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ABSTRACT
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abilities were analyzed to determine the nature of possible reference
tests for cognitive abilities. They are the Guilford analysis of
cognition, Guttman's facet design, and the Primary Mental Abilities
of the Thurstones. This analysis led to a fourth schema for
classifying abilities that deal with cognizing concepts. A battery of
56 tests was developed to study the relationships among the four
schemata. Data for the 56 tests were collected on 172 boys and 210
girls who had just completed the fifth grade. Six sets of derived
factors, three orthogonal and three oblique, were interpreted. Six
clear comparable common factors and one that is fairly clear were
obtained for the boys. The six clear comparable common factors appear
to represent most closely six of the seven Primary Mental Abilities.
The comparable common factor that is fairly clear may be a missing
Primary Mental Ability--Spatial Ability. Five clear comparable common
factors obtained for girls appear to be five of the seven Primary
Mental Abilities. (Author)

TECHNICAL REPORT NO. 192

ANALYSIS OF DIMENSIONS OF A BATTERY OF REFERENCE TESTS FOR COGNITIVE ABILITIES: FIFTH GRADE BOYS AND GIRLS

REPORT FROM THE PROJECT ON A STRUCTURE
OF CONCEPT ATTAINMENT ABILITIES

Margaret L. Harris

WISCONSIN RESEARCH AND DEVELOPMENT

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COGNITIVE LEARNING

RESEARCH

COGNITIVE
LEARNING

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Appendix E materials

Statement of Focus

The Wisconsin Research and Development Center for Cognitive Learning focuses on contributing to a better understanding of cognitive learning by children and youth and to the improvement of related educational practices. The strategy for research and development is comprehensive. It includes basic research to generate new knowledge about the conditions and processes of learning and about the processes of instruction, and the subsequent development of research-based instructional materials, many of which are designed for use by teachers and others for use by students. These materials are tested and refined in school settings. Throughout these operations behavioral scientists, curriculum experts, academic scholars, and school people interact, insuring th at the results of Center activities are based soundly on knowledge of subject matter and cognitive learning and that they are applied to the improvement of educational practice.

This Technical Report is from the Project on the Structure of Concept Attainment Abilities in Program 1. The general objectives of this project are to identify basic concepts in language arts, mathematics, science, and social studies appropriate at a given grade level; to develop tests to measure achievement of these concepts; and to develop and identify reference tests for cognitive abilities. These will be used to study the relationships among learned concepts in various subject matter areas, cognitive abilities, and possibly, certain cognitive styles. The results of these will be a formulation of a model of structure of abilities in concept attainment.

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Abstract

Three systems for defining general cognitive abilities were analyzed
to determine the nature of possible reference tests for cognitive abilities.
They are the Guilford analysis of cognition, Guttman's facet design, and
the Primary Mental Abilities of the Thurstones. This analysis led to a
fourth schema for classifying abilities that deal with cognizing concepts.

A battery of 56 tests was developed to study the relationships among
the four schemata. Data for the 56 tests were collected on 172 boys and
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Six sets of derived factors, three orthogonal and three oblique, were
interpreted. Six clear comparable common factors and one that is fairly
clear were obtained for boys. The six clear comparable common factors
appear to represent most closely six of the seven Primary Mental Abili-
ties. The comparable common factor that is fairly clear may be a missing
Primary Mental Ability--Spatial Ability. Five clear comparable common
factors obtained for girls appear to be five of the seven Primary Mental
Abilities.

I
Introduction

The primary objective of the project entitled "A Structure of Concept Attainment Abilities" (hereafter referred to as the CAA Project) is to formulate one or more models or structures of concept attainment abilities, and to assess their consistency with actual data. The major steps for attaining this primary objective were taken to be:

1. To identify basic concepts in language arts, mathematics, science, and social studies appropriate at the fourth grade level,

2. To develop tests to measure achievement of these concepts,

3. To identify reference tests for cognitive abilities, and

4. To study the relationships among learned concepts in these four subject matter fields and the identified cognitive abilities.

There are two major phases of Step 3. One is the examination of available systems for defining cognitive abilities followed by the selection and/or construction of tests implied by these systems. These efforts are described in "Three Systems of Classifying Cognitive Abilities as Bases for Reference Tests" (Harris & Harris, in press (c)). A description of the procedures used for constructing some of the tests implied by these systems and summary item and test statistics for all of the tests in the battery compiled as administered to two different samples, one composed of fifth grade boys and one of fifth grade girls, are reported in "Item Analyses and Reliabilities for Reference Tests for Cognitive Abilities: Fifth Grade Boys and Girls" (Harris & Harris, in press (a)). The second major phase of

Step 3 is the empirical study of the interrelations of these tests in an attempt to validate and/or reconstruct these systems; this paper describes these efforts.

Three fairly well-known systems for defining general cognitive abilities were analyzed to determine the nature of possible reference tests for cognitive abilities. They are the Guilford (1967) analysis of cognition using three contents and six products; the facet design for achievement, consisting of three tasks and three types of content, proposed by Guttman (1970); and the Primary Mental Abilities schema of the Thurstones (1938, 1941). In analyzing these three systems it became apparent that modifications in the schemata might be appropriate for both content and the operation or task required; this led to a fourth schema for classifying abilities that deal with cognizing concepts. It involves classifying the nature of exemplars as things or relations; the content as verbal-semantic, picture-semantic, number-semantic, figural, number-symbolic, letter-symbolic, or word-form; and the task as classifying, excluding, or naming. Each of the 56 tests in the battery was classified in the content category; only those tests dealing with the cognition of concepts were classified in the other two categories. This schema is discussed in more detail in Harris and Harris (in press (c)).

A battery of 56 tests was developed to study the relationships among the Guilford, Guttman, and Thurstone schemata. For factor analysis, it is desirable to have at least two, and preferably three, tests to measure each hypothesized ability (each of the identified possible cognitive abilities). Tests were selected, adapted, or constructed as specific measures of the ability implied by a cell of interest in at least one of the schemata, including the newly proposed system for the cognition of concepts. Since Guilford's

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Table 1. Classification of Each of the 56 Tests in Each of the Schemata

Test		Guilford								
	CMU	CMC	CMR	CMS	CSU	CSC	CSR	CSS	CFU	CFC
1 Picture Meaning	x									
2 Verbal Classification		*								
3 Number Series								*		
4 Remembering Classes: Members										
5 Number Class Extension						x				
6 Word Groups						*				
7 Remembering Classes: Members II					*					
8 Disemvowelled Words						*				
9 Letter Grouping						*				
10 Circle Reasoning								*		
11 Figure Exclusion										*
12 Seeing Trends							*			
13 Picture Classification		y								
14 Paragraph Comprehension	*									
15 Remembering Classes: Names										
16 Word Group Naming										
17 Gestalt Completion									*	
18 Card Rotations										
19 Spatial Relations										
20 Verbal Exclusion		*								
21 Best Word Class										
22 Omelet					*					
23 Picture Group Naming										
24 Concealed Words									*	
25 Perceptual Speed										
26 Letter Triangle								*		
27 Letter Classification						x				
28 Picture Class Memory										
29 Puzzles										
30 Spelling					*					
31 Picture Exclusion		y								
32 Sensitivity to Order			*							
33 Figure Analogies										
34 Scrambled Sentences	*									
35 Same–Opposite	x									
36 Figure Matrix										
37 Remote Class Completion										
38 Number Exclusion						x				
39 Sentence Order										
40 Vocabulary	x									
41 Word Relations							*			
42 Verbal Analogies			*							
43 Best Trend Name										
44 Picture Arrangement										
45 Arithmetic Problems										
46 Identical Pictures										
47 Picture Group Name Selection						*				
48 Number Classification						*				
49 Word Exclusion						x				
50 Number Relations						*				
51 Word Linkage			*							
52 Figure Classification										*
53 Class Name Selection										
54 Necessary Arithmetic Operations				*						
55 Verbal Analogies III										
56 Remembering Classes: Members III										

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Table 1. Classification of Each of the 56 Tests in Each of the Schemata (continued)

Test	Guilford									
	CFR	CFT	MMC	MSI	NMC	NMS	EMC	EMR	EMI	EFU
1 Picture Meaning										
2 Verbal Classification										
3 Number Series										
4 Remembering Classes: Members			y							
5 Number Class Extension										
6 Word Groups										
7 Remembering Classes: Members II			x							
8 Disemvowelled Words										
9 Letter Grouping										
10 Circle Reasoning										
11 Figure Exclusion										
12 Seeing Trends										
13 Picture Classification										
14 Paragraph Comprehension										
15 Remembering Classes: Names			*							
16 Word Group Naming					y					
17 Gestalt Completion										
18 Card Rotations		*								
19 Spatial Relations		*								
20 Verbal Exclusion										
21 Best Word Class							*			
22 Omelet										
23 Picture Group Naming					y					
24 Concealed Words									*	
25 Perceptual Speed										
26 Letter Triangle										
27 Letter Classification										
28 Picture Class Memory			*							
29 Puzzles									*	
30 Spelling										
31 Picture Exclusion										
32 Sensitivity to Order										
33 Figure Analogies	*									
34 Scrambled Sentences										
35 Same–Opposite										
36 Figure Matrix	*									
37 Remote Class Completion					y					
38 Number Exclusion										
39 Sentence Order						*				
40 Vocabulary										
41 Word Relations										
42 Verbal Analogies										
43 Best Trend Name								*		
44 Picture Arrangement						*				
45 Arithmetic Problems				*						
46 Identical Pictures									*	
47 Picture Group Name Selection							y			
48 Number Classification										
49 Word Exclusion										
50 Number Relations										
51 Word Linkage										
52 Figure Classification										
53 Class Name Selection						*				
54 Necessary Arithmetic Operations										
55 Verbal Analogies III								*		
56 Remembering Classes: Members III			x							

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Table 1. Classification of Each of the 56 Tests in Each of the Schemata (continued)

Test	RI: V	RI: N	RI: P	RA: V	RA: N	RA: P	A: V	A: N	A: P
1 Picture Meaning									x
2 Verbal Classification	x								
3 Number Series		x							
4 Remembering Classes: Members				x					
5 Number Class Extension		x							
6 Word Groups	(RI: no content for)								
7 Remembering Classes: Members II									
8 Disemvowelled Words							x		
9 Letter Grouping	(RI: no content for)								
10 Circle Reasoning				x					
11 Figure Exclusion				x					
12 Seeing Trends	(RI: no content for)								
13 Picture Classification				x					
14 Paragraph Comprehension							x		
15 Remembering Classes: Names				x					
16 Word Group Naming	x								
17 Gestalt Completion						x			
18 Card Rotations						x			
19 Spatial Relations						x			
20 Verbal Exclusion	x								
21 Best Word Class	x								
22 Omelet							x		
23 Picture Group Naming				x					
24 Concealed Words						x			
25 Perceptual Speed						x			
26 Letter Triangle	(RI: no content for)								
27 Letter Classification	(RI: no content for)								
28 Picture Class Memory						x			
29 Puzzles							x		
30 Spelling							x		
31 Picture Exclusion				x					
32 Sensitivity to Order	x								
33 Figure Analogies				x					
34 Scrambled Sentences							v		
35 Same–Opposite					y				
36 Figure Matrix				x					
37 Remote Class Completion	x								
38 Number Exclusion			x						
39 Sentence Order					y				
40 Vocabulary							x		
41 Word Relations	(RI: no content for)								
42 Verbal Analogies	x								
43 Best Trend Name	x								
44 Picture Arrangement						y			
45 Arithmetic Problems								x	
46 Identical Pictures						x			
47 Picture Group Name Selection				x					
48 Number Classification		x							
49 Word Exclusion	(RI: no content for)								
50 Number Relations		x							
51 Word Linkage							x		
52 Figure Classification				x					
53 Class Name Selection	x								
54 Necessary Arithmetic Operations					x				
55 Verbal Analogies III	x								
56 Remembering Classes: Members III				x					

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Table 1. Classification of Each of the 56 Tests in Each of the Schemata (continued)

Test					Thurstone				
	S	P	N	V	W	M	I	D	C1
1 Picture Meaning				*					
2 Verbal Classification							x		
3 Number Series							x		
4 Remembering Classes: Members						x			
5 Number Class Extension							x		
6 Word Groups							x		
7 Remembering Classes: Members II						x			
8 Disemvowelled Words					x				
9 Letter Grouping			•				x		
10 Circle Reasoning							x		
11 Figure Exclusion							*		
12 Seeing Trends							x		
13 Picture Classification							x		
14 Paragraph Comprehension				*					
15 Remembering Classes: Names						x			
16 Word Group Naming							x		
17 Gestalt Completion									x
18 Card Rotations	*								
19 Spatial Relations	*								
20 Verbal Exclusion							*		
21 Best Word Class							x		
22 Omelet					*				
23 Picture Group Naming							x		
24 Concealed Words									x
25 Perceptual Speed		*							
26 Letter Triangle							x		
27 Letter Classification							x		
28 Picture Class Memory						x			
29 Puzzles								*	
30 Spelling					*				
31 Picture Exclusion							x		
32 Sensitivity to Order							x		
33 Figure Analogies							x		
34 Scrambled Sentences				x					
35 Same-Opposite				x					
36 Figure Matrix							x		
37 Remote Class Completion							x		
38 Number Exclusion							x		
39 Sentence Order				x					
40 Vocabulary				*					
41 Word Relations							x		
42 Verbal Analogies				x					
43 Best Trend Name							x		
44 Picture Arrangement				x					
45 Arithmetic Problems			*						
46 Identical Pictures		*							
47 Picture Group Name Selection							x		
48 Number Classification							x		
49 Word Exclusion							x		
50 Number Relations							x		
51 Word Linkage				x					
52 Figure Classification							x		
53 Class Name Selection							x		
54 Necessary Arithmetic Operations								*	
55 Verbal Analogies III				x					
56 Remembering Classes: Members III						x			

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Table 1. Classification of Each of the 56 Tests in Each of the Schemata (continued)

Column groups: *Nature of Exemplars* = T, R; *Cognition of Concepts — Content* = V-M, P-M, N-M, F, N-S, L-S, W-F; *Task* = C, E, N.

