the Kolmogorov-Smirnov and Shapiro-Wilk tests were used to assess for normality. According to the values of the Kolmogorov-Smirnov and Shapiro-Wilk tests, respectively $D(597) =$

.055, $p < .05$ and $D(597) = .994$, $p < .001$, the data is significantly non-normal. The histogram of the data with a normal curve is shown in figure 1. This information indicates that the data appears normal.

Table 3: Tests for Normality for the ECT version 1.2

Tests of Normality	Statistics	Degrees of Freedom	Significance
Kolmogorov-Smirnov	.055	597	.000
Shapiro-Wilk	.994	597	.013

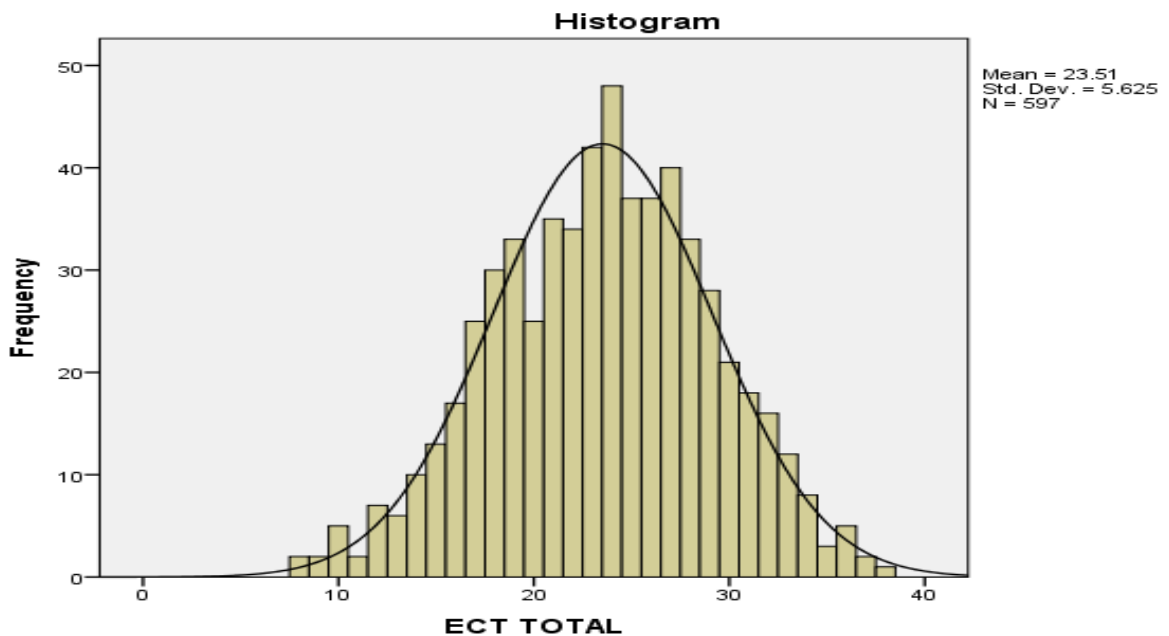


Figure 1: Histogram of the ECT version 1.2

The ECT version 1.3: The descriptive statistics indicated the following: a minimum score of 8, a maximum score of 39 and a mean of 26. Similarly, the values of skewness, -.256, and kurtosis, -.082, specify that the data is negatively skewed and has a flat distribution (Field, 2017). The Kolmogorov-Smirnov and Shapiro-Wilk tests (observed in table 4) indicate the following respectively: $D(881) = .063, p < .001$ and $D(881) = .987, p < .001$. This indicates that the data is significantly non-normal. The histogram of the data is shown in figure 2 with a normal curve. This information indicates that the data appears to be normally distributed.

The data for both test versions indicate that the test was negatively skewed, which would imply that the individuals taking the test experienced it as easy (Field, 2017). The normality of the two test versions suggest that the data is not normal based on the results of the tests of normality.

