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ABSTRACT

To provide empirical data from which inferences could be made about the definition of critical reading and also the relationship between critical reading and critical thinking were the main objectives of this study. The Reading Comprehension Test; the Test of Critical Thinking, Form G; the Nelson-Denny Reading Test, Form A; and the Lorge-Thorndike Intelligence Tests were administered to 57 twelfth-grade students at Robinson High School, Tampa, Florida. The subjects had already taken the Florida Statewide Twelfth Grade Tests. Factor analysis of the subtests indicated a general factor with substantial language variance, a critical reading factor, a nonverbal factor, and several small critical thinking and language factors. Rotation sharpened the factors indicated in the factor analysis. The general factor became a strong group verbal language factor, particularly vocabulary. The critical reading factor consisting of all critical reading subtests and three critical thinking subtests was sharpened. Several other small factors were identified. It was concluded that critical reading overlaps substantially with reading, thinking, and language activities, particularly vocabulary. It was also concluded that there is considerable overlap between critical reading and critical thinking. Tables and references are given. (Author/DE)

Correlational and Factor Analysis of Critical Reading and Critical Thinking--Twelfth Grade*

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Introduction

Critical reading and critical thinking are constructs which have received attention for years. Their definitions and relationship have been vague and unclear. Lack of empirical examination of the definitions is the paramount reason for the lack of clarity. This lack of clarity has been further compounded by the abundance of definitions both of critical reading and critical thinking. This abundance has resulted in considerable confusion, uncertainty, and ambiguity becoming associated

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with the definitions of both critical reading and critical thinking. The ambiguity and confusion characterising the definition of critical reading is apparent from the Wolf, et al. (15) review of the critical reading literature and from the assertion by Gainsburg (6) among others that the term critical reading is not sufficiently accurate to describe its nature. The ambiguity, uncertainty, and confusion characterising the definition of critical thinking have been noted by Rust (11), Ennis (4), Penfold and Abou-Hatab (10), and Follman (5).

Wolf, et al. (15) recently provided evidence that critical reading consists of a number of skills. Follman (5) in a factor analytic study of critical thinking test and subtest scores found that critical thinking also was a composite of specific skills, particularly recognition of assumptions, judgments if conclusions follow, relevance of evidence, certainty of judgment about the degree to which conclusions follow.

There is still little knowledge of the relationship between critical reading and critical thinking. The principal reason is probably the paucity of critical reading tests as has been noted by Denberg and Jones (3) and Trela (14). This contention might properly be qualified by the condition that there are few critical reading tests about which much is known. Many scholars including Gainsburg (6), Simmons (12), and Wolf, et al. (15) have contended that there is substantial overlap between critical reading and critical thinking. However, apparently the only empirical evidence of this overlap is a correlation of .77 on twelfth grade pupils' scores between the Watson-Glaser Test of Critical Thinking and the Martin Reading Comprehension Test described by Glaser (7) as a test of critical reading.

The objectives of this study were to determine empirically the phenotypic interrelationships and factor structure of critical reading and critical thinking tests and subtests from which genotypic inferences could be made about the definitions of critical reading, and critical thinking, and also the relationship

between critical reading and critical thinking.

This study reports the primary statistical analysis of a twelfth grade data collection, half of a research program examining empirically the definition of critical reading. The other half of the research program is a fifth grade data collection.

Procedure

The subjects (Ss) were 57 twelfth grade students at Robinson High School, Hillsborough County Public Schools, Tampa, Florida. The students were selected by the school administrators and teachers to represent the range of ability characteristic of their twelfth grade students.

One critical reading test, Reading Comprehension Test (CR) (Martin, 9), one critical thinking test, Test of Critical Thinking Form G (CT) (American Council on Education, 1), one reading test, the Nelson-Denny Reading Test Form A (READ) (Brown, 2), and one intelligence test, The Lorge-Thorndike Intelligence Tests Form A (IQ) (Lorge and Thorndike, 8), were administered in December, 1969.