Test	T	R	V-M	P-M	N-M	F	N-S	L-S	W-F	C	E	N
1 Picture Meaning				x								
2 Verbal Classification	x		x							x		
3 Number Series		x			x					x		
4 Remembering Classes: Members			x									
5 Number Class Extension	x				x					x		
6 Word Groups	x								x	x		
7 Remembering Classes: Members II			x									
8 Disemvowelled Words			x									
9 Letter Grouping	x							x			x	
10 Circle Reasoning		x				x				x		
11 Figure Exclusion	x					x					x	
12 Seeing Trends		x							x	x		
13 Picture Classification	x			x						x		
14 Paragraph Comprehension			x									
15 Remembering Classes: Names			x									
16 Word Group Naming	x		x									x
17 Gestalt Completion				x								
18 Card Rotations						x						
19 Spatial Relations						x						
20 Verbal Exclusion	x		x								x	
21 Best Word Class	x		x									x
22 Omelet			x									
23 Picture Group Naming	x			x								x
24 Concealed Words			x									
25 Perceptual Speed						x						
26 Letter Triangle		x						x		x		
27 Letter Classification	x							x		x		
28 Picture Class Memory				x								
29 Puzzles			x									
30 Spelling			x									
31 Picture Exclusion	x			x							x	
32 Sensitivity to Order		x	x							x		
33 Figure Analogies		x				x				x		
34 Scrambled Sentences			x									
35 Same-Opposite			x									
36 Figure Matrix		x				x				x		
37 Remote Class Completion	x		x							x		
38 Number Exclusion	x						x				x	
39 Sentence Order			x									
40 Vocabulary			x									
41 Word Relations		x							x	x		
42 Verbal Analogies		x	x									x
43 Best Trend Name		x	x									x
44 Picture Arrangement				x								
45 Arithmetic Problems					x							
46 Identical Pictures						x						x
47 Picture Group Name Selection	x			x			x			x		
48 Number Classification	x							x	x		x	
49 Word Exclusion	x								x		x	
50 Number Relations		x			x						x	
51 Word Linkage			x			x				x		
52 Figure Classification	x					x				x		
53 Class Name Selection	x		x		x							x
54 Necessary Arithmetic Operations			x		x							
55 Verbal Analogies III		x	x							x		
56 Remembering Classes: Members III			x									

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Table 1. Classification of Each of the 56 Tests in Each of the Schemata (continued)

Key: * Developer's identification and/or source
      y Test was selected to measure this ability
      x Secondary classification in alternative schema

Key to Schema Classifications: Guilford   Operations: C Cognition
                                            (letter 1)   M Memory
                                                          D Divergent-Production
                                                          N Convergent-Production
                                                          E Evaluation
                                            Contents: M Semantic
                                            (letter 2)   S Symbolic
                                                          F Figural
                                            Products: U Units
                                            (letter 3)   C Classes
                                                          R Relations
                                                          S Systems
                                                          T Transformations
                                                          I Implications

                                 Guttman   RI Rule-Inferring
                                            RA Rule-Applying
                                             A Achievement or rule-applying when the rule
                                                used is formally taught in school
                                             V Verbal
                                             N Numerical
                                             P Pictorial

                                 Thurstone S Spatial
                                            P Perceptual Speed
                                            N Numerical
                                            V Verbal
                                            W Word Fluency
                                            M Memory
                                            I Induction
                                            D Deduction
                                            C₁ Closure One

                                 Cognition of Concepts
                                            Nature of Exemplars:
                                                T Things
                                                R Relations
                                            Content:
                                                V-M Verbal-Semantic
                                                P-M Picture-Semantic
                                                N-M Number-Semantic
                                                F   Figural
                                                N-S Number-Symbolic
                                                L-S Letter-Symbolic
                                                W-F Word-Form
                                            Task:
                                                C Classify
                                                E Exclude
                                                N Name

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Structure of Intellect model is the most specific of the three schemata analyzed, most of the tests were initially chosen from his point of view. It should be pointed out here, however, that many of these tests are of the same type as those initially studied by the Thurstones. Each of the tests can be classified, a priori, into a relevant cell of each of the schemata.

The nature and classification of each of the tests are discussed in Harris & Harris (in press (c)). The section of that paper that includes a brief description of each test along with an example item for each appears in Appendix E of this paper. The a priori classification of the tests in each of the schemata is given in Table 1. The tests are listed in the order of administration. An alphabetical listing of the tests with numbers corresponding to this table is given in Appendix A for ease in locating any particular test of interest.

For each of the tests, there is either an asterisk, a y, or an x in one of the columns for each of the schemata. (Note that for the Cognition of Concepts schema, each test has an x in the content dimension, but only those tests that deal with cognizing concepts are classified with respect to the nature of exemplars and task dimensions.) An asterisk means that the developer of the schema says the test measures the ability implied by that column in the schema; it is the primary classification and/or source of the test. A y means that the test was selected by us primarily to measure the ability implied by that column in that schema. An x stands for our a priori secondary classification of the test in each of the remaining schemata. It should be pointed out here that the basis for the secondary classification for most of the tests was obtained from the literature. Thirteen of the tests—Nos. 11, 14, 18, 19, 20, 22, 25, 29, 30, 40, 45, 46, and 54—have primary classification status in both the Guilford and the Thurstone schemata. (Verbal Exclusion is our name for Guilford's Word Classification and Necessary Arithmetic Operations is often called Arithmetic Reasoning.) Six of the tests do not have an asterisk or a y (primary classifications) in any of the columns. Four of these (5, 27, 38, and 49) were constructed to complete the portion of the proposed Cognition of Concepts system that was selected for rigorous study—the classification and exclusion of things for all seven of the kinds of content. The other two—Remembering Classes: Members II (7) and Remembering Classes: Members III (56)—are the same test as Remembering Classes: Mem-

bers (4); in other words, the same test was administered three different times. This was done to study possible differences in memory as a function of time intervening between study and recall of the material studied. Test No. 4 (Remembering Classes: Members) was given immediately following study of the material. Remembering Classes: Members II is this same test given at the end of the same testing session with two other tests intervening but without restudy of the material. Remembering Classes: Members III was given on the last day of testing with 7 days intervening for girls and 3 days for boys, again without restudy of the material.

As can be seen from Table 1, the newly proposed system for the cognition of concepts is the most specific; it forms a 7 by 3 by 2 matrix. Of the three published schemata analyzed, Guilford's structure of intellect is the most specific. There are many interesting relationships, according to the hypothesized classifications, which can be seen by studying Table 1. Just a few of them will be pointed out.

Most of the columns in the table differ in their entries. One exception is the two columns headed by Guilford's CSU and Thurstone's W. Note that in classifying the Perceptual Speed ability of the Thurstones' Primary Mental Abilities in each of the other schemata, the speeded aspect of this ability had to be ignored. Guilford (1971) says speed is not an important feature. Seven tests which would be rule-inferring in the Guttman system were not classified according to content because it was felt there was no content which was really appropriate. Instead of classifying them as either verbal or pictorial, we preferred to leave them unclassified along the content dimension or facet.

It is interesting to look at other classifications for the tests which have a three-way classification under the new schema, Cognition of Concepts. All 31 tests that involve the cognition of concepts (have a three-way classification in this system) are classified as Induction in the Thurstone Primary Mental Abilities and Rule-inferring in Guttman's facet design, except for Verbal Analogies (42) and Verbal Analogies III (55) which are classified as Thurstone's V. The most general classification is Thurstone's Induction containing all but two of these tests. These tests are classified under Guttman's Rule-inferring, and subdivided into three kinds of content. The new system is somewhat more specific with the addition of four more contents, three types of tasks (only two are complete), and two different natures of exemplars for what is being cognized (only

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one is complete). There is no single category for these 31 tests in the Guilford system. Many of them are classified as cognition of classes for the three different contents, but other classifications include cognition of relations and systems, and convergent production and evaluation of classes. Note that tests having relations as exemplars in the Cognition of Concepts schema are ones having relations or systems as a product in the Guilford schema with the exception of one test, Number Relations (50). We call the exemplars given for this test 'relations," but Guilford calls the product "classes," which would be interpreted as "things" in our schema.

Of the total battery of 56 tests, 35 of them were constructed for this project. These 35 include Concealed Words, Gestalt Completion, and Verbal Analogies in which some or all of the items were adapted from another source. These 35 tests are described in "Newly Constructed Reference Tests for Cognitive Abilities" (Harris & Harris, in press (b)). The source of each of the 56 tests is given in Appendix B. As was discussed earlier, Tests 4, 7, and 56 are the same test given on three different occasions.

A discussion of the procedures used and the results obtained from an empirical study of the interrelations of these tests in an attempt to validate and/or reconstruct these systems for defining cognitive abilities is presented in the following sections.

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II
Procedures

This section contains a discussion of the data collection procedures, subjects, and treatment of the data. The test battery was administered to two different samples, one composed of fifth grade boys and one of fifth grade girls, for the purpose of studying the interrelations of the tests.

Subjects

The battery of 56 cognitive abilities tests was administered during summer, 1970, to 172 boys and 210 girls who had just completed the fifth grade in the public school system of Madison, Wisconsin. The students were randomly selected from the population of all such girls and boys. The Madison Public School System made available the information concerning the populations and used their computing facilities to designate the random sample of girls. Project researchers identified the random sample of boys.

Initially, a random sample of 350 girls was drawn. Letters were sent to the parents of these students explaining the purpose and details of the testing, and inviting their daughter to participate in the testing program. A stamped and addressed postcard was enclosed which the parents were asked to complete and return indicating whether or not they were willing to allow their daughter to participate. One hundred and thirty-nine yes responses and 62 no responses were obtained from the cards returned. Those parents who had not returned the card by a specified date were phoned. An additional 49 yes and 72 no responses were obtained by phone. Since this total of yes responses did not give as many subjects as were desired, an additional sample of 100 girls was drawn at random.

From this sample, 33 yes and 30 no responses were obtained by card. Thus, of the total sample of 450 girls, 221 yes and 164 no responses were received; 11 students did not complete the testing, which resulted in a total of 210 girls tested. These students were paid $15.00 for participating.

A random sample of 450 boys was drawn and letters were sent. By mail, 136 yes and 34 no responses were received, in addition to 36 yes and 80 no responses by phone. From an additional sample of 80 boys drawn at random, 21 yes and 45 no responses were obtained. Thus, of the total sample of 530 boys, 193 yes and 159 no responses were received; 21 students did not complete the testing, which resulted in a total of 172 boys tested. As with the girls, the boys who completed the testing program were paid $15.00.

Since the participation of all students comprising the random samples was impossible to attain, test score and IQ data were obtained from the files of the Madison Public School System for both the school population and those participating students for whom the information was available. Table 2 includes the summary statistics for the population of fifth grade students in the Madison Public School System during the 1969-70 school year, and for the boys and the girls who comprised the tested samples for the cognitive abilities tests. The IQs were obtained in the fall of 1968 when the subjects were fourth graders using the Lorge-Thorndike Intelligence Test, and the scores on the Iowa Tests of Basic Skills, given in grade equivalent scores, were obtained in the fall of 1969 when the subjects were fifth graders.

Data were collected from the students regarding their fathers' occupations using the Master Occupational Code of the United States Bureau of the Census. These data were tabulated and are presented in Table 3.

Table 2. Test Data for Population and Samples

Test		Population	Boys	Girls
Lorge-Thorndike	$\overline{X}$	106.60	108.30	111.12
Intelligence	s		15.05	13.82
	N	2605	157	206
Iowa Basic Skills				
Vocabulary	$\overline{X}$ ·	5.53	5.69	5.66
	s		1.42	1.41
	N	2520	171	203
Reading Comprehension	$\overline{X}$	5.44	5.51	5.87
	s		1.55	1.42
	N	2520	171	203
Language Skills	$\overline{X}$	5.24	5.18	5.67
	s		1.44	1.32
	N	2520	171	202
Work-Study Skills	$\overline{X}$	5.46	5.71	5.73
	s		1.34	1.13
	N	2520	171	202
Arithmetic Skills	$\overline{X}$	5.05	5.24	5.24
	s		1.09	1.05
	N	2520	171	202
Composite	$\overline{X}$	5.35	5.46 ·	5.64
	s		1.25	1.12
	N	2520	171	201

Data Collection

The data for the girls were collected in two centrally-located schools, one on the East side and one on the West side of the city, during nine 2 1/2-hour daily sessions over a two-week period. Subjects could choose the weeks and the school in which they wanted to report for testing. A two-week session was held at Hawthorne School from June 29 to July 10, and a two-week session was held at Hoyt School from July 20 to July 31. Each 2 1/2-hour session consisted of the students responding to two booklets composed, in most cases, of three tests each, and an activity break between the two of approximately 1/2 hour.

The data for the boys were collected at the University of Wisconsin during five 3 1/2-hour daily sessions for one week. Two different weekly sessions, August 17 to August 21 and August 24 to August 28, were held and the subjects could choose the week

which they preferred.

The 56 tests in the battery were arranged in 18 booklets composed of three tests each with the exception of two booklets that contained four tests each. The tests were given in the same order to all of the subjects in each of the samples. The students responded to the tests by marking their chosen response for each item directly on a machine-scorable answer sheet for 45 of the tests. For the remaining 11 tests, the students responded directly in the test booklet. The subjects' responses to these 11 tests were later coded onto machine-scorable answer sheets. All of the answer sheets were read by machine and the responses punched onto data cards. The tests were given by experienced test administrators to groups of approximately 30 subjects each.

The tests were not administered in a speeded fashion except for two tests, Perceptual Speed and Identical Pictures, which were designed to be speeded tests. A suggested

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Table 3. Distribution of Fathers' Occupations

Occupation	Boys	Girls
PROFESSIONAL, TECHNICAL, AND KINDRED WORKERS		
00. Accountant	6	4
01. Architect	2	1
02. Dentist	--	1
03. Engineer	3	10
04. Lawyer, Judge	4	1
05. Clergyman	3	2
06. Doctor	9	3
07. Nurse	--	--
08. Teacher, Professor	15	9
09. Other Professional	12	21
FARMER		
11. Farmer	--	--
MANAGERS, OFFICIALS, PROPRIETORS, EXCEPT FARM		
21. Owner of Business	3	5
22. Manager, Official	19	20
CLERICAL AND KINDRED WORKERS		
31. Bookkeeper	1	1
32. Receptionist	--	--
39. Other Clerical and Kindred Workers	2	8
SALES WORKERS		
49. Salesman	20	19
CRAFTSMEN, FOREMEN, AND KINDRED WORKERS (SKILLED WORKERS)		
51. Craftsmen, Skilled Worker	20	10
52. Foreman	4	1
53. Armed Services – Officer	2	1
54. Armed Services – Enlisted Man	2	--
OPERATIVES AND KINDRED WORKERS (SEMI-SKILLED WORKERS)		
61. Truck Driver	5	1
62. Operative in Factory	9	9
69. Other operative and Kindred Workers	13	32
PRIVATE HOUSEHOLD AND SERVICE WORKERS		
71. Fireman	--	4
72. Policeman	2	1
73. Other Protective Service Worker	--	--
74. Practical Nurse, Nurses Aid	1	2
75. Private Household Workers	--	--
79. Other Service Workers	17	23
81. Non-Farm Laborer	1	--
82. Farm Laborer	--	--
91. Not presently in labor force	2	6
99. Not ascertained	6	12

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time limit was given for each test. If five or more students were still working at the end of the time limit, the time for the test was extended until fewer than five subjects were still working. If all subjects finished the test before the suggested time limit was up, the test administrator went on to the next test. The suggested time limit was ample for every subject to complete most tests.

Treatment of the Data

The treatment of the data consisted of two main procedures: reliability estimation and factor analysis. The data were analyzed separately for each sample. Hoyt analysis of variance reliability estimates were obtained for each of the 56 tests for each of the groups studied. Means, standard deviations, and the intercorrelations of the tests were computed.