Table 4: Tests for Normality for the ECT version 1.3

Tests of Normality	Statistics	Degrees of Freedom	Significance
Kolmogorov-Smirnov	.063	881	.000
Shapiro-Wilk	.987	881	.000

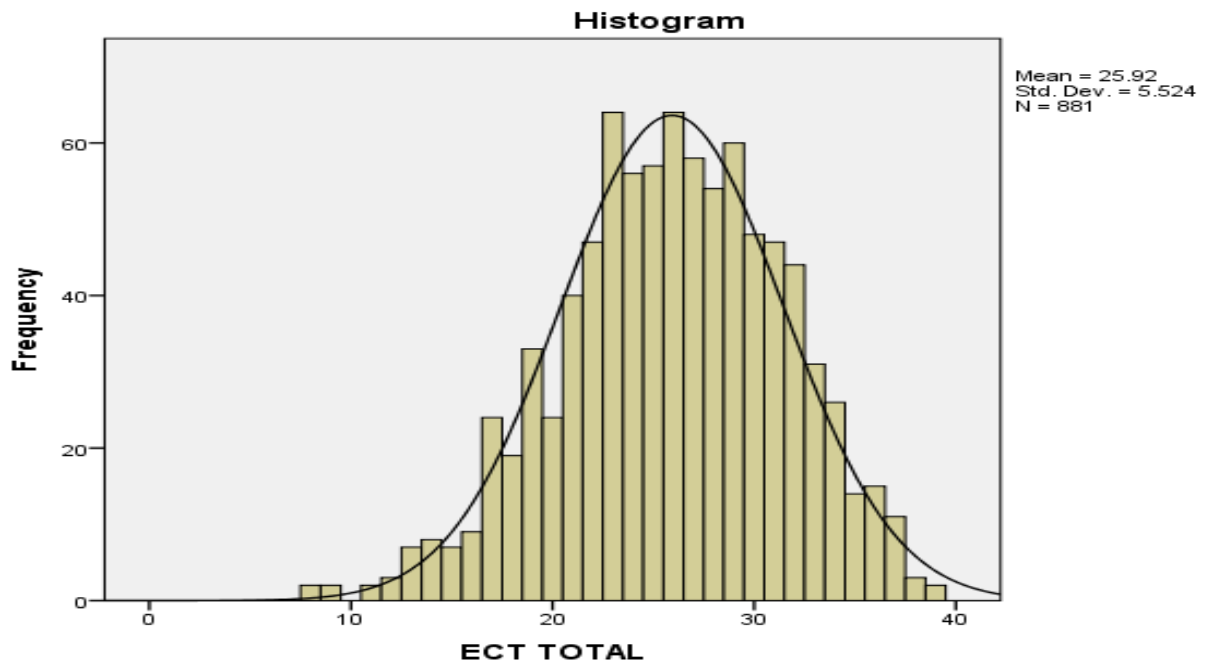


Figure 2: Histogram of the ECT version 1.3

In the correlation matrixes for both test versions, the determinant was .001 (ECT version 1.2) and .002 (ECT version 1.3) which satisfied the assumption of multicollinearity. The KMO values were .826 (ECT version 1.2) and .830 (ECT version 1.3) respectively which indicated adequacy for factor analysis. The Bartlett's Test for Sphericity was significant ($p = .00$) across both test versions.

The ECT version 1.2 analyses identified 15 components for both PCA and PAF, which explained 64% of the variance in the test. The ECT version 1.3 analyses identified 17 components for both PCA and PAF, which explained 66% of the variance of the test. The Scree-plot was also consulted, which indicated that 3 factors (ECT version 1.2) and 4

factors (ECT version 1.3) should be retained. When using the 4-factor solution for the ECT version 1.3, there were only two items which independently loaded on the fourth factor and as such, it was decided that a 3-factor solution would be used instead. The 3 factors that were retained for the ECT version 1.2 explained 25% of the variance for both PCA and PAF. The 3 factors retained for the ECT version 1.3 explained 24% of the variance in the test for both the PCA and PAF.