The Ss had already taken the Florida Statewide Twelfth Grade Tests Form PRT (Swineford, 13).

The following subtests were used:

Test of Critical Thinking Form G (CT)

- Pertinent Information (PERT INFO)
- Valid Inferences 1 (VAL INF 1)
- Valid Inferences 2 (VAL INF 2)
- Relevant Generalizations (REL GENS)
- Recognition of Assumptions (RECOG ASSUMP)
- Valid Inferences 3 (VAL INF 3)
- Valid Inferences 4 (VAL INF 4)
- Hypothesis Verification 1 (HYP VER 1)
- Hypothesis Verification 2 (HYP VER 2)

Nelson-Denny Reading Test (READ)

- Vocabulary (VOCAB)
- Comprehension (COMP)

The Lorge Thorndike Intelligence Tests (IQ)
- Vocabulary (VOCAB)
- Sentence Completion (SENT COMP)
- Arithmetical Reasoning (ARITH REAS)
- Verbal Classification (VERB CLASS)
- Verbal Analogies (VERB ANAL)
- Figure Classification (FIG CLASS)
- Number Series (NO SERIES)
- Figure Analogies (FIG ANAL)

Reading Comprehension Test (CR)
- Main Points (MAIN PTS)
- Specific Facts (SPEC FACTS)
- Cause and Effect Relationships (CAUSE EFFECT)
- Inference (INFERENCE)
- Vocabulary (VOCAB)

Florida Statewide Twelfth Grade Tests (FLA)
- Verbal (VERB)
- Quantitative (QUANT)
- English (ENGLISH)
- Social Science (SOC SCI)
- Natural Science (NAT SCI)
- Mathematics (MATH)
- Reading Index (FLA READ INDEX)

Pearson product moment correlations were calculated to determine the subtest score matrix, and the total test score matrix, independently. Principal components factor analysis and Kaiser Varimax rotation of all factors with eigenvalues in excess of one were conducted for the subtest score matrix, and the total test score matrix, independently.

Results

Table 1 indicates the intercorrelations for the 33 subtests.

Ns ranged from 57 to 51 for the different correlations as not all students took all subtests. Therefore Ns, means, and standard deviations for the 495 correlations are not presented because of space limitations. These data are available upon request.

A correlation of .28 is significant at the .05 level and a correlation of .36 is significant at the .01 level for an N of 51, the smallest N.