Kaiser, Meyer, and Olkin have developed a measure to assess the sampling adequacy of a set of data for factor analytic purposes called the Measure of Sampling Adequacy (MSA) (Kaiser, 1970). It is a relative measure of the "amount" of correlation in the data and serves as an aid in determining whether or not the sample of variables is a good representation of the domain of interest. A similar measure, MSA (J), can be obtained for each variable. The overall MSA was obtained for each of the correlation matrices, one for the data collected on the boys and the one for the girls, and the MSA (J) was obtained for each test separately.[1]

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[1] We are indebted to Professor Henry Kaiser, University of California, Berkeley, for performing this analysis on our data.

Three initial factor solutions were secured, separately for the boys and the girls, from the intercorrelations of these tests: Alpha (Kaiser & Caffrey, 1965), Harris R-S^2 (Harris, 1962), and Unrestricted Maximum Likelihood Factor Analysis (UMLFA) (Jöreskog, 1967). All three of these solutions are independent of the initial scale of the variables. These three methods provide a factor solution with a statistical basis for the number of factors (UMLFA) and two with a psychometric basis: one for a relatively small number of factors (Alpha) and one for a relatively large number of factors (Harris R-S^2). A critical value of .05 was used to determine the number of factors for the UMLFA method.

For each initial solution, a derived orthogonal solution using the normal varimax transformation (Kaiser, 1958) was secured. For each of the sets of orthogonal common factors, two derived oblique solutions were secured using the procedures of Harris and Kaiser (1964). An independent cluster solution was obtained first. When this gave bipolar factors, indicating that the data did not fit an independent cluster model, a second oblique solution, A'A Proportional to L, was obtained. Hakstian (1971), as a result of comparing several prominent methods of oblique factor transformation, recommends using the Harris-Kaiser procedure-- independent cluster for factorially simple data and A'A Proportional to L for complex data.

These six sets of derived factors, three orthogonal and three oblique (A'A Proportional to L), were interpreted using a strategy illustrated by Harris and Harris (1970). This strategy provides a way to compare the results obtained from a number of different factor solutions of the same data, and suggests regarding as the important substantive findings those factors that are robust with respect to method-- factors which tend to include the same variables across methods.

The next section will include the results obtained from these treatments of the data and a discussion of those results.

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III
Results and Discussion

The means, standard deviations, and Hoyt reliability estimates obtained for the summer, 1970, test battery data are presented separately for boys and girls, for each test. The intercorrelations, measures of sampling adequacy, and factor results for this data are presented and discussed, once again separately for boys and girls.

Reliability Estimates and Test Statistics

Table 4 contains the means, standard deviations, and Hoyt reliability estimates obtained for the data collected during summer, 1970, using the 56 tests in the battery. These 56 tests consist of 35 which were constructed specifically for the CAA Project, 19 published tests used in this project for research purposes, with permission from the various publishers, and two which are merely two further administrations of one of the memory tests. The source of each test is given in Appendix B. The data were analyzed separately for the 172 boys and the 210 girls. Table 4 includes the results for both of the samples. The number of items composing each of the tests is given in Table 4. If one is interested, the number of choices for each item of each test can be found in Appendix B. The tests are included in Table 4 in the order of administration. An alphabetical listing of the tests is given in Appendix A.

The mean scores and standard deviations are very similar for boys and for girls. The reliability estimates are generally slightly higher for boys than they are for girls. The reliability estimates are, in general, quite good with only 13 of the 112 estimates below .70; 56 of the estimates are equal to or greater than .80 with 13 of these being equal to or greater than .90. Of the 13 reliability estimates below .70, seven of them are for tests using pictures as semantic content.

Perhaps it is more difficult to build reliable tests using pictures for the stimulus material. The reliability estimates for one test, Verbal Analogies III, were quite low for both boys and girls. Evidently this test was too difficult for these subjects.

These are relatively short tests, but only numbers 25 (Perceptual Speed) and 46 (Identical Pictures) were administered in a speeded fashion. For these two speeded tests, the Hoyt reliability estimate probably is an overestimate. It is interesting to note that the reliability estimates for the memory test that was given on three different occasions--at the beginning of an hourly session; at the end of this same hour session without restudy of the material; and as the last test in the battery, again without restudy of the material--remained almost identically the same over the three occasions. The means are much the same for the first two occasions but dropped somewhat for the third occasion. These three test administrations are numbered 4, 7, and 56.

The reliability estimates are sufficiently high to warrant study of the dimensionality of these selected cognitive abilities tests (with the exception of the Verbal Analogies III test), which is a major objective of the CAA Project and is the main purpose for developing this battery of 56 tests.

Factor Analyses

The correlation matrices for the 56 tests upon which the factor analyses were based can be found in Appendix C. The correlations range from -.03 to .86 for both boys and girls. There are a large number of correlations with considerable magnitude.

Table 5 contains the Kaiser-Meyer-Olkin Measures of Sampling Adequacy (MSA) that were obtained. The overall measures are .942 and .949 for boys and girls respectively. Kaiser

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Table 4.
Means, Standard Deviations, and Reliability Estimates: Boys and Girls

Test	Number of Items	Mean Boys[a]	Mean Girls[a]	Standard Deviation Boys	Standard Deviation Girls	Hoyt Reliability Boys	Hoyt Reliability Girls
1 Picture Meaning	30	21.85	20.74	4.28	4.66	.78	.80
2 Verbal Classification	20	16.13	16.53	3.34	3.02	.77	.74
3 Number Series	20	13.62	13.25	4.43	4.17	.85	.82
4 Remembering Classes: Members	20	14.49	15.08	3.60	3.58	.75	.77
5 Number Class Extension	20	10.40	9.72	4.74	3.98	.83	.74
6 Word Groups	20	14.85	15.31	4.09	3.73	.82	.80
7 Remembering Classes: Members II	20	14.26	15.11	3.90	3.51	.78	.75
8 Disemvowelled Words	32	21.66	23.45	7.82	6.42	.93	.89
9 Letter Grouping	20	11.52	12.50	3.95	3.48	.77	.72
10 Circle Reasoning	20	8.43	9.90	4.94	4.61	.86	.83
11 Figure Exclusion	25	20.06	20.00	2.89	2.70	.64	.59
12 Seeing Trends	20	11.91	12.52	4.30	4.32	.80	.81
13 Picture Classification	20	12.74	12.53	3.28	2.84	.69	.59
14 Paragraph Comprehension	32	18.23	19.45	6.27	5.60	.84	.80
15 Remembering Classes: Names	20	16.96	18.36	3.28	2.39	.81	.79
16 Word Group Naming	20	12.25	12.30	3.73	3.40	.75	.68
17 Gestalt Completion	20	12.81	12.85	3.43	3.67	.72	.76
18 Card Rotations	112	92.02	86.38	22.34	20.84	.98	.97
19 Spatial Relations	25	16.70	16.75	4.58	4.31	.81	.78
20 Verbal Exclusion	20	13.42	13.80	3.23	2.61	.70	.56
21 Best Word Class	20	12.35	12.61	4.11	3.78	.79	.75
22 Omelet	20	10.87	12.21	4.44	4.21	.84	.82
23 Picture Group Naming	20	12.74	12.02	3.54	3.37	.72	.67
24 Concealed Words	20	9.77	8.67	3.88	3.45	.78	.72
25 Perceptual Speed	40	21.76	23.06	6.32	5.44	.89	.86
26 Letter Triangle	20	14.78	15.45	3.68	3.64	.79	.81
27 Letter Classification	20	12.72	13.87	4.30	3.77	.81	.78
28 Picture Class Memory	20	15.33	15.60	2.98	3.29	.69	.76
29 Puzzles	30	22.09	23.41	4.39	4.24	.74	.76
30 Spelling	30	17.14	19.45	7.00	6.32	.89	.87
31 Picture Exclusion	20	12.74	12.45	2.92	2.92	.56	.57
32 Sensitivity to Order	20	13.63	13.94	4.26	3.98	.84	.81
33 Figure Analogies	22	15.89	16.64	5.95	4.87	.92	.88
34 Scrambled Sentences	20	13.47	13.45	2.88	2.87	.53	.52
35 Same-Opposite	20	16.27	16.50	3.86	3.51	.84	.81
36 Figure Matrix	20	10.95	9.36	4.63	4.11	.82	.76
37 Remote Class Completion	26	12.73	13.08	4.32	4.42	.77	.80
38 Number Exclusion	20	11.97	12.15	4.30	3.53	.81	.71
39 Sentence Order	40	32.42	34.31	8.01	7.01	.93	.93
40 Vocabulary	30	19.24	19.20	6.70	6.00	.89	.86
41 Word Relations	20	12.66	13.07	5.44	5.64	.90	.91
42 Verbal Analogies	24	14.92	14.82	4.49	4.69	.78	.81
43 Best Trend Name	20	10.65	10.50	4.12	3.71	.77	.70
44 Picture Arrangement	16	9.86	9.61	2.37	2.71	.50	.63
45 Arithmetic Problems	35	16.58	16.59	7.19	7.40	.90	.91
46 Identical Pictures	48	22.09	25.44	5.39	6.17	.88	.91
47 Picture Group Name Selection	20	14.41	14.00	3.01	3.21	.66	.70
48 Number Classification	30	22.75	22.44	7.24	7.31	.93	.93
49 Word Exclusion	20	11.67	11.33	3.70	3.45	.73	.68
50 Number Relations	20	11.94	10.37	5.16	4.52	.87	.81

[a] Number of subjects is 172 for boys and 210 for girls.

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Test	Number of Items	Mean		Standard Deviation		Hoyt Reliability	
		Boys	Girls	Boys	Girls	Boys	Girls
51 Word Linkage	20	11.48	11.90	4.28	4.34	.78	.79
52 Figure Classification	20	14.42	14.43	3.84	4.13	.82	.82
53 Class Name Selection	20	15.36	14.94	3.59	3.74	.80	.81
54 Necessary Arithmetic Operations	15	10.53	10.48	3.78	3.74	.85	.84
55 Verbal Analogies III	20	6.44	6.15	2.43	2.44	.39	.43
56 Remembering Classes: Members III	20	13.05	13.72	3.88	3.71	.77	.75

Table 5. Kaiser-Meyer-Olkin Measure of Sampling Adequacy

	Boys	Girls		Boys	Girls
Overall MSA	.942	.949			
MSA (J)					
1 PictMn	.941	.954	29 Puzzle	.953	.970
2 VerbEx	.930	.962	30 Spellg	.940	.945
3 NumbSe	.963	.970	31 PictEx	.918	.962
4 RemClM	.918	.882	32 SensOr	.954	.970
5 NumClE	.958	.955	33 FigAna	.942	.968
6 WordGp	.953	.966	34 ScramS	.925	.953
7 RmClM2	.939	.913	35 SameOp	.960	.969
8 Disvow	.973	.960	36 FigMat	.953	.978
9 LetGrp	.928	.949	37 Remote	.956	.936
10 CirRea	.932	.939	38 NumbEx	.937	.913
11 FigExc	.935	.953	39 SentOr	.928	.927
12 SeeTnd	.967	.954	40 Vocab	.955	.956
13 PictCl	.898	.928	41 WordRl	.959	.952
14 ParaCp	.964	.970	42 VerbAn	.971	.960
15 RemClN	.961	.948	43 BestTN	.955	.905
16 WdGpNm	.944	.945	44 PictAr	.940	.925
17 Gestal	.564	.829	45 ArithP	.947	.954
18 CardRt	.894	.923	46 IdentP	.679	.740
19 SpatRl	.927	.943	47 PicGNS	.964	.964
20 VerbEx	.947	.963	48 NumbCl	.934	.930
21 BestWC	.964	.970	49 WordEx	.956	.938
22 Omelet	.908	.928	50 NumbRl	.970	.948
23 PictGN	.953	.958	51 WordLk	.964	.945
24 ConWrd	.903	.941	52 FigCla	.923	.960
25 PerSpd	.372	.829	53 ClasNS	.938	.927
26 LetTri	.939	.958	54 NecAOp	.953	.963
27 LetCla	.907	.966	55 VerbA3	.916	.951
28 PictCM	.927	.897	56 RmClM3	.947	.959

says: "It appears that we don't have good factor-analytic data until MSA gets to be at least in the .80s, and really excellent data does not occur until we reach the .90s." (Kaiser, 1970, p. 405). Thus, the correlation matrices obtained for the boys and for the girls are excellent data from this point of view. The MSA (J) values obtained for each variable are also given in Table 5. "MSA (J) measures to what extent a given variable 'belongs to the family,' psychometrically." (Kaiser, 1970, p. 405). These values are almost uniformly high for both boys and girls; practically all of the MSA (J)s are in the .90s. Exceptions are Gestalt Completion (17), Perceptual Speed (25), and Identical Pictures (46). Gestalt Completion has a fairly high MSA for girls (.829) but only .564 for boys. The other two tests with low MSA (J)s are the only two speeded tests in the battery--Perceptual Speed (25) and Identical Pictures (46). Evidently, contrary to what Guilford believes (Guilford, 1971), these speeded tests are measuring something that is at least somewhat different from the other tests in the battery. Since there are other tests in the battery that have figural content which is to be judged but that are not speeded, it may be concluded that speed is an important feature. As will be seen later, these two tests appear on a separate factor which is essentially uncorrelated with the other factors of the oblique solutions. The MSAs and MSA (J)s are very similar for the boys and the girls with the exception of the three tests just discussed.

The numbers of factors obtained for the initial solutions and for the derived solutions, orthogonal and oblique (A'A Proportional to L), are given in Table 6 according to the numbers of common, specific, and null factors.

A common factor is defined as one having at least two variables with coefficients greater than .30 (absolute); a specific factor has only one coefficient greater than .30 (absolute); and a null factor does not have any coefficients greater than .30 (absolute). The factors rotated for the derived oblique solutions were the orthogonal common factors obtained for that method. For this purpose a common factor was defined as one having at least two variables with coefficients greater than .300 (absolute).

The factor results for each derived solution (orthogonal, independent cluster oblique, and A'A Proportional to L oblique) for each of the three initial methods (Alpha, Harris R-S^2, and UMLFA) can be found in the tables of Appendix D for boys and for girls. Coefficients greater than .300 (absolute) are included in these tables. Only the common factors are included for the orthogonal solutions; each of the factors obtained, common and specific, is included for the oblique solutions. The order of the factors in each table is arbitrary. The intercorrelations of the factors are also included for the oblique solutions. The intercorrelations of the factors are considerably lower for the A'A Proportional to L solution than they are for the Independent Cluster solution. We first derived the Independent Cluster oblique solution. It was apparent from the bipolarity that these data do not consist of independent clusters, and so the hypothesis of independent clusters was rejected and the A'A Proportional to L oblique solution was obtained and interpreted for each of the three initial methods.