In Table 5 and 6, the Reasoning factor (referring to a general reasoning ability) was labelled as such because the items loaded on this factor could possibly involve the same cognitive process of reasoning and critically evaluating. The Vocabulary factor is comprised of all the antonym items which relates to the meaning of words. The Deduction factor involves items that allow for inferences to be made.

All the factor loadings have been indicated in tables 5 - 8, but only the most salient (> 0.30) factor loadings for the 3-factor solution, which is in bold, will be interpreted.

In table 5, the 27 items loaded as follows: 18 items (1 item cross-loading) on the Reasoning Factor, 5 items on the Vocabulary Factor and 4 items on the Deduction Factor.

Table 5: Pattern Matrix of the PCA: ECT 1.2

Items	Reasoning Factor	Vocabulary Factor	Deduction Factor
Sentence Construction	.545	-.006	.010
Synonym	.532	.022	-.381
Synonym	.509	-.024	.157
Sentence Construction	.505	.147	-.130
Tenses	.495	-.056	-.268

Tenses	.493	.013	.247
Sentence Construction	.473	.039	.108
Disadvantages	.46	-.055	.002
Synonym	.396	-.134	-.015
Sentence Construction	.39	.096	.081
Synonym	.381	-.013	.169
Summary	.379	-.027	-.134
Advantages	.364	.069	.061
Word Description	.348	-.034	.024
True & False	.344	-.015	.100
True & False	.322	.149	.223
Synonym	.319	-.015	.034
True & False	.31	-.136	.230
Antonym	-.083	.908	-.008
Antonym	-.052	.903	-.005
Antonym	.070	.771	-.023
Antonym	.094	.697	-.088
Antonym	.007	.686	.069
Fact or Opinion	.234	-.034	-.623
Fact or Opinion	.075	-.056	.539
Tenses	.024	.060	.333
Summary	.271	-.023	.302

**Promax rotation converged in 4 iterations.*

In table 6, the 20 items loaded as follows: 5 items on the Vocabulary Factor, 10 items on the Reasoning Factor and 5 items on the Deduction Factor.

Table 6: Pattern Matrix of the PAF: ECT 1.2

Items	Reasoning Factor	Vocabulary Factor	Deduction Factor
Antonym	-.094	.946	-.040
Antonym	-.076	.936	-.013
Antonym	-.003	.701	.111
Antonym	.034	.583	.088
Antonym	.192	.554	-.140
Sentence Construction	.623	-.024	-.040

Tenses	.613	.004	-.092
Sentence Construction	.570	.076	-.164
Sentence Construction	.498	.011	.041
Synonym	.466	-.015	.054
Sentence Construction	.357	.129	.082
Synonym	.343	-.088	-.006
Synonym	.326	.001	.057
True & False	.323	.099	.077
Summary	.306	-.011	.001
Tenses	.009	-.019	.412
Disadvantages	.100	-.040	.387
Tenses	-.033	.056	.380
Tenses	-.174	-.007	.363
True & False	-.133	-.014	.359

**Promax rotation converged in 5 iterations.*

The PCA pattern matrix has more item loadings and has a very strong factor 1, while in the PAF analysis; there is a strong factor 2. Despite these differences in factor loadings, there is support for a dominant factor (Reasoning factor) emerging from both analyses. Some interesting observations were made with regards to the items that loaded onto the different factors for both PCA and PAF analyses, such as: the identical loadings on the Vocabulary factor; 1 item cross-loading on Reasoning and Deduction factors, the Reasoning factor appears to have the most item loadings and most of the item loadings on the Deduction factor are different across these analyses.

In table 7, the 25 items loaded as follows: 13 items on the Reasoning factor, 5 items on the Vocabulary factor and 7 items on the Deduction factor.