Table 1

Subtests' Intercorrelations

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
1 CT PERT INFO																																
2 CT VAL INF 1	-.05																															
3 CT VAL INF 2	.15	.50																														
4 CT REL GENS	.06	.28	.30																													
5 CT RECOG ASSUMP	.17	.16	.43	.30																												
6 CT VAL INF 3	.12	.15	.30	.30	.26																											
7 CT VAL INF 4	.14	.19	.41	.36	.53	.44																										
8 CT HYP VER 1	.29	.36	.46	.41	.44	.41	.45																									
9 CT HYP VER 2	.22	.21	.33	.14	.34	.23	.27	.51																								
10 READ VOCAB	.19	.33	.44	.60	.52	.42	.48	.37	.28																							
11 READ COMP	.17	.30	.42	.44	.53	.28	.38	.24	.17	.76																						
12 IQ VOCAB	.27	.19	.50	.47	.63	.39	.58	.32	.16	.80	.72																					
13 IQ SENT COMP	.40	.23	.53	.33	.50	.46	.48	.37	.22	.63	.54	.67																				
14 IQ ARITH REAS	.22	.23	.42	.28	.44	.35	.49	.42	.38	.35	.30	.39	.46																			
15 IQ VERB CLASS	.30	.25	.55	.03	.44	.28	.36	.38	.34	.50	.55	.52	.54	.30																		
16 IQ VERB ANAL	.43	.22	.50	.36	.48	.50	.42	.46	.31	.77	.63	.70	.69	.43	.56																	
17 IQ FIG CLASS	-.11	.18	.29	.08	.16	.31	.26	.35	.17	.07	.02	.10	.05	.44	.20	.13																
18 IQ NO SERIES	.26	.16	.22	.25	.15	.33	.25	.41	.12	.39	.32	.30	.41	.35	.35	.52	.50															
19 IQ FIG ANAL	.07	.29	.20	.08	-.09	.21	.06	.27	.24	.02	-.11	-.09	.16	.31	.19	.18	.46	-.30														
20 IQ VERB	.40	.28	.63	.38	.64	.49	.60	.49	.35	.78	.71	.87	.83	.63	.74	.86	.23	.48	.16													
21 IQ NON VERB	.11	.29	.29	.17	.06	.35	.21	.43	.24	.18	.06	.09	.27	.45	.31	.34	.77	.71	.84	.35												
22 CR MAIN POINTS	.23	.27	.46	.31	.56	.18	.31	.30	.29	.39	.38	.42	.53	.45	.34	.43	.05	.05	.10	.54	.09											
23 CR SPEC FACTS	.22	.17	.47	.36	.51	.29	.33	.23	.08	.41	.43	.50	.62	.23	.34	.42	-.04	.21	-.03	.53	.05	.71										
24 CAUSE EFFECT	.30	.13	.45	.49	.57	.23	.33	.28	.17	.58	.53	.67	.65	.37	.34	.55	.13	.27	.00	.66	.14	.64	.70									
25 INFERENCE	.37	.10	.36	.42	.48	.19	.27	.41	.38	.48	.36	.44	.52	.46	.31	.48	.03	.39	.08	.55	.21	.57	.61	.61								
26 CR VOCAB	.35	.16	.36	.50	.47	.32	.47	.30	.14	.58	.49	.65	.63	.26	.29	.58	-.04	.26	-.01	.62	.08	.60	.74	.69	.56							
27 FLA VERB	.28	.26	.48	.28	.54	.50	.46	.38	.35	.71	.62	.66	.61	.44	.65	.73	.23	.37	.15	.79	.30	.54	.44	.48	.41	.62						
28 FLA QUAN	.35	.16	.43	.27	.38	.43	.49	.48	.39	.53	.40	.51	.50	.59	.50	.61	.28	.44	.23	.69	.39	.54	.39	.46	.46	.53	.70					
29 FLA ENG	.28	.30	.50	.52	.57	.43	.47	.43	.19	.78	.65	.75	.53	.35	.41	.61	.20	.36	-.05	.69	.17	.45	.44	.63	.40	.61	.70	.58				
30 FLA SOC SCI	.33	.13	.59	.40	.54	.43	.42	.43	.35	.66	.60	.66	.76	.45	.63	.74	.17	.47	.14	.82	.32	.59	.55	.61	.50	.61	.75	.67	.60			
31 FLA NAT SCI	.33	.36	.65	.39	.36	.45	.52	.42	.35	.66	.56	.67	.74	.41	.61	.66	.12	.34	.24	.79	.31	.54	.53	.56	.46	.67	.78	.72	.64	.81		
32 FLA MATH	.25	.27	.57	.24	.33	.41	.46	.50	.47	.49	.45	.47	.52	.56	.56	.60	.35	.51	.35	.68	.51	.49	.38	.44	.41	.46	.66	.87	.53	.70	.77	

The nine CT subtests generally intercorrelated low or moderately. In general the CT subtests correlated low to moderately with the CR subtests, the reading and the IQ verbal subtests, low with the IQ non-verbal tests, and moderately with the FLA achievement tests, although VAL INF 2 and RECOG ASSUMP correlated somewhat higher.