The common factor results obtained from applying the interpretation strategy of Harris and Harris (1970) are presented in Table 7 according to the Comparable Common Factors

Table 6. Numbers of Initial and Derived Factors

Factor Method	Initial Factors		Derived Orthogonal Factors						Derived Oblique Factors[a]					
			Common[b]		Specific[c]		Null[d]		Common[b]		Specific[c]		Null[d]	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
Alpha	9	9	9	9	0	0	0	0	8	9	1	0	0	0
Harris R-S^2	35	34	13	12	12	14	10	8	11	11	2	2	0	0
UMLFA	11	13	11	10	0	3	0	0	11	10	0	1	0	0

[a] A'A Proportional to L
[b] At least two variables have coefficients greater than .30 (absolute).
[c] Just one variable has a coefficient greater than .30 (absolute).
[d] No variable has a coefficient greater than .30 (absolute).

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Table 7. Common Factor Results[a]

| | Boys | | | | | | Girls | | | | | |
| | Orthogonal | | | Oblique | | | Orthogonal | | | Oblique | | |
Test	A	H	U[b]	A	H	U	A	H	U	A	H	U
COMPARABLE COMMON FACTOR 1												
1 PICTURE MEANING	56	64	70	37	46	70	55	76	76	62	67	73
14 PARAGRAPH COMPREHENSION	57	60	54	49	41		51	61	56	46	44	46
21 BEST WORD CLASS	67	68	71	48	48	47	63	66	52		52	40
35 SAME-OPPOSITE	62	58	58	52	48		56	52	36	38		
37 REMOTE CLASS COMPLETION	62	71	62	45	63	37	50	52	45	33	40	36
40 VOCABULARY	76	76	79	60	47	53	62	72	61	34	64	55
42 VERBAL ANALOGIES	69	62	64	54	33		51	48	43	35		
43 BEST TREND NAME	56	54	58	34	34		39	41	40	37		
47 PICTURE GROUP NAME SELECTION	65	57	64	59	32	36	57	58	46		41	33
51 WORD LINKAGE	59	60	54	53	39			50	57	63	33	43
53 CLASS NAME SELECTION	61	53	55	55			47	45	31	33		
55 VERBAL ANALOGIES III	49	38	47	38			43	46	46	35	40	
15 REMEMBERING CLASSES: NAMES	53	42	49	47			54					
16 WORD GROUP NAMING	52	51	62			44	57	37	31			
23 PICTURE GROUP NAMING	57	50	64	31		43	53	36				
29 PUZZLES	64	60	58	65	35		43	40	31			
34 SCRAMBLED SENTENCES	49	36	46	35			35					
39 SENTENCE ORDER	41	33	36	40			50					
41 WORD RELATIONS	43	49	43		35		33					
54 NECESSARY ARITHMETIC OPERATIONS	52	44	50	34				35	31	38		
30 SPELLING	51	53	53				50	52	41		36	33
44 PICTURE ARRANGEMENT							39	35	35			33
2 Verbal Classification	39	38	45				55	38				
3 Number Series	42	39	43									
4 Remembering Classes: Members	41	39	40				31					
6 Word Groups	44	39	42									
7 Remembering Classes: Members II	35	31	36									
8 Disemvowelled Words	41	41	42				37	35				
10 Circle Reasoning							36					
12 Seeing Trends									34	35		
13 Picture Classification			36									
18 Card Rotations							32		31			
20 Verbal Exclusion	42	40	43				50	34				
22 Omelet	42	42	40									
31 Picture Exclusion			35				33					
32 Sensitivity to Order	51	42	47				60	43				
33 Figure Analogies	36	32	38				38					
36 Figure Matrix			32									
45 Arithmetic Problems	39	35	34									
48 Number Classification	34											
49 Word Exclusion	35	31										
50 Number Relations		32	31									
52 Figure Classification	37		31	31								
56 Remembering Classes: Members III	37	32	41									

[a] Decimals have been omitted
[b] A = alpha, H = Harris R-S^2, U = Unrestricted Maximum Likelihood Factor Analysis

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Table 7. (Continued)

	Boys Orthogonal			Boys Oblique			Girls Orthogonal			Girls Oblique		
Test	A	H	U	A	H	U	A	H	U	A	H	U
COMPARABLE COMMON FACTOR 2												
26 LETTER TRIANGLE	70	63	75	55	56	76	48	39	49	31		
27 LETTER CLASSIFICATION	66	73	68	60	69	51	60	54	56	43	41	39
48 NUMBER CLASSIFICATION	66	44	67	52			71	73	70	64	65	63
49 WORD EXCLUSION	63	37	58	44			66	62	66	56	54	53
52 FIGURE CLASSIFICATION	60	40	59	39			52	45	48	35		
5 NUMBER CLASS EXTENSION	36	41	41		34							
6 WORD GROUPS	55	43	57	43	31		46	37	44			
9 LETTER GROUPING	58	58	58	52	53		40	33	39			
18 CARD ROTATIONS	48	36	49	36			37		36			
32 SENSITIVITY TO ORDER	53	38	55	39			42	33	35			
36 FIGURE MATRIX	57	39	60				55	49	56	35	37	37
38 NUMBER EXCLUSION	58		51	31			66	70	69	65	66	66
39 SENTENCE ORDER	53		50				54	49	49	49	38	42
41 WORD RELATIONS	51	34	52				51	47	53	31	31	33
53 CLASS NAME SELECTION	44		40				47	39	37	31		
54 NECESSARY ARITHMETIC OPERATIONS	45		42				54	43	48	39		
1 Picture Meaning				-37								
2 Verbal Classification			32									
3 Number Series	50	35	50				33		32			
7 Remembering Classes: Members II			31									
8 Disemvowelled Words	52	35	52									
10 Circle Reasoning	36		38				35	31	36			
11 Figure Exclusion	51		47	36			37	34	39			
12 Seeing Trends	49	35	49				37	32	37			
13 Picture Classification							34					
14 Paragraph Comprehension	39		40				38		37			
15 Remembering Classes: Names	39		40									
19 Spatial Relations	36		34				31					
20 Verbal Exclusion	45		43									
28 Picture Class Memory	34		37									
29 Puzzles	43		44				40	32	38			
30 Spelling	34		32									
31 Picture Exclusion	38		39				32					
33 Figure Analogies	49		51				46	38	43			
35 Same-Opposite							34		32			
40 Vocabulary									31			
42 Verbal Analogies	38		36				39	37	38			
43 Best Trend Name			31				35		35			
45 Arithmetic Problems	36		32				41	33	42			
47 Picture Group Name Selection	36		42				36	31	34			
50 Number Relations	45		42				43		39			

Table 7. (Continued)

Test	Boys Orthogonal			Boys Oblique			Girls Orthogonal			Girls Oblique		
	A	H	U	A	H	U	A	H	U	A	H	U
COMPARABLE COMMON FACTOR 3[C]												
4 REMEMBERING CLASSES: MEMBERS	71	76	79	76	77	85	54	60	85	58	59	89
7 REMEMBERING CLASSES: MEMBERS II	73	76	77	78	75	80	61	72	69	75	85	78
28 PICTURE CLASS MEMORY	39		34	39		32	52		35	64		36
56 REMEMBERING CLASSES: MEMBERS III	56	59	52	55	55	50	48	62	49	45	62	47
43 BEST TREND NAME	35	39	34		32							
10 Circle Reasoning	35											
COMPARABLE COMMON FACTOR 4												
8 DISEMVOWELLED WORDS	34	31	31	31			47	46	47	40	38	36
22 OMELET	56	49	53	66	45	53	64	67	64	61	65	56
24 CONCEALED WORDS	53	68	64	55	67	70	53	51	53	58	48	53
30 SPELLING	50	50	52	56	46	47	56	54	55	49	47	42
3 NUMBER SERIES	39	32	35	36					34			
41 WORD RELATIONS							44	35	45	35		37
45 ARITHMETIC PROBLEMS	38			36			48	39	55	47		56
5 Number Class Extension									32			
16 Word Group Naming	42			45								
20 Verbal Exclusion			31									
21 Best Word Class							32					
23 Picture Group Naming	38			43								
26 Letter Triangle							32					
29 Puzzles									32			
40 Vocabulary							34		31			
50 Number Relations	36			31				33	41			41
54 Necessary Arithmetic Operations									34			
COMPARABLE COMMON FACTOR 5												
25 PERCEPTUAL SPEED	77	69	72	77	69	72	63	55	64	63	50	62
46 IDENTICAL PICTURES	58	67	55	53	64	51	64	70	66	61	68	63
33 Figure Analogies							32					

[C] Two analyses were combined to identify this factor for girls. In one of them variable No. 56 was incorrectly scored and in the other analysis variable No. 7 was not included. The factor results in Appendix D are for the analysis for which variable No. 7 was not included.

Table 7. (Continued)

	Boys						Girls					
	Orthogonal			Oblique			Orthogonal			Oblique		
Test	A	H	U	A	H	U	A	H	U	A	H	U
COMPARABLE COMMON FACTOR 6												
19 SPATIAL RELATIONS	35	34	49			42		60	61		62	66
17 GESTALT COMPLETION	73	71	56	74	70	54			38			
9 Letter Grouping								36			32	
11 Figure Exclusion								39	35		34	
18 Card Rotations									33			
24 Concealed Words					32							
31 Picture Exclusion					38	31			47			
33 Figure Analogies									34			
36 Figure Matrix					32							
44 Picture Arrangement									32			
47 Picture Group Name Selection									33			
COMPARABLE COMMON FACTOR 7												
13 PICTURE CLASSIFICATION	55	63		57	64		37	65	62	39	65	71
31 PICTURE EXCLUSION	49	45		52	43		50	42		56	38	38
1 Picture Meaning	31			34								
5 Number Class Extension	32											
11 Figure Exclusion	34			35						34		
16 Word Group Naming	32											
17 Gestalt Completion							50			39		
18 Card Rotations							35			37		34
19 Spatial Relations	37			40			39			43		
24 Concealed Words							34					
44 Picture Arrangement							39			31		
45 Arithmetic Problems							32					
47 Picture Group Name Selection										31		
55 Verbal Analogies III	32											
COMPARABLE COMMON FACTOR 8												
53 CLASS NAME SELECTION		46	47		49	64		49	67		60	79
52 FIGURE CLASSIFICATION		56	34		61	48		37			44	
54 NECESSARY ARITHMETIC OPERATIONS			38			48		36	33		43	37
35 Same–Opposite						31						
42 Verbal Analogies						33						
45 Arithmetic Problems			36			35						

Table 7. (Continued)

| | Boys | | | | | | Girls | | | | | |
| | Orthogonal | | | Oblique | | | Orthogonal | | | Oblique | | |
Test	A	H	U	A	H	U	A	H	U	A	H	U
COMPARABLE COMMON FACTOR 9												
5 NUMBER CLASS EXTENSION	32	43	55	39	43	59	32	57			57	
12 SEEING TRENDS	43		31	51		33	33					
45 ARITHMETIC PROBLEMS		59	43	31	62	50		40		·	38	
50 NUMBER RELATIONS		44	36		45	40	36	35			31	
1 Picture Meaning							57					
10 Circle Reasoning				31								
13 Picture Classification							31					
14 Paragraph Comprehension	33			33			45					
31 Picture Exclusion							31					
40 Vocabulary							34					
42 Verbal Analogies							37					
43 Best Trend Name							38					
47 Picture Group Name Selection							35					
51 Word Linkage							60					
54 Necessary Arithmetic Operations		47			48	33	38					
55 Verbal Analogies III							48					
COMPARABLE COMMON FACTOR 10												
41 WORD RELATIONS	31	32	45			51						
44 PICTURE ARRANGEMENT	44	58	44	40	56	43						
33 Figure Analogies			31			41						
34 Scrambled Sentences				-32								
38 Number Exclusion				31								
COMPARABLE COMMON FACTOR 11												
16 WORD GROUP NAMING		46			59		37	61	62	55	62	64
23 PICTURE GROUP NAMING		46			57		34	62	68	52	64	71
1 Picture Meaning					35							
2 Verbal Classification										33		
4 Remembering Classes: Members							31					
COMPARABLE COMMON FACTOR 12												
3 NUMBER SERIES							39	55	31	41	61	
9 LETTER GROUPING							48		45	55		44
12 SEEING TRENDS							37	33	40	40	33	42
33 FIGURE ANALOGIES							34	34		32	36	
26 Letter Triangle									31	32		33
51 Word Linkage									38			40

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Table 7. (Continued)

	Boys						Girls					
	Orthogonal			Oblique			Orthogonal			Oblique		
Test	A	H	U	A	H	U	A	H	U	A	H	U
COMPARABLE SPECIFIC FACTOR 13												
15 REMEMBERING CLASSES: NAMES		46			52			54	49	46	54	38
2 Verbal Classification									42			
20 Verbal Exclusion									40			
21 Best Word Class									47	39		36
27 Letter Classification									36			
29 Puzzles		37			43				31			
30 Spelling									32			
32 Sensitivity to Order									53	52		40
33 Figure Analogies									31			
34 Scrambled Sentences									33	34		
35 Same-Opposite									51	41		45
37 Remote Class Completion									32			
39 Sentence Order		57			64				47	39		33
40 Vocabulary									44	39		
47 Picture Group Name Selection									39	33		
53 Class Name Selection									37	39		
FACTORS SPECIFIC TO SINGLE INITIAL SOLUTIONS:												
12 Seeing Trends	40			37								
38 Number Exclusion	58			55								
49 Word Exclusio·	50			50								
12 Seeing Trends		31			37							
14 Paragraph Comprehension		34			44							
29 Puzzles		33			45							
38 Number Exclusion					35							
39 Sentence Order		33			43							
51 Word Linkage					33							
26 Letter Triangle		-31										
31 Picture Exclusion					33							
32 Sensitivity to Order					31							
34 Scrambled Sentences		42			51							
47 Picture Group Name Selection					36							
48 Number Classification					42							
55 Verbal Analogies III					34							
32 Sensitivity to Order									34			
34 Scrambled Sentences									56		55	

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(CCF), Comparable Specific Factors (CSF), and those factors that are specific to single initial solutions. All of the common factors from each of the six derived solutions (three orthogonal and three oblique) are included in the table; only variables with coefficients greater than .300 (absolute) are used in the interpretation of the factors. The comparable common factors, those that are robust over solutions, are probably the factors that one should pay attention to as being meaningful in the sense that they appear to be reasonably independent of factoring method; they are unlikely to be simply a function of the method used for analyzing the data. For this study the comparable common factors are the ones taken as meaningful factors and are the ones interpreted. In determining the comparable common factors, variables were deemed relevant to a factor if they appeared on that factor for at least four of the six derived solutions. In Table 7, capital letters denote the variables deemed relevant to the comparable common factor. The variables in small letters may be "noise." For some of the comparable common factors, e.g. CCF 1, the relevant variables (those in capital letters) are arranged in three different groups. The first group consists of those variables that are relevant ones for both boys and girls; the second consists of variables that are relevant for boys only (note that a dotted line box is drawn around the coefficients of these variables for girls); the third group consists of variables that are relevant for girls only (a dotted line box is drawn around the coefficients of these variables for boys).

Eight comparable common factors were obtained that appear to be essentially the same factors for both boys and girls. The remaining ones appear for only one of the two samples. There is also one comparable specific factor for girls (it includes only one variable with coefficients on at least four of the six derived solutions). Three factors specific to initial solutions were obtained for boys and one for girls.