Table 7: Pattern Matrix of the PCA: ECT 1.3

Items	Reasoning Factor	Vocabulary Factor	Deduction Factor
Sentence Construction	.596	.009	-.173
Fact or Opinion	.537	-.090	-.432
Disadvantages	.513	.048	-.026
True & False	.502	.088	.039
Synonym	.415	-.032	.011
True & False	.392	.049	-.077
Plurals	.392	-.026	.236
Advantages	.391	-.010	.024
Word Description	.349	-.032	.070
True & False	.340	.082	.049
Sentence Construction	.327	.057	.071
Synonym	.325	-.126	.132
Purpose	.309	-.002	.056
Antonym	-.053	.880	-.029
Antonym	-.044	.866	-.056
Antonym	.018	.775	.010
Antonym	.067	.658	.030
Antonym	.123	.655	-.034
Fact or Opinion	-.356	.073	.613
Plural	.263	.048	.492
Synonym	.310	.054	.433
Sentence Construction	.306	.026	.394
True & False	.237	.108	-.378
Synonym	.134	-.102	.336
Fact or Opinion	.194	-.033	.301

**Promax rotation converged in 6 iterations.*

In table 8, the 20 items loaded as follows: 5 items on the Vocabulary factor, 7 items (3 items cross-loading) on the Deduction factor and 8 items (1 item cross-loading) on the Reasoning factor.

Table 8: Pattern Matrix of the PAF: ECT 1.3

Items	Reasoning Factor	Vocabulary Factor	Deduction Factor
Antonym	-.061	.929	-.069
Antonym	-.035	.910	-.099
Antonym	.015	.691	.029
Antonym	.097	.521	.050
Antonym	.024	.501	.109
Sentence Construction	-.090	.024	.666
Plural	-.015	.047	.538
Synonym	.037	.055	.491
Sentence Construction	.005	-.040	.410
Plural	.138	-.018	.382
Synonym	-.059	-.058	.349
True & False	.004	.061	.316
Tenses	.445	.002	-.118
Fact or Opinion	.412	-.056	-.156
Sentence Construction	.384	.015	.081
Tenses	.352	.043	-.148
True & False	.334	.067	-.287
True & False	.327	.059	.205
Disadvantages	.322	.043	.149
Tenses	.319	-.038	.003

**Promax rotation converged in 5 iterations.*

A dominant factor (Reasoning factor) emerged in both analyses, which proposes an argument for unidimensionality, but this cannot however be inferred from this analysis. As observed in the analysis of the ECT version 1.2, the PCA analysis has a few items cross-loading on the Reasoning and Deduction factors. The Vocabulary factor has identical item loadings and the item content for the Deduction factor is similar across the analyses.

Table 9: Component Correlation Matrix of the PCA (ECT version 1.2)

Factors	Reasoning Factor	Vocabulary Factor	Deduction Factor
Reasoning Factor	1	.366	.178
Vocabulary Factor	.366	1	.084

Table 10: Component Correlation Matrix for PCA (ECT version 1.3)

Factors	Reasoning Factor	Vocabulary Factor	Deduction Factor
Reasoning Factor	1	.323	.319
Vocabulary Factor	.323	1	.181

In table 9 and 10, there are small correlations between the Reasoning and Vocabulary factors and very small correlations between the Vocabulary and the Deduction factors across the two test versions. The size of the relationship between the Reasoning and Deduction factors differ across the two test versions.

Table 11: Factor Correlation Matrix of the PAF (ECT version 1.2)

Factors	Vocabulary Factor	Deduction Factor	Reasoning Factor
Vocabulary Factor	1	.331	.376
Deduction Factor	.331	1	.548

Table 12: Component Correlation Matrix for PAF (ECT version 1.3)

Factors	Vocabulary Factor	Reasoning Factor	Deduction Factor
Vocabulary Factor	1	.390	.365
Reasoning Factor	.390	1	.528

In table 11 and 12, there are small correlations between the Vocabulary and Reasoning factors and the Vocabulary and Deduction factors across the two test versions. There is also a large relationship between the Reasoning and Deduction factors across the two test versions.