READ VOCAB correlated moderately to high with nearly all variables except CT PERT INFO, CT VAL INF 1, CT HYP VER 2, and the non-verbal subtests. READ COMP correlated similarly except for low correlations with more CT subtests. The two subtests correlated high.

Three of the five IQ VERB subtests, IQ VOCAB, IQ SENT COMP, and IQ VERB ANAL correlated similarly, high with each other and most other variables, moderately with most CT and CR subtests, moderately to high with the FLA achievement subtests, high with reading subtests, and low with non-verbal subtests. The other two IQ VERB subtests, IQ ARITH REAS and VERB CLASS correlated low to moderately with nearly all variables. The three IQ non-verbal subtests, FIG CLASS, NO SERIES, and FIG ANAL had generally low correlations and some moderate ones with most other variables, and moderate intercorrelations.

The CR subtests correlated consistently low to moderately with the CT subtests, moderately with the READ and IQ VERB subtests, low with the IQ NON VERB subtests, and moderately to high with each other and the FLA subtests.

The FLA subtests correlated low to moderately with the CT subtests, moderately to high with READ and IQ VERB and each other and low with the IQ NON VERB subtests.

Table 2 indicates the subtests' means, standard deviations, unrotated and rotated factor loadings, %s of variance accounted for by each factor, and eigenvalues (N = 50).