Comparable Common Factor 1

Comparable Common Factor 1 is of considerable interest. It is a rather broad factor, involving twelve variables that are relevant (appear substantially on at least four of the six solutions) for both boys and girls, an additional eight variables relevant for boys, and an additional two variables relevant for girls. The intercorrelations of these variables have been extracted from the matrices in the

Appendix and are presented separately in Table 8.

A circled correlation coefficient in Table 8 signifies that this correlation is the highest one for both of the intersecting tests, i.e., the highest correlation either of these tests has with any other test is for the two. Vertical lines along the sides of a correlation signify that this is the highest correlation obtained for the column variable, and horizontal lines along the top and bottom of a correlation signify that it is the highest correlation that row variable has with any of the other variables. The first group of tests listed in Table 8 are those that are relevant for both boys and girls, the second group are relevant only for boys, and the third group are relevant only for girls. The vocabulary test (40) seems to be a "core" for this factor, extending into those tests that are relevant for one sample only.

This factor (CCF 1) is broad not only in terms of the number of tests with substantial coefficients, but also in terms of the a priori classifications of the included tests. For example, the 12 tests which appear substantially on this factor for both samples have the following a priori classifications:

    Guilford CMU – 4, CMR – 2, NMC – 1,
              EMC – 3, EMR – 2

    Guttman   RI:V – 6, RI:P – 1, RA:V – 1,
              A:V – 3, A:P – 1

    Thurstone V – 7, I – 5

    Cognition of Concepts
              Exemplars: T – 4, R – 3
              Content: V-M – 10, P-M – 2
              Task: C – 3, N – 4

Note that only 7 of the 12 tests have a threeway classification in the Cognition of Concepts schema. Adding the classifications for the 10 additional relevant variables (those relevant for one of the samples) yields the following:

    Guilford CMU – 5, CMR – 2, CMS – 1,
              CSU – 1, CSR – 1, MMC – 1,
              NMC – 3, NMS – 2, EMC – 3,
              EMR – 2, EMI – 1

    Guttman   RI:V – 7, RI:P – 2, RA:V – 3,
              RA:N – 1, RA:P – 1, RI: – 1,
              A:V – 6, A:P – 1

    Thurstone V – 10, I – 8, D – 2, M – 1,
              W – 1

    Cognition of Concepts Exemplars: T – 6, R – 4

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Table 8. Intercorrelations of Tests on Comparable Common Factor 1[a]

Boys

Test	1	14	21	35	37	40	42	43	47	51	53	55
1 PictMn												
14 ParaCp	50											
21 BestWC	60	63										
35 SameOp	36	49	56									
37 Remote	55	58	56	54								
40 Vocab	62[c]	69[b]	70[b]	60	64							
42 VerbAn	52	67	67	58	60	73[d]						
43 BestTN	54	58	62	48	56	64	66					
47 PicGNS	48	58	63	52	50	67	59	55				
51 WordLk	50	62	58	45	58	63	68	55	54			
53 ClasNS	46	57	61	53	55	67	68	50	59	56		
55 VerbA3	43	43	49	38	38	46	50	55	47	45	43	
15 RemClN	34	53	55	37	44	65	58	52	58	53	56	42
16 WdGpNm	54	52	61	39	49	62	56	51	57	48	50	41
23 PicGpN	51	46	57	44	48	61	58	51	56	45	58	34
29 Puzzle	41	66	64	50	55	71	68	59	60	60	61	44
34 ScramS	32	43	44	44	36	48	47	43	44	36	38	45
39 SentOr	26	53	48	37	36	61	56	43	49	53	54	26
41 WordRl	43	61	65	49	56	62	62	57	53	57	53	39
54 NecAOp	41	58	64	50	46	68	67	56	57	54	70	47
30 Spellg	41	49	57	49	57	69	62	48	45	49	58	36
44 PictAr	35	41	38	30	33	38	41	41	31	38	32	34

Girls

Test	1	14	21	35	37	40	42	43	47	51	53	55
1 PictMn												
14 ParaCp	72											
21 BestWC	68	68										
35 SameOp	60	61	72									
37 Remote	61	57	62	56								
40 Vocab	74	69	70[b]	70	63							
42 VerbAn	67	68	66	65	63	67						
43 BestTN	55	59	56	52	54	62	62					
47 PicGNS	62	66	69	63	55	72	64	58				
51 WordLk	64	64	60	50	58	61	62	59	58			
53 ClasNS	51	56	61	54	41	60	63	50	64	56		
55 VerbA3	51	45	46	44	38	49	46	47	49	54	38	
15 RemClN	39	48	52	51	40	46	42	38	52	33	47	23
16 WdGpNm	56	54	57	47	54	57	60	50	54	44	39	41
23 PicGpN	53	54	55	49	44	55	55	48	55	48	44	37
29 Puzzle	53	64	62	60	48	64	59	60	60	47	50	40
34 ScramS	37	41	48	46	48	47	49	47	42	39	47	24
39 SentOr	34	49	49	55	37	58	53	48	56	36	51	34
41 WordRl	48	57	58	61	53	65	70	64	56	55	51	41
54 NecAOp	53	63	54	59	47	59	64	55	56	58	69	43
30 Spellg	58	57	64	57	52	67	57	49	52	44	54	36
44 PictAr	50	40	44	38	36	45	50	36	38	32	26	33

Note:

Boys

	16	23	47	53
16 WdGpNm				
23 PictGN	70			
47 PicGNS	57	56		
53 ClasNS	50	58	59	

Girls

	16	23	47	53
16 WdGpNm				
23 PictGN	72			
47 PicGNS	54	55		
53 ClasNS	39	44	64	

Where:

	Produce	Select
Words	16	53
Pictures	23	47

[a] Decimals have been omitted.
[b] Highest correlation for both of the intersecting variables.
[c] Highest correlation for the column variable.
[d] Highest correlation for the row variable.

Content: V-M - 16, P-M - 4,
         V-M/N-M - 1, W-F - 1
Task: C - 4, N - 6

The classifications of these 22 tests are ex-
tracted from Table 1 and are presented in
Table 9. For the Guilford classifications,
those given in parentheses indicate our place-

after careful study of the three systems, and
thus we believe that this lack of correspon-
dence is meaningful. First, consider the
Thurstone PMA schema in relation to CCF 1.
The 12 tests were classified a priori as either
V or I. The I classification was assigned to
tests which require what we described as the
"cognition of concepts" with any of the three

Table 9. Classifications of the Comparable Common Factor 1
Relevant Variables in Each of the Schemata

Test	Guilford[a]	Guttman	Thurstone	Cognition of Concepts		
1 Picture Meaning	(CMU)	A:P	V		P-M	
14 Paragraph Comprehension	CMU	A:V	V		V-M	
21 Best Word Class	EMC	RI:V	I	T	V-M	N
35 Same-Opposite	(CMU)	RA:V	V		V-M	
37 Remote Class Completion	(NMC)	RI:V	I	T	V-M	C
40 Vocabulary	CMU	A:V	V		V-M	
42 Verbal Analogies	CMR	RI:V	V	R	V-M	C
43 Best Trend Name	EMR	RI:V	I	R	V-M	N
47 Picture Group Name Selection	(EMC)	RI:P	I	T	P-M	N
51 Word Linkage	CMR	A:V	V		V-M	
53 Class Name Selection	EMC	RI:V	I	T	V-M	N
55 Verbal Analogies III	EMR	RI:V	V	R	V-M	C
15 Remembering Classes: Names	MMC	RA:V	M		V-M	
16 Word Group Naming	(NMC)	RI:V	1	T	V-M	N
23 Picture Group Naming	(NMC)	RI:P	I	T	P-M	N
29 Puzzles	EMI	A:V	D		V-M	
34 Scrambled Sentences	CMU	A:V	V		V-M	
39 Sentence Order	NMS	RA:V	V		V-M	
41 Word Relations	CSR	RI	I	R	W-F	C
54 Necessary Arithmetic Operations	CMS	RA:N	D		V-M/N-M	
30 Spelling	CSU	A:V	W		V-M	
44 Picture Arrangement	NMS	RA:P	V		P-M	

[a] Parentheses in this column indicate our placement of the test in the Structure-of-Intellect;
the others are Guilford's identifications.

ment of the test in a particular cell in the Struc-
ture-of-Intellect; the others are Guilford's iden-
tifications.
    These analyses indicate that CCF 1 cannot
be identified unequivocally with any one Guil-
ford, Guttman, or Thurstone a priori classifica-
tion. We believe that these classifications
were made in a fair and reasonable fashion

tasks (classifying, excluding, or naming) being
employed. These I tests differed in content,
ranging over the seven types of content. CCF 1
suggests that when the content is verbal-seman-
tic or picture-semantic, these "cognition of
concepts" tests function like vocabulary and
paragraph comprehension tests and thus asso-
ciate themselves with the V or verbal compre-

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hension tests. Next, consider the Guttman facet design in relation to CCF 1 relevant variables. According to the a priori classifications, all three of Guttman's tasks and two of the three contents are present in the 12 tests; there is no numerical content. In Guilford's terms, 4 of the 12 tests measure CMU. Other classifications of CCF 1 relevant tests include CMR, NMC, EMC, and EMR. Thus, three of the four operations studied (there were no divergent production tests) and three types of products are represented by these 12 tests. All 12, however, use semantic content. When the 10 tests that are relevant ones for a single sample are added, all four of the operations studied and five types of products are represented; note, however, that the content remains semantic only. The seven tests that have a three-way classification in the Cognition of Concepts schema involve both things and relations as exemplars and the two tasks of classifying and naming. Tests employing the exclusion task which were possible ones for CCF1 do not appear there. Other evidence for excluding-type tests (to be discussed later, along with these results for CCF 1) indicates, however, that there are no functional differences in the three tasks or the two kinds of exemplars as hypothesized in the Cognition of Concepts schema. All 12 of the CCF 1 relevant tests employ verbal-semantic or picture-semantic content. This remains the case for content when the other 10 tests are added, with the exception of one test that consists of word-form content. Note that one of the tests was classified as employing both verbal-semantic and number-semantic content. This test, Necessary Arithmetic Operations, is highly correlated with other tests employing one or the other of these kinds of contents.

Because the 12 relevant tests of CCF 1 have several different Guilford classifications, it was of interest to make a further analysis at the level of the correlations themselves to see whether or not these 12 tests can reasonably be regarded as representing a single common factor. To do this we extracted the intercorrelations of these 12 tests for both samples from the larger matrices. These submatrices are presented in Table 8. We then used the Spearman model to compute single common factor coefficients for each of the 12 tests from these correlations. The computation procedure is given in Holzinger and Harman (1941, pp. 112-114). These single common factor coefficients were then used to reproduce intercorrelations among the 12 variables, and these reproduced correlations were subtracted

from the original correlations to yield matrices of residuals. Almost all of the residuals are in the range -.05 to +.05. Thus, despite the varied a priori classifications of these 12 tests, they fit the single common factor model very well. The Spearman coefficients, the reproduced correlations, and the residual correlations are given in Table 10.

Our conclusion is that these 12 tests represent a single common factor which can best be described as involving comprehension of information including induction of classes when verbal- and pictorial-semantic content is employed. Later we will indicate that the induction of classes when the content employed is figural and/or symbolic rather than semantic characterizes another factor. It is our view that CCF 1 is completely consistent with the early Thurstone notion of a verbal comprehension or verbal ability factor. Note, however, that such a factor is not adequately described by the Guilford code of Cognition of Semantic Units.

A few other additional points related to CCF 1 can be made. Of major interest are the differences in CCF 1 for the two samples. CCF 1 appears to be much more comprehensive for boys than it does for girls. Twelve variables are relevant for both boys and girls with an additional eight being relevant for boys and two additional relevant ones for girls. As can be seen from Table 8, many of the tests on CCF 1 for boys have their highest correlation with Vocabulary (40); not as many do for girls. The most striking difference in this respect is for the tests that are relevant for boys only. For girls, three of this set of tests have their highest correlation with one of the 12 tests relevant for both samples. As can be seen in Table 8, one of these, Remembering Classes: Names (15), appears as a comparable specific factor for girls (CSF 13). The other two, Word Relations (41) and Necessary Arithmetic Operations (54), are relevant variables on CCF 2 for girls; this can be seen in Table 8. Spelling (30) has its highest correlation with Vocabulary (40) for both boys and girls. It is a relevant variable on CCF 1 for girls but not for boys; spelling is a relevant variable on CCF 4 for both boys and girls. The intercorrelations of the relevant variables on CCF 4 can be found in the top section of Table 13 (p. 34).

The exemplars given are the same for many of the items for four of the tests that are on CCF 1: numbers 16, 23, 47, and 53. The purpose of this was to study the relationships among producing and selecting a class name when the exemplars are given in verbal-semantic and picture-semantic content; the exemplars

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Table 10. Spearman Single Common Factor Coefficients, Reproduced Correlations, and Residual Correlations for Comparable Common Factor 1 Relevant Variables[a]

Boys — Reproduced Correlations

Test	Spearman Coeff.	1	14	21	35	37	40	42	43	47	51	53
1 PictMn	67											
14 ParaCp	77	52										
21 BestWC	83	56	64									
35 SameOp	66	44	51	55								
37 Remote	73	49	56	61	48							
40 Vocab	88	59	68	73	58	64						
42 VerbAn	85	57	65	71	56	62	75					
43 BestTN	76	51	59	63	50	55	67	65				
47 PicGNS	74	50	57	61	49	54	65	63	56			
51 WordLk	75	50	58	62	50	55	66	64	57	56		
53 ClasNS	75	50	58	62	50	55	66	64	57	56	56	
55 VerbA3	59	40	45	49	39	43	52	50	45	44	44	44

Boys — Residual Correlations

Test	1	14	21	35	37	40	42	43	47	51	53
1 PictMn											
14 ParaCp	-02										
21 BestWC	04	-01									
35 SameOp	-08	-02	01								
37 Remote	06	02	-05	06							
40 Vocab	03	01	05	02	00						
42 VerbAn	-05	02	-04	02	-02	-02					
43 BestTN	03	-01	-01	-02	01	-03	01				
47 PicGNS	-02	01	02	03	-04	02	-04	-01			
51 WordLk	00	04	-04	-05	03	-03	04	-02	-02		
53 ClasNS	-04	-01	-01	03	00	01	04	-07	03	00	
55 VerbA3	03	-02	00	-01	-05	-06	00	10	03	01	-01

Girls — Reproduced Correlations

Test	Spearman Coeff.	1	14	21	35	37	40	42	43	47	51	53
1 PictMn	82											
14 ParaCp	82	67										
21 BestWC	84	69	69									
35 SameOp	76	62	62	64								
37 Remote	71	58	58	60	54							
40 Vocab	86	71	71	72	65	61						
42 VerbAn	83	68	68	70	63	59	71					
43 BestTN	72	59	59	60	55	51	62	60				
47 PicGNS	81	66	66	68	62	58	70	66	58			
51 WordLk	76	62	62	64	58	54	65	63	55	62		
53 ClasNS	70	57	57	59	53	50	60	58	50	57	53	
55 VerbA3	59	48	48	50	45	42	51	49	42	48	45	41

Girls — Residual Correlations

Test	1	14	21	35	37	40	42	43	47	51	53
1 PictMn											
14 ParaCp	05										
21 BestWC	-01	-01									
35 SameOp	-02	-01	06								
37 Remote	03	-01	02	02							
40 Vocab	03	-02	04	05	02						
42 VerbAn	-01	00	-04	02	04	-04					
43 BestTN	-04	00	-04	-03	03	00	02				
47 PicGNS	-04	00	01	01	04	00	-02	00			
51 WordLk	02	02	-04	-08	04	-04	-01	04	-04		
53 ClasNS	-06	-01	02	01	-09	00	05	00	07	03	
55 VerbA3	03	-03	-04	-01	-04	-02	-03	05	01	09	-03

a Decimals have been omitted.