Discussion

The distribution of the data across both test versions of the ECT indicated that the test could be easy for individuals. The test does however contain both easy and difficult items. The exploratory factor analyses conducted on the ECT version 1.2 and 1.3 revealed noteworthy findings. The PCA and PAF analyses for both test versions presented fairly similar results, yet the PCA pattern matrix had a few items cross-loading across the two test versions. The labelled factors for the ECT version 1.2 are as follows: factor 1: Vocabulary, factor 2: Reasoning, factor 3: Deduction. The labelled factors and factors for the ECT version 1.3 are as follows: factor 1: Vocabulary, factor 2: Deduction, factor 3: Reasoning. The correlation matrix for the PCA and PAF for both versions also indicated a similar trend among the factors for these respective analyses. The factors of the PCA analyses were less

related across the two test versions, while all factors in the PAF analyses were related across both test versions. The PAF analyses link to the literature in that the factors, Reasoning, Vocabulary and Deduction are interrelated processes, while also linking to the PCA analyses, in that they are still separate factors which contribute to the overall performance on the ECT. These factors are thus all necessary in the conceptualisation of the construct underlying the ECT, which based on the factor descriptions, suggests that the ECT is an assessment of cognitive aptitude to a small extent (preliminary only on a verbal level). This construct should however be explored further in a different study.

The similarity between the factors for both test versions endorses the presence of a definite dominant factor within the ECT, despite the few changes between the test versions. Although there is a common factor structure observed across the two test versions, the ECT 1.3 has a more diverse sample and appears to present a conceptually stronger factor structure than the ECT 1.2. This is a crucial finding which will supplement the development and construct validation of the ECT. Since this is an exploratory study, these results will require more investigation and other analyses to be conducted that will provide more substantial information on the constructs being measured by the ECT. The factor analysis performed in this study did not control for the language ability of the sample and this may have impacted on the factors emerging for the ECT and is thus a limitation for this study. It is therefore recommended that the sample be split into English first language and English second/third language groups and separate factor analyses be performed. These findings

can be compared to the combined factor structure which will provide more insight into the factor structure of the ECT, especially within a multilingual context.

The naming of factors can be problematic in factor analysis, because the items loading on each factor might make it difficult to identify what the factor is measuring (Tabachnick & Fidell, 2013). For this reason, the factor analysis is considered an exploratory technique and does not attempt to answer or test any hypotheses (Williams, Onsman & Brown, 2010). Hence, the arguments made in this paper are tentative and require further investigation into the constructs of the ECT. The suggested analyses which will assist with the construct validity of the ECT are confirmatory factor analyses and multi-trait multi-method analyses.

A very general approach was taken with the development of the initial items which is a limitation of this study. The sample of the ECT was conveniently selected which leads to a restriction of range. These results cannot be generalized and are specific to the population that was utilized. The item bank for the ECT is rather small, especially since it is still in development. This can be problematic when many items do not perform adequately in the test. In addition to this, the time-limit imposed on the one test version of the test (ECT version 1.2) might have had an impact on how the individuals performed. Their motivation, anxiety and ability to complete a test within a specified time could have impacted their performance on the test. The time of day (afternoon) on which they completed this test could have been influenced by fatigue and needs to be acknowledged as this could also have impacted their performance on the test. The use of excel sheets for the

data capturing of the ECT is also mentioned as a possible limitation because although the data sheets have been checked several times, the reality of human error is possible.

Conclusion

This exploratory study of the factors emerging from the newly developed ECT has provided important insights into the underlying structure of the test. Although a dominant factor was observed for both factor analyses conducted across the two test versions, unidimensionality could not be inferred and further investigation is required. The labelled factors of the ECT also suggest that the underlying construct of the ECT could be a measure of cognitive (verbal) aptitude. These results are considered tentative and require further analyses to be conducted to confirm these initial findings. The comparison of the two test versions of the ECT indicated that there were both common and cognitive factors observed. The ECT 1.3 was however, an improved test version due to the conceptually stronger factor structure. The significance of this study rests in the development and validation of a local test developed specifically for South Africans.

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