Table 2

Subtests, Means, Standard Deviations, Unrotated and Rotated Factor Loadings

	$\bar{X}$	SD	Unrotated							Rotated						
			1	2	3	4	5	6	7	1	2	3	4	5	6	7
CT PERT INFO	4.36	1.79	.41	-.14	-.47	.42	.13	.07	-.23	.18	-.03	-.36	.19	.07	.19	-.65
CT VAL INF 1	1.38	1.03	.36	.19	.19	-.60	.14	-.42	-.24	.16	.03	-.12	-.81	.27	.11	.21
CT VAL INF 2	2.92	1.61	.71	.13	-.01	-.35	-.22	-.11	-.07	.52	.11	-.36	-.42	-.05	.31	.13
CT REL GENS	2.50	1.36	.55	-.08	.19	-.13	.64	-.04	-.11	.23	.06	-.21	-.19	.79	.17	-.05
CT RECOG ASSUMP	6.02	1.81	.70	-.18	-.01	-.35	-.07	.29	.33	.44	.04	-.55	.10	.14	.37	.42
CT VAL INF 3	1.24	1.14	.55	.31	.32	.27	-.01	.08	-.25	.63	.25	.21	-.08	.18	.21	-.22
CT VAL INF 4	.98	1.00	.65	.15	.19	-.04	-.12	.32	.03	.60	.16	-.09	.06	.09	.40	.14
CT HYP VER 1	5.90	2.07	.59	.42	-.07	-.15	.32	.23	-.14	.25	.28	-.08	-.18	.34	.64	-.10
CT HYP VER 2	2.58	2.13	.43	.34	-.29	-.28	.07	.47	-.28	.14	-.01	-.09	-.12	.04	.85	-.08
READ VOCAB	32.26	13.63	.81	-.19	.36	.00	.18	.05	-.07	.72	.02	-.23	-.05	.51	.10	.05
READ COMP	20.74	5.78	.75	-.28	.35	-.11	.01	.01	.04	.70	-.04	-.32	-.06	.36	.02	.21
IQ VOCAB	15.04	4.53	.81	-.29	.30	.07	-.04	.07	.10	.78	.03	-.35	.10	.30	.01	.12
IQ SENT COMP	8.16	2.28	.80	-.12	-.07	.16	-.11	-.19	-.06	.64	.12	-.47	-.12	.08	.04	-.24
IQ ARITH REAS	8.40	3.01	.59	.39	-.18	-.09	.03	.16	.28	.26	.50	-.31	-.01	.03	.48	.07
IQ VERB CLASS	13.90	3.16	.68	.06	.06	-.06	-.45	-.07	-.01	.68	.13	-.28	-.19	-.23	.14	.07
IQ VERB ANAL	9.28	3.28	.83	-.04	.11	.21	.05	-.05	-.06	.70	.19	-.31	-.04	.28	.11	-.20
IQ FIG CLASS	13.02	3.70	.26	.73	.14	.00	-.02	-.10	.48	.11	.86	.07	-.11	-.06	.17	.23
IQ NO SERIES	13.52	4.48	.50	.37	.10	.40	.29	-.23	.31	.29	.74	-.12	.03	.30	-.05	-.22
IQ FIG ANAL	19.34	6.83	.18	.68	-.19	-.01	.04	-.46	-.14	-.04	.54	.04	-.58	-.12	.13	-.31
CR MAIN POINTS	3.48	1.46	.68	-.18	-.43	-.29	-.15	-.11	.06	.30	-.02	-.77	-.21	-.08	.27	-.02
CR SPEC FACTS	12.90	2.59	.67	-.38	-.31	-.10	-.02	-.25	.13	.33	-.03	-.80	-.10	.09	-.02	-.08
CR CAUSE EFFECT	3.36	1.44	.75	-.31	-.16	-.02	.13	-.16	.25	.40	.13	-.73	.01	.27	.00	-.02
CR INFERENCE	6.28	2.18	.66	-.09	-.46	-.03	.34	.09	.11	.13	.15	-.67	.06	.31	.39	-.23
CR VOCAB	11.36	3.07	.76	-.35	-.13	.09	.12	-.13	-.05	.51	-.05	-.60	-.03	.29	.03	-.24
FLA VERB	27.64	8.33	.86	-.01	.15	.05	-.20	.02	-.06	.81	.13	-.30	-.10	.08	.19	-.03
FLA QUAN	29.00	8.67	.78	.22	-.15	.20	-.11	.15	-.01	.59	.31	-.30	.05	-.02	.41	-.24
FLA ENG	51.00	13.64	.79	-.15	.30	.02	.11	.08	.03	.70	.08	-.27	.01	.42	.13	.08
FLA SOC SCI	38.42	11.35	.86	-.03	-.05	.17	-.16	-.02	-.02	.72	.18	-.42	-.03	.04	.16	-.19
FLA NAT SCI	32.64	10.44	.87	.00	.00	.10	-.19	-.12	-.28	.78	.05	-.33	-.25	.04	.19	-.28
FLA MATH	24.14	11.78	.78	.35	-.12	.11	-.19	.04	-.07	.61	.37	-.24	-.15	-.09	.41	-.21
% of σ^2 accounted for			45.79	8.68	5.59	4.74	4.29	3.93	3.44	35.63[1]	10.55[1]	20.31[1]	6.72[1]	8.96[1]	11.52[1]	6.31[1]
Eigenvalues			13.74	2.60	1.68	1.42	1.29	1.18	1.03							

[1] % of σ^2 of these seven factors accounted for by these seven factors, not % of total σ^2

Factor analysis indicated a group near general factor accounting for about 46% of the total variance with only two variables (non-verbal) having loadings less than .36. This factor apparently consists of language, reading, thinking, vocabulary, and verbal activities.

The second factor was a non-verbal variable.

Factor 3 represents critical reading activities.

Factor 4 represents critical thinking activities.

Factor 5 apparently involves language categorization activity.

Factor 6 and 7 are essentially uninterpretable.

Rotation sharpened the factors identified in the factor analysis. The large group factor had strong loadings from fewer tests, with 12 loadings below .36 instead of two as in the factor analysis. This is demonstrably a verbal, language factor particularly vocabulary. The loadings of .59 of FLA QUAN and .61 of FLA MATH merely document the well known substantial amount of verbal variance involved in these alleged non-verbal tests.

The non-verbal factor identified in the factor analysis was more clearly delineated in the second factor with loadings of .86 from IQ FIG CLASS, .74 from IQ NO SERIES, .54 from IQ FIG ANAL, .50 from IQ ARITH REAS, and .37 from FLA MATH.