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were held constant so knowledge of specific things would be held to a minimum as a confounding influence. The intercorrelations of these four tests are extracted and listed at the bottom of Table 8; also included is a diagram to show the nature of each of the tests. Note that the two tests for which the name was produced are highly correlated with each other. In addition to being a relevant variable on CCF 1 for boys, they form a doublet on a comparable common factor for girls (CCF 11) and are a doublet factor for boys for the Harris R-S^2 method; a possible explanation for their high correlation will be included with the discussion of CCF 11. The two tests for which the names of the classes were selected are relevant variables on CCF 1 for both boys and girls.

Of the tests that appear on CCF 1, 11 have their highest correlation with Vocabulary (40) for boys; only 5 do for girls. Of the 55 correlations of Vocabulary with each of the remaining tests, 45 of them for boys and 48 for girls are equal to or greater than .40; 33 for boys and 31 for girls are equal to or greater than .50.

The nonrelevant variables (appearing on only three or fewer of the six solutions) are indicated in small letters and are associated almost entirely with orthogonal solutions.

Comparable Common Factor 2

Comparable Common Factor 2 is a second rather broad factor of considerable interest. It involves 10 variables that are relevant for boys and 11 that are relevant for girls, but only 5 of these are relevant for both boys and girls. The intercorrelations of these variables have been extracted from the matrices in the Appendix and are presented separately in Table 11. The highest correlation for a test is identified and the tests are grouped the same as for CCF 1 in Table 8.

As with CCF 1, this factor (CCF 2) is broad not only in terms of the number of tests with substantial coefficients, but also in terms of the a priori classifications of the included tests. The a priori classifications of these tests are extracted from Table 1 and presented in Table 12. In summary, the five tests which are relevant on this factor for both samples have the following a priori classifications:

Guilford CSC - 3, CSS - 1, CFC - 1

Guttman RI: - 3, RI:N - 1, RI:P - 1

Thurstone I - 5

Cognition of Concepts Exemplars: T - 4, R - 1

Table 11. Intercorrelations of Tests on Comparable Common Factor 2[a]

Test	Boys						Girls				
	26	27	48	49	52		26	27	48	49	52
26 LetTri											
27 Let Cla	60[b]						50	‾			
48 NumbCl	51	49					41	57			
49 WordEx	48	52	63[d]				48	51	57[c]		
52 FigCla	53	51	56	54			39	47	51	49	
5 NumClE	45	48	43	42	41		37	45	33	29	34
6 WordGp	51	50	59	50	54		47	60	46	51	48
9 LetGrp	48	58	54	51	47		42	44	38	47	38
18 CardRt	41	48	36	43	34		30	40	42	38	46
32 SensOr	54	55	65	54	54		46	60	46	50	52
36 FigMat	58	52	61	56	60		53	60	55	58	50
38 NumbEx	46	41	49	59	47		36	50	52	49	44
39 SentOr	48	41	49	48	50		39	59	54	46	48
41 WordRl	54	44	53	55	56		60	57	53	61	54
53 ClasNS	44	41	54	56	68		39	50	54	48	57
54 NecAOp	43	45	51	54	57		48	53	51	53	60

[a] Decimals have been omitted.

[b] Highest correlation for both of the intersecting variables.

[c] Highest correlation for the column variable.

[d] Highest correlation for the row variable.

Table 12. Classifications of the Comparable Common Factor 2
Relevant Variables in Each of the Schemata

Test	Guilford[a]	Guttman	Thurstone	Cognition of Concepts Exem.	Content	Task
26 Letter Triangle	CSS	RI	I	R	L-S	C
27 Letter Classification	(CSC)	RI	I	T	L-S	C
48 Number Classification	CSC	RI:N	I	T	N-S	C
49 Word Exclusion	(CSC)	RI	I	T	W-F	E
52 Figure Classification	CFC	RI:P	I	T	F.	C
5 Number Class Extension	(CSC)	RI:N	I	T	N-M	C
6 Word Groups	CSC	RI	I	T	W-F	C
9 Letter Grouping	CSC	RI	I	T	L-S	E
18 Card Rotations	CFT	RA:P	S		F	
32 Sensitivity to Order	CMR	RI:V	I	R	V-M	C
36 Figure Matrix	CFR	RI:P	I	R	F	C
38 Number Exclusion	(CSC)	RI:N	I	T	N-S	E
39 Sentence Order	NMS	RA:V	V		V-M	
41 Word Relations	CSR	RI	I	R	W-F	C
53 Class Name Selection	EMC	RI:V	I	T	V-M	N
54 Necessary Arithmetic Operations	CMS	RA:N	D		'V-M/N-M	

[a] Parentheses in this column indicate our placement of the test in the Structure-of-Intellect;
the others are Guilford's identifications.

Content: L-S - 2, N-S - 1,
W-F - 1, F - 1
Task: C - 4, E - 1

Note that all five of the tests have a three-
way classification in the Cognition of Con-
cepts schema. Thus, they all require the
induction from the given exemplars (things or
relations) of a notion of a class or series and
then either selecting another exemplar that
belongs to that class (classification task),
selecting the one nonexemplar that is given
(exclusion task), or selecting a name for the
class (naming task).

Adding the classifications for the 11
additional relevant variables (those relevant
for one of the samples only) yields the follow-
ing:

Guilford   CSC - 7, CSS - 1, CSR - 1,
CFC - 1, CFR - 1, CFT - 1,
CMS - 1, CMR - 1, NMS - 1,
EMC - 1

Guttman   RI: - 6, RI:N - 3, RI:P - 2,
RI:V - 2, RA:N - 1, RA:P - 1,
RA:V - 1

Thurstone   I - 13, D - 1, S - 1, V - 1

Cognition of Concepts
Exemplars: T - 9, R - 4
Content: L-S - 3, N-S - 2,
W-F - 3, F - 3,
N-M - 1, V-M - 3,
N-M/N-M - 1
Task: C - 9, E - 3, N - 1

Note that for the 11 additional tests, eight
of them have a three-way classification in
the Cognition of Concepts schema.

These analyses indicate that the five
tests relevant for both boys and girls can be
identified unequivocally with one a priori
classification--Thurstone's I. All five of
these tests are classified as Induction in the
Thurstone schema. This classification holds
up quite well when the additional tests are
added. Of the 16 relevant tests on CCF 2,
13 of them are classified a priori as I. The
remaining three are one each for D, S, and
V.

Looking at the classifications of the
five main tests in the other schemata: all
are rule-inferring for Guttman, but include
varied contents; all five are cognition for
Guilford, but include symbolic and figural
contents and two different products; and all
involve the "cognition of concepts," but

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include both types of exemplars and two tasks (no naming-task tests were included for symbolic and figural contents). The most interesting result in terms of the last schema is that all types of nonsemantic contents are included--letters are used as symbols, numbers are used as symbols, words are used as forms, and figures are used.

Since the three sets of relevant variables (those for both boys and girls, those for boys, and those for girls) are quite different for CCF 2, it may be appropriate to make some comparisons among the three sets in terms of the a priori classifications. Most of the tests are I in the Thurstone schema with one in the boys' set being S and one each for V and D in the girls' set. All but three of the tests are rule-inferring in the Guttman schema, with all types of content represented in each set except for verbal in the combined set. In the Guilford schema, the tests all employ the operation of cognition except for two in the girls' set. Tests in each of the sets employ both symbolic and figural contents with the addition of one semantic test for boys and two for girls. Four different products are involved: two in the combined set, three in the boys' set, and three in the girls' set. For the Cognition of Concepts schema, all three sets include tests which employ both things and relations as exemplars, all three sets include both classifying and excluding tasks with one naming task for a semantic content test for the girls, and all four kinds of nonsemantic contents are well represented--all four in the combined set, three in the boys' set with two semantic contents, and three in the girls' set (not the same three as the boys) with three semantic content tests. As with the Guilford schema, figural and symbolic contents are included in each of the three sets. As was pointed out before, 13 of these 16 tests deal with the "cognition of concepts."

Our conclusion is that these tests represent a common factor which can best be described as involving the induction of classes when nonsemantic content is employed. It is our view that CCF 2 is completely consistent with the early Thurstone notion of an induction factor; this induction factor, however, is limited to nonsemantic content. Note that the distinctions made in the Guilford schema between figural and symbolic content, in the Cognition of Concepts schema among figural and three kinds of symbolic content, and in the Guttman schema among contents are not functional differences.

As with CCF 1, the nonrelevant variables on CCF 2 are associated almost entirely with orthogonal solutions only.

Comparable Common Factor 3

CCF 3 is primarily a function of the fact that the same memory test was administered twice on the first day and again on the last day of testing without further restudy of the material for the second and third administrations. A second memory test, Picture Class Memory (28), appears on this factor but with much smaller coefficients. Another memory test, Remembering Classes: Names (15), which used the same sets of exemplars as Remembering Classes: Members (4) for each class but required the subject to induce and remember the class name rather than just remember the class members (exemplars), appears not here, but on CCF 1 for boys and CSF 13 for girls. Apparently Test 15 functions more like a verbal ability test than a memory test; for boys it has its highest correlation with Vocabulary, and for girls with Best Word Class (21) and Picture Group Name Selection (47). Both of these tests require the selection of the best class name for a given exemplar or set of exemplars; Test 21 uses one word exemplar and Test 47 uses three pictured exemplars.

These results give no evidence that immediate and longer-term recall are different latent abilities. This is also borne out by the correlations. The correlation of Tests 4 and 7 is very high for both boys and girls (.86 in each case); the correlations of Tests 4 and 7 with No. 56 drop somewhat, as is to be expected, to the high .60s for boys and the mid .60s for girls.

Our conclusion is that CCF 3 can be called a memory factor.

Comparable Common Factor 4

Comparable Common Factor 4 is the early Word Fluency (W) factor of the Primary Mental Abilities, where it was defined by spelling and anagrams tests, or the Guilford CSU factor. The relevant variables for both boys and girls are the three that were hypothesized for this factor (8, 22, and 30) and one additional one, Concealed Words (24). It is plausible that spelling ability operated to assist these fifth grade students in the concealed words task. Guilford (1967, p. 72) said that such a test is in part a measure of CSU because of the word-recognition feature of it.

The intercorrelations of the relevant variables on CCF 4 are given in the top section of Table 13. Spelling (30) has its highest correlation with Vocabulary (40) for both boys and girls (see Table 8); however, for both

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boys and girls, Omelet (22) and Concealed Words (24) have their highest correlations with Spelling. Number Series (3) is a relevant variable for boys. The correlation between Test 3 and Disemvowelled Words (8) is the highest one for each of them. There is quite a difference in the magnitude of the correlations of Test 3 with the four main relevant variables of CCF 4 (Nos. 8, 22, 24, and 30) for boys and for girls. For girls, Number Series has its highest correlation with Figure Analogies (33) (see CCF 12). Word Relations (41) and Arithmetic Problems (45) are relevant variables for girls. Disemvowelled Words has its highest correlation with Word Relations, and Concealed Words has its highest correlation with Arithmetic Problems (tied with Spelling). The correlation between Word Relations and Arithmetic Problems is .64 for girls (the highest one for Arithmetic Problems) but it is only .50 for boys. Evidently the fluency ability operated to some extent with numbers, more so for girls than for boys.

Our conclusion is that these tests represent a latent ability which we prefer to describe as the early Thurstone Word Fluency ability, which Guilford later labelled Cognition of Symbolic Units.

Comparable Common Factor 5

CCF 5 is a perceptual speed doublet; it is the Perceptual Speed factor of the Primary Mental Abilities. The two tests that appear on this factor were the only ones included in the battery that were administered in a speeded fashion. As indicated by the MSA (J)s obtained for these two tests, their correlations with the other tests in the battery are very low. The intercorrelation of the two is lower than was expected--.49 for boys and .44 for girls-- since both tests involve almost exactly the same task. Perceptual Speed (25) involves circling the two identical figures from four given figures, and Identical Pictures (46) involves marking the figure, from five choices, that is identical to a given figure. The subjects responded directly in the test booklet for both of these tests. The reliability estimates obtained are in the high .80s and low .90s so unreliability is not a reason for the low correlations. Since there are other tests in the battery that involve judging figural content, it seems that speed, contrary to what Guilford (1971) believes, is an important feature and involves something that is different from the other abilities measured by the tests in this battery.

Guilford considers these two tests as measuring the ability named Evaluation of Figural Units; thus this factor may also be interpreted as being Guilford's EFU. According to Guilford, evaluation is more complex than cognition. "As for operations, cognition is basic to all other kinds...if no cognition, no memory...if no memory, no production... if neither cognition nor production, then no evaluation" (Guilford, 1967, p. 63). When the speeded aspect is removed, it seems that the task required by these two tests is merely one of recognition which may be more basic than Guilford's cognition, which he defines as "...how much the examinee knows or can readily discover on the basis of what he knows" (Guilford, 1967, p. 62). Thus, we prefer to call this factor Perceptual Speed as first identified by the Thurstones.

Comparable Common Factor 6

Comparable Common Factor 6 is a strange one in some ways. Card Rotations (18) and Spatial Relations (19) were included in the battery as hypothesized measures of the Spatial factor of the Primary Mental Abilities. Card Rotations is the same type of test as those used by the Thurstones' to define this ability. The Spatial Relations test is the one included in the PMA 4-6 test battery (Thurstone, 1962) to measure Spatial Ability. Guilford believes these two tests are measures of the ability named CFT.

Gestalt Completion (17) and Concealed Words (24) were included in the battery as hypothesized measures of Guilford's CFU; they are also measures of Thurstone's (1944) Closure One factor. French, Ekstrom, and Price (1963) called this factor Speed of Closure. Using the term speed may be misleading.

The intercorrelations of these four variables are given in the middle section of Table 13. Gestalt Completion is relatively uncorrelated with all of the other tests in the battery. As shown in Table 13, the highest correlation it has with any of the other tests is .36 with Spatial Relations for boys, and .34 with Concealed Words for girls. CCF 6 is a doublet of Gestalt Completion and Spatial Relations for boys; for girls it is a specific factor for Spatial Relations. Thus, for these two samples of subjects, Gestalt Completion and Concealed Words are not measures of the same ability as Guilford and Thurstone believed; their correlations are only .33 for boys and .34 for girls. As was mentioned in the discussion of CCF 4, spelling ability evidently

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Table 13.
Intercorrelations of Tests on Comparable Common Factors 4, 6, and 9[a]

		Boys						Girls			
Test		8	22	24	30		8	22	24	30	
8	Disvow										
22	Omelet	49					56				
24	ConWrd	48	52				41	47			
30	Spellg	59	|55|c	|54|			56	|58|	|49|		
3	NumbSe	68b	51	53	66		56	39	41	44	
41	WordRl	65	44	41	55		|63|	50	43	57	
45	ArithP	52	54	42	54		54	45	|49|	54	

		17	18	19	24		17	18	19	24	
17	Gestal										
18	CardRt	20					21				
19	SpatRl	|36|	37				28	48			
24	ConWrd	33	22	35			|34|	28	33		

		3	5	12	45	50	3	5	12	45	50
3	NumbSe										
5	NumClE	61d					46				
12	SeeTnd	50	52				56	44			
45	ArithP	63	59	51			54	|55|	43		
50	NumbRl	66	56	48	62		45	48	45	58	
54	NecAOp	67	54	48	71	64	52	53	52	55	|61|

[a] Decimals have been omitted.

[b] Highest correlation for both of the intersecting variables.

[c] Highest correlation for the column variable.

[d] Highest correlation for the row variable.

operated to assist these fifth grade students in the concealed words task. If nonsense words were used for this task, perhaps it would be more a perceptual or visualization (spatial) ability. Guilford (1967, p. 72) said the word recognition feature of such a test as Concealed Words makes it in part a measure of CSU. The correlations of Concealed Words with six other tests can be seen at the top of Table 13. Gestalt Completion does not appear as a relevant variable on any of the CCFs for girls. For the Harris R-S^2 method it is a specific factor in the orthogonal solution; this factor was not included in the oblique rotation.

Also, for these two samples of subjects, Card Rotations and Spatial Relations are not measures of the same ability as believed by Guilford and as hypothesized for the Thurstone schema, the basis of which was derived directly from the literature. Evidently the ability to determine whether a given card merely is rotated in space or is a mirror image of that card is not the same as the ability to visualize the shape of a figure that is required to complete a given incomplete square. These two tests have correlations of .37 for boys and .48 for girls; each of the tests has many higher correlations. Card Rotations is a relevant variable on CCF 2 for boys, and Spatial Relations is a nonrelevant variable; both are nonrelevant for girls. Both of these tests appear as nonrelevant variables on CCF 7 for girls; Spatial Relations is nonrelevant for boys.

CCF 6 may be similar to Thurstone's Closure One factor. The tests involved, Gestalt Completion and Spatial Relations, demand visualization of missing portions of figures or pictures. They differ from Card Rotations in this respect--nothing is missing

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from the given figures for Card Rotations.
Concealed Words demands the visualization
of missing portions of letters but evidently
spelling ability played a big role in this task.
Further study is needed to definitively identify
this factor.

Comparable Common Factor 7

CCF 7 is a doublet, with the same pic-
ture sets used as exemplars in both tests.
We used the same exemplars in order to study
the two tasks of classification and exclusion.
It is interesting that other similar potential
doublets did not appear. Word Groups (6)
and Word Exclusion (49) use the same sets
of words as exemplars; Number Exclusion
(38) and Number Classification (48) use the
same sets of numbers as exemplars; and
Letter Grouping (9) and Letter Classification
(27) use the same letter sets. Instead of
appearing as separate doublets, all of these
tests appear on CCF 2--one test of each of
the sets is a relevant variable for both boys
and girls, and the other test of the set is a
relevant variable for either boys or girls.
These separations are not along the classifi-
cation-exclusion lines. The one thing that
is made clear by CCF 7 and the three sets of
tests that are on CCF 2 is that the classifi-
cation and exclusion tasks are not different
abilities; thus, this distinction is not an
important functional one or one that needs to
be accounted for in a battery of reference
tests for cognitive abilities.

Comparable Common Factor 8

CCF 8 is a strange one. Figure Classifi-
cation (52) and Class Name Selection (53)
are relevant variables for boys. Class Name
Selection involves inferring a class name
from four given exemplars (verbal-semantic
content) and then choosing the best name of
three given ones. As the name of the test
implies, Figure Classification uses figural
content; three exemplars are given and the
subject is to infer a class and select another
exemplar of that class from five given choices.
At first glance it appears that these two tests
have nothing in common; a closer look reveals
that they might. Class Name Selection in-
volves selecting the best, most restrictive
yet complete, class name, e.g., dogs rather
than animals. Upon inspecting the items of
the Figure Classification test, it appears
that many of them involve selecting the best,

most complete, choice. This is illustrated by
the example item for this test given in Appendix
E. If one paid attention to only one of the
dimensions of the three given figures, number
of lines, choice A could be correct. If one
also attended to the fact that the lines inter-
sect, choice C could be correct. However,
taking into account not only that the lines
intersect but also the manner in which they
intersect, choice D is the correct answer.
Many of the items are of the type that if fewer
than the total number of dimensions are con-
sidered, the subject would clearly choose an
incorrect answer. However. if all of the
dimensions are considered, there is clearly
one best answer. Thus, what Guilford calls
an "evaluation" ability may be operating here
with both semantic and figural content.

Class Name Selection (53) and Necessary
Arithmetic Operations (54) are relevant variables
for girls. In both, a best class name is being
selected. The Necessary Arithmetic Operations
test requires only that the name of the opera-
tion or operations necessary for solving a given
problem be selected. In this sense, the best
class name (class of operations) is being re-
quested. Thus, this may also be some kind
of evaluative ability but it is not limited to
a specific kind of content for girls either.

Comparable Common Factor 9

Comparable Common Factor 9 is a nice one
for boys. It is defined primarily by tests using
numbers as cardinal numbers; those using num-
bers as nominal symbols do not appear here.
This factor for boys appears to be the early
Thurstone number factor. Guilford (1971) be-
lieves that the distinction between MSI and CSC
was blurred in the Thurstone studies and that
his data support the factorial separation of
these; our evidence indicates that the Guilford
CSC is blurred. Tests that use numbers as
cardinal numbers (number-semantic content
in our terms) are different from tests that use
numbers as symbols without any cardinal value
(number-symbolic in our terms); Guilford clas-
sifies both of these types as symbolic. This
number factor does not emerge for the girls
except for the Harris $R-S^2$ method.

Included in the bottom section of Table 13
are the intercorrelations of all of the tests using
number-semantic content: 3, 5, 45, 50, and 54
(54 seems to be a combination of two kinds of
contents, verbal-semantic and number-semantic).
One other test, Seeing Trends (12), is also in-
cluded here because it is a relevant variable on
CCF 9 for boys. It is a nonrelevant variable on

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CCF 12 for girls. Its correlations are as high or higher with many of the tests on CCF 2 and might have appeared there.

Of the five tests using number-semantic content, two do not appear on CCF 9 as relevant variables. Number Series (3) has its highest correlation with Disemvowelled Words (8). Thus, even though both Number Class Extension (5) and Number Relations (50) have their highest correlations with Number Series, it appears on CCF 4 instead of CCF 9. Even though Arithmetic Problems (45) and Necessary Arithmetic Operations (54) share the highest correlation, Necessary Arithmetic Operations appears on CCF 9 for only three of the six solutions; it is a relevant variable on CCF 1. This is understandable when one looks at the correlations of No. 54 with the remaining variables. It has many high correlations with the variables that are relevant on CCF 1 (see Table 8 and Appendix C). Apparently, as hypothesized for the Cognition of Concepts schema, both the verbal-semantic and the number-semantic contents of Necessary Arithmetic Operations are functioning and it is not a clear measure of either ability.

The correlations among this set of five tests using number-semantic content are generally lower for girls than they are for boys. Perhaps fifth grade boys have a better developed number ability than do fifth grade girls.

Comparable Common Factor 10

CCF 10 is specific to boys and is not readily interpretable.

Comparable Common Factor 11

CCF 11 is specific to girls, except for the Harris R-S^2 method for boys, and consists of a doublet of two tests which use the same sets of exemplars, one with verbal-semantic content and one with picture-semantic content. However, two other tests (Nos. 47 and 53) also use these same sets. All four of these tests appear on CCF 1--Tests 47 and 53 as relevant variables and Tests 16 and 23 as nonrelevant variables. See Table 8 for the intercorrelations of these four tests as well as their correlations with the other relevant variables on CCF 1. This may be Guilford's NMC as hypothesized (he said these two tests are measures of NMU), but a third test for which a response was produced by the subject after inducing a class from given

exemplars, Remote Class Completion (37), does not appear on this factor.

CCF 11 seems to be specific to producing a name for an induced class, but the amount of this specificity related to the use of the same sets of exemplars cannot be determined. A feasible speculation is that this specificity may be accounted for in large part by the scoring key that was used for these tests. The tests were scored requiring the subjects to give an explicit class name. For example, for the item using the exemplars ant, bee, fly, and beetle, the class name BUGS which was given by a large number of subjects was considered to be too general and was not accepted as a suitable response; the only acceptable response was INSECTS. This same item was employed for Tests 47 and 53, but response choices were given from which the subject chose his answer; the class name INSECTS was, of course, a choice but BUGS was not. Hence, this distinction never arose.

Comparable Common Factor 12

CCF 12 is specific to girls and is not readily interpretable.

Comparable Specific Factor 13

Comparable Specific Factor 13, consisting of the test for Remembering Classes: Names (15), is specific to girls except for the Harris R-S^2 method for boys. For boys this test appears as a relevant variable on CCF 1.

Factors Specific to a Single Initial Solution

The remaining factors are specific to a single initial solution and thus are not considered to be meaningful substantive findings.

Intercorrelations of Oblique Factors

The intercorrelations of the oblique factors which contribute to the comparable common and comparable specific factors are given in Table 14. They are grouped together for each of the three initial methods (Alpha, Harris R-S^2, and UMLFA) for easier comparison. The intercorrelations of these factors are low to moderate except that the correlations of CCF 5 and CCF 6 with the other factors are all quite low. CCF 5 is the early Thurstone Word Fluency ability and CCF 6 tests involve the visualization of missing portions of figures or pictures.

Table 14. Intercorrelations of Oblique Factors[a]

Comparable Factors	1 B	1 G	2 B	2 G	3 B	3 G	4 B	4 G	5 B	5 G	6 B	6 G	7 B	7 G	8 B	8 G	9 B	9 G	10 B	10 G	11 B	11 G	12 B	12 G
2 A[b]	37	35																						
H	21	25																						
U	10	22																						
3 A	46	32	30	17																				
H	36	34	27	17																				
U	35	32	26	17																				
4 A	49	40	32	27	32	25																		
H	29	36	26	21	16	24																		
U	33	37	26	30	21	27																		
5 A	08	15	12	16	09	18	12	17																
H	02	10	10	11	07	17	10	15																
U	08	11	11	13	08	18	11	17																
6 A	05		13		08		12		16															
H	03	28	13	31	07	23	14	15	15	17														
U	02	25	13	29	07	21	06	24	11	14														
7 A	40	33	30	33	37	27	36	24	08	15	18													
H	27	27	22	27	27	23	18	10	03	14	14	30												
U		30		33		27		24		12		36												
8 A																								
H	35	40	32	39	24	24	22	25	07	08	08	28	15	30										
U	36	36	37	35	33	19	35	27	12	09	03	18		27										
9 A		33		36		33		26		06		10		28										
H	36	26	33	27	33	26	32	29	14	09	10	25	23	25	31	25								
U	26		30		33		30		12		14				31									
10 A	22		31		16		16		02		10		18				19							
H	25		20		23		15		02		13		25		19		19							
U	28		37		31		26		03		17				36		31							
11 A		38		25		26		32		12				30										
H	46	40	20	25	30	31	31	25	10	09	11	28	28	21	25	25	34	22	15					
U		38		28		28		31		09		27		26		25								
12 A		34		43		24		32		21				32								25		
H		33		40		26		33		20		39		30		25		28				28		
U		30		35		23		34		16		22		25		28						24		
13 A		44		37		28		36		13				32								37		30
H	42	30	33	28	30	19	25	19	12	08	05	19	16	22	35	24	33	07	21		29	29		26
U		37		30		26		34		13		24		28		32						34		25

[a] Decimals have been omitted.
[b] A = Alpha   H = Harris R-S^2 U = Unrestricted Maximum Likelihood Factor Analysis

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IV
Summary and Conclusions

The primary objective of the project entitled "A Structure of Concept Attainment Abilities" is to formulate one or more models or structures of concept attainment abilities, and to assess their consistency with actual data. One of the major steps for attaining this primary objective was taken to be the identification of reference tests for cognitive abilities.

Fifty-six tests of possible cognitive abilities were suggested by an analysis of three fairly well-known systems for defining general cognitive abilities and by a fourth schema which was suggested by this analysis. These 56 tests were administered during summer, 1970, to 172 boys and 210 girls who had just completed the fifth grade. The data were analyzed separately for each sample.

The means, standard deviations, and Hoyt reliability estimates obtained for each of the tests are presented and discussed. Kaiser-Meyer-Olkin MSAs and MSA (J)s (Kaiser, 1970) were obtained. Three initial factor solutions were secured from the intercorrelations of these tests: Alpha (Kaiser & Caffrey, 1965), Harris R-S^2 (Harris, 1962), and Unrestricted Maximum Likelihood Factor Analysis (Jöreskog, 1967). For each initial solution a derived orthogonal solution using the normal varimax transformation (Kaiser, 1958) was secured. For each of the sets of orthogonal common factors, two derived oblique solutions were secured using the procedures of Harris and Kaiser (1964). The A'A Proportional to L oblique solution was the one interpreted.

Six sets of derived factors, three orthogonal and three oblique, were interpreted using a strategy proposed by Harris & Harris (1970). Eight comparable common factors were obtained that appear to be essentially the same factors for both boys and girls. Four comparable common factors appear for one sample

only, two CCFs for boys and two for girls. There is also one comparable specific factor for girls. Three factors specific to initial solutions were obtained for boys and one for girls. The comparable common factors were the ones taken as meaningful results and were the factors interpreted.

A summary of the interpretation of the comparable common factors shows that there are six clear ones and one that is fairly clear for boys; there are only five clear ones for girls. The six clear CCFs for boys appear to represent six of the seven Primary Mental Abilities. They are: CCF 1 — Comprehension of information including induction of classes when verbal and pictorial semantic content is employed (verbal comprehension or verbal ability); CCF 2 — Induction of classes when nonsemantic content is employed (Thurstone's I, but limited to nonsemantic content); CCF 3 — Memory; CCF 4 — Word Fluency; CCF 5 — Perceptual Speed; and CCF 9 — Number. The CCF that is fairly clear for boys (CCF 6) may be the missing factor of the Primary Mental Abilities, Spatial Ability, but it is not clearly identified; CCF 6 is characterized by tests that demand visualization of missing portions of figures or pictures. This may be similar to Thurstone's Closure One factor or it may be Spatial Ability. Two of the CCFs obtained for the boys are not easily interpretable and the remaining one may be some kind of evaluative ability.