Factor 3 is empirical evidence for a relationship between critical reading and critical thinking with loadings from all five CR subtests and three CT subtests and a few other subtests. The relationship encompasses such activities as judgment about the relationship of statements to conclusions, accuracy of interpretation of information, and interpretation of the assumptive nature of statements.

The strong loadings of the CR subtests are evidence that CR represents rather specific, unique activities in association with some critical thinking activities, but distinct from verbal ability, reading ability, and probably intelligence.

Factor 4 is difficult to interpret but apparently involves language interpretation and categorization.

Factor 5 apparently is focally involved with understanding of language.

Factor 6 has strong loadings of .85 from CT HYP VER 2 and .64 from CT HYP VER 1 but may actually represent the same unique subtest content for both subtests, rather than some identical underlying activity, i.e., hypothesis verification.

Factor 7 has a strong loading from CT PERT INFO and involves judgment whether a statement does or does not support a given conclusion.

Table 3 indicates the total test score correlations for CT, READ, IQ, CR, and READ INDEX.

Table 3

Total Test Score Correlations

	CT	READ	IQ	CR	READ INDEX
CT					
READ	.62				
IQ	.70	.60			
CR	.62	.59	.51		
READ INDEX	.72	.81	.72	.69	

All correlations significant at .01 level

Ns for these correlations were 55, 53, 57, 55, 52, 55, 53, 53, 51, and 55 respectively. Means and standard deviations are available upon request.

The total test score correlations indicated substantial common variance between CT, READ, IQ, CR, and READ INDEX.

Table 4 indicates total test score means, standard deviations, unrotated and rotated factor loadings, %s of variance accounted for by each factor and eigenvalues.

Table 4

Total Test Score Means, Standard Deviations, and Unrotated and Rotated Factor Loadings

	$\bar{X}$	SD	Unrotated 1	Unrotated 2	Rotated 1	Rotated 2
CT	27.88	8.80	.87	.11	.54	.69
READ	53.00	18.51	.86	-.09	.68	.54
IQ	100.66	20.21	.83	.48	.25	.92
CR	37.38	9.16	.81	-.47	.90	.24
READ INDEX	72.16	18.75	.93	-.04	.69	.63
% of σ^2 accounted for			74.20	9.28	50.39[1]	49.61[1]
Eigenvalues			3.71	.46		

[1]% of rotation σ^2 accounted for, not % of total σ^2.

N was 50. Factor analysis indicated a general factor accounting for 74% of the variance consisting of strong loadings from all total test scores. Presumably this factor represents common language variance. The second factor had moderate loadings from IQ probably reflecting IQ's non-language component, and variance measured by some of the CR subtests.

Rotation split the general factor. One factor consisted essentially of CR and also variance from READ INDEX, READ, and CT. The other factor consisted essentially of IQ with variance also from CT, READ INDEX, and READ. It accounted for only nine percent of the total variance. Finally factor analysis of only five variables has limited meaning and that heuristic meaning if its results are consistent with the subtests' analyses.

Conclusions

1. Critical reading has substantial overlap with reading, thinking, and language activities, particularly vocabulary and some critical thinking activities. Language ability in general and vocabulary ability in particular is seen as basic to critical reading.

2. There is overlap between critical reading and critical thinking. This overlap represents substantially what CR measures and is in addition to language ability and is distinct from a number of other rather specific thinking activities.

3. Critical thinking consists of some activities separate from the other thinking, language, non-language, and critical reading abilities identified herein.

4. Additional analyses of the critical reading and critical thinking tests and subtests are suggested, particularly inter-item correlations, factor analysis and rotation, and first and second order partial correlation, and canonical correlation.

5. A final caveat, the validity of any correlational and factor analytic study depends upon the reliability and validity of the tests and subtests used.

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