The five clear CCFs for girls appear to represent five of the seven Primary Mental Abilities. They are the same as CCFs 1, 2, 3, 4, and 5 for boys. The Number factor does not appear for girls except for the Harris R-S^2 method, and the Spatial factor is less clear than it is for boys. Three of the CCFs obtained for the girls are not easily interpretable and, as with the boys, the remaining one may be some kind of evaluative ability.

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Selection of Tests for Further Study

In addition to using the results of the factor analyses to compare various schemata for defining cognitive abilities, these results were used as a basis for selecting 30 tests of mental abilities that were used during summer, 1971, to study the relationships between knowledge of concepts in four subject matter areas and these tests of cognitive abilities. In making the selection of tests we attempted to represent, by at least two tests, each of the well-identified comparable common factors. The data gathered in summer, 1971, will also enable us to check on the stability of these factors. The 30 selected tests are listed in Table 15.

Table 15. Selected Cognitive Abilities Reference Tests

Arithmetic Problems
Class Name Selection
Concealed Words
Figure Exclusion
Figure Matrix
Gestalt Completion
Identical Pictures
Letter Classification
Number Class Extension
Number Classification
Number Exclusion
Number Relations
Number Series
Omelet
Perceptual Speed
Picture Arrangement
Picture Class Memory
Picture Classification
Picture Group Name Selection
Picture Meaning
Puzzles
Remembering Classes: Members
Remembering Classes: Names
Remote Class Completion
Seeing Trends
Spatial Relations
Spelling
Vocabulary
Word Group Naming
Word Groups

References

French, J. W., Ekstrom, R. B., and Price, L. A. Manual for kit of reference tests for cognitive factors. (Rev. ed.) Princeton, N. J.: Educational Testing Service, 1963.

Guilford, J. P. The nature of human intelligence. New York: McGraw-Hill, 1967.

Guilford, J. P. Thurstone's Primary Mental Abilities and Structure-of-Intellect Abilities. Accepted for publication in Psychological Bulletin, 1971.

Guttman, L. Integration of test design and analysis. In Proceedings of the 1969 Invitational Conference on Testing Problems. Princeton, N. J.: Educational Testing Service, 1970.

Hakstian, A. R. A comparative evaluation of several prominent methods of oblique factor transformation. Psychometrika, 1971, 36, 175-193.

Harris, C. W. Some Rao-Guttman relationships. Psychometrika, 1962, 27, 247-263.

Harris, C. W., and Kaiser, H. F. Oblique factor analytic solutions by orthogonal transformations. Psychometrika, 1964, 29, 347-362.

Harris, M. L., and Harris, C. W. A factor analytic interpretation strategy. Wisconsin Research and Development Center for Cognitive Learning, Technical Report No. 115, 1970. Also published in Educational and Psychological Measurement, 1971, 31 589-606.

Harris, M. L., and Harris, C. W. Item analyses and reliabilities for reference tests for cognitive abilities: Fifth grade boys and girls. Wisconsin Research and Development Center for Cognitive Learning, Tech-

nical Report No. 191, in press (a).

Harris, M. L., and Harris, C. W. Newly constructed reference tests for cognitive abilities. Wisconsin Research and Development Center for Cognitive Learning, Working Paper No. 80, in press (b).

Harris, M. L., and Harris, C. W. Three systems of classifying cognitive abilities as bases for reference tests. Wisconsin Research and Development Center for Cognitive Learning, Theoretical Paper No. 33, in press (c).

Holzinger, K. J., and Harman, H. H. Factor analysis. Chicago: The University of Chicago Press, 1941.

Jöreskog, K. G. Some contributions to maximum likelihood factor analysis. Psychometrika, 1967, 32, 443-482.

Kaiser, H. F. The varimax criterion for analytic rotation in factor analysis. Psychometrika, 1958, 23, 187-200.

Kaiser, H. F. A second generation Little Jiffy. Psychometrika, 1970, 35, 401-415.

Kaiser, H. F., and Caffrey, J. Alpha factor analysis. Psychometrika, 1965, 30, 1-14.

Thurstone, L. L. Primary mental abilities. Psychometric Monograph No. 1. Chicago: The University of Chicago Press, 1938.

Thurstone, L. L. A factorial study of perception. Psychometric Monograph No. 4. Chicago: The University of Chicago Press, 1944.

Thurstone, L. L., and Thurstone, T. G. Factorial studies of intelligence. Psychometric Monograph No. 2. Chicago: The University of Chicago Press, 1941.

Thurstone, T. G. Primary Mental Abilities for grades 4-6: Test battery. Chicago: Science Research Associates, Inc., 1962.

Appendix A
Alphabetical Listing of Tests

Arithmetic Problems (45)
Best Trend Name (43)
Best Word Class (21)
Card Rotations (18)
Circle Reasoning (10)
Class Name Selection (53)
Concealed Words (24)
Disemvowelled Words (8)
Figure Analogies (33)
Figure Classification (52)
Figure Exclusion (11)
Figure Matrix (36)
Gestalt Completion (17)
Identical Pictures (46)
Letter Classification (27)
Letter Grouping (9)
Letter Triangle (26)
Necessary Arithmetic Operations (54)
Number Class Extension (5)
Number Classification (48)
Number Exclusion (38)
Number Relations (50)
Number Series (3)
Omelet (22)
Paragraph Comprehension (14)
Perceptual Speed (25)
Picture Arrangement (44)
Picture Class Memory (28)
Picture Classification (13)
Picture Exclusion (31)
Picture Group Name Selection (47)
Picture Group Naming (23)
Picture Meaning (1)
Puzzles (29)
Remembering Classes: Members (4)
Remembering Classes: Members II (7)
Remembering Classes: Members III (56)
Remembering Classes: Names (15)
Remote Class Completion (37)
Same-Opposite (35)
Scrambled Sentences (34)
Seeing Trends (12)
Sensitivity to Order (32)
Sentence Order (39)
Spatial Relations (19)

Spelling (30)
Verbal Analogies (42)
Verbal Analogies III (55)
Verbal Classification (2)
Verbal Exclusion (20)
Vocabulary (40)
Word Exclusion (49)
Word Group Naming (16)
Word Groups (6)
Word Linkage (51)
Word Relations (41)

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Apendix B

Source of Test and Number of Choices for Each Item

Test	Source	Number of Choices
1 Picture Meaning	Primary Mental Abilities Tests (1962)	4
2 Verbal Classification	Constructed[a]	3
3 Number Series	Constructed	5
4 Remembering Classes: Members	Constructed	2
5 Number Class Extension	Constructed	3
6 Word Groups	Constructed	3
7 Remembering Classes: Members II	Constructed	2
8 Disemvowelled Words	Constructed	5
9 Letter Grouping	Constructed	4
10 Circle Reasoning	Constructed	7
11 Figure Exclusion	Primary Mental Abilities Tests (1962)	4
12 Seeing Trends	Constructed	3
13 Picture Classification	Constructed	3
14 Paragraph Comprehension	Iowa Tests of Basic Skills (1964)	4
15 Remembering Classes: Names	Constructed	2
16 Word Group Naming	Constructed	Free response[b]
17 Gestalt Completion	Adapted from Gestalt Completion Test--C-1 (ETS Kit, 1962)	Free response[b]
18 Card Rotations	Card Rotations Test--S-1, Part II (ETS Kit, 1962)	2
19 Spatial Relations	Primary Mental Abilities Tests (1962)	4
20 Verbal Exclusion	Constructed	4
21 Best Word Class	Constructed	4
22 Omelet	Constructed	Free response[b]
23 Picture Group Naming	Constructed	Free response[b]
24 Concealed Words	Adapted from Concealed Words Test--Cs-2 (ETS Kit, 1962)	Free response[b]
25 Perceptual Speed	Primary Mental Abilities Tests (1962)	6
26 Letter Triangle	Constructed	3
27 Letter Classification	Constructed	3
28 Picture Class Memory	Constructed	2
29 Puzzles	Selected items from Test of Logical Ability (Hill, 1960)	2
30 Spelling	Iowa Tests of Basic Skills (1964)	5
31 Picture Exclusion	Constructed	4
32 Sensitivity to Order	Constructed	5
33 Figure Analogies	Lorge-Thorndike Intelligence Tests (1964)	5
34 Scrambled Sentences	Constructed	2
35 Same-Opposite	Constructed	2
36 Figure Matrix	Sheridan Psychological Services, Inc. (1969)	5

Appendix B. (Continued)

Test	Source	Number of Choices[b]
37 Remote Class Completion	Adapted from WADDLE Test (Warren & Davis, 1970)	Free response[b]
38 Number Exclusion	Constructed	4
39 Sentence Order	Constructed	3
40 Vocabulary	Iowa Tests of Basic Skills (1964)	4
41 Word Relations	Constructed	5
42 Verbal Analogies	Items adapted from Analogy Questions (Gouber, 1967)	4
43 Best Trend Name	Sheridan Psychological Services, Inc. (1969)	3
44 Picture Arrangement	Dorothy C. Adkins' adaptation of the Comic Strip "Louie"	Free response[b]
45 Arithmetic Problems	Adapted by and obtained from J. P. Guilford	Free response[b]
46 Identical Pictures	Identical Pictures Test--P-3, Part II (ETS Kit, 1962)	5
47 Picture Group Name Selection	Constructed	3
48 Number Classification	Constructed	5
49 Word Exclusion	Constructed	4
50 Number Relations	Constructed	4
51 Word Linkage	Constructed	3
52 Figure Classification	Lorge-Thorndike Intelligence Tests (1964)	5
53 Class Name Selection	Constructed	3
54 Necessary Arithmetic Operations	NLSMA Reports (1968)	4
55 Verbal Analogies III	Sheridan Psychological Services, Inc. (1969)	4
56 Remembering Classes: Members III	Constructed	2

[a] The tests for which the source is "Constructed" can be found in "Newly Constructed Reference Tests for Cognitive Abilities" (Harris & Harris, in press). The adapted Concealed Words and Gestalt Completion tests can also be found there, as can the Verbal Analogies test.

[b] Each item of this test was scored right or wrong.

Appendix C
Correlation Matrices

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Table C-1. Intercorrelations of Tests: Boys[a]

Test	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1 PictMn																			
2 VerbCl	42																		
3 NumbSe	40	55																	
4 RemClM	46	49	58																
5 NumClE	34	36	61	45															
6 WordGp	31	50	58	50	48														
7 RmClM2	41	46	59	86	48	51													
8 Disvow	44	51	68	50	54	58	48												
9 LetGrp	18	29	57	43	48	50	46	50											
10 CirRea	36	35	45	48	44	42	48	42	34										
11 FigExc	20	28	51	29	38	36	31	47	43	30									
12 SeeTnd	32	42	50	42	52	44	45	53	40	52	34								
13 PictCl	37	49	42	39	42	31	36	34	34	38	35	42							
14 ParaCp	50	46	57	57	51	53	54	59	42	51	36	59	43						
15 RemClN	34	37	60	51	43	58	53	51	41	37	35	44	38	53					
16 WdGpNm	54	49	58	50	50	47	49	54	41	31	33	38	42	52	46				
17 Gestal	14	10	18	19	16	14	22	15	10	18	21	17	14	16	18	09			
18 CardRt	20	24	36	30	34	42	33	37	38	29	38	39	37	34	32	24	20		
19 SpatRl	37	30	45	30	34	38	31	45	37	35	45	32	38	31	37	35	36	37	
20 VerbEx	41	51	58	49	39	54	48	59	46	30	39	44	34	49	50	45	18	35	44
21 BestWC	60	57	62	58	45	54	54	58	36	42	33	46	42	63	55	61	16	33	43
22 Omelet	31	38	51	29	37	35	31	49	32	25	20	33	26	37	43	45	18	13	31
23 PictGN	51	45	55	45	42	46	45	48	32	25	27	31	41	46	50	70	22	23	40
24 ConWrd	31	32	53	30	31	33	29	48	35	27	26	32	36	35	33	45	33	22	35
25 PerSpd	00	11	20	08	08	12	12	09	16	08	28	04	08	00	21	13	13	15	21
26 LetTri	20	39	56	31	45	51	38	54	48	38	38	45	21	42	45	36	23	41	42
27 LetCla	14	39	50	38	48	50	44	47	58	40	36	50	27	45	39	32	14	48	31
28 PictCM	18	29	41	44	26	29	46	34	25	37	27	35	23	35	33	20	12	21	23
29 Puzzle	41	44	59	52	40	59	52	58	41	41	32	46	35	66	65	48	12	40	29
30 Spellg	41	50	66	43	44	52	41	59	36	37	27	42	37	49	47	53	07	32	31
31 PictEx	42	44	50	49	45	37	46	52	50	38	44	40	54	48	38	49	27	40	48
32 SensOr	38	55	62	57	45	63	57	62	48	41	34	52	39	58	54	53	20	41	40
33 FigAna	41	51	64	52	43	54	47	57	44	44	42	43	38	44	49	50	14	37	46
34 ScramS	32	32	41	39	37	33	35	39	26	32	19	38	34	43	42	42	09	23	13
35 SameOp	36	42	52	45	29	47	39	42	34	32	25	28	29	49	37	39	-03	20	25
36 FigMat	42	46	60	50	50	54	49	61	45	53	46	55	42	52	50	44	30	40	52
37 Remote	55	44	48	53	41	46	43	48	29	36	25	35	32	58	44	49	10	19	31
38 NumbEx	20	35	46	41	32	44	39	46	35	39	36	52	25	48	39	25	05	33	20
39 SentOr	26	41	57	40	36	50	44	55	41	42	40	49	24	53	60	40	07	30	32
40 Vocab	62	54	66	60	51	56	61	60	39	45	32	48	40	69	65	62	07	32	36
41 WordRl	43	54	69	50	49	57	44	65	49	48	41	53	42	61	48	46	18	47	41
42 VerbAn	52	53	64	59	47	56	54	59	42	44	36	46	47	67	58	56	12	42	41
43 BestTN	54	46	54	65	54	55	61	58	41	36	33	43	44	58	52	51	16	39	31
44 PictAr	35	36	44	41	32	26	35	32	25	33	23	33	36	41	34	26	12	25	31
45 ArithP	34	44	63	47	59	47	54	52	44	40	35	51	37	53	48	50	23	31	43
46 IdentP	20	15	26	15	24	17	24	22	22	19	15	19	10	17	26	25	31	13	22
47 PicGNS	48	46	58	46	40	56	49	50	41	39	33	38	38	58	58	57	14	31	37
48 NumbCl	25	40	56	39	43	59	41	62	54	42	43	49	30	56	45	36	15	36	34
49 WordEx	30	39	52	50	42	50	48	56	51	43	47	58	37	58	44	44	17	43	38
50 NumbRl	40	46	66	48	56	51	50	62	47	44	41	48	35	53	44	49	18	40	40
51 WordLk	50	38	56	46	47	47	43	55	37	36	32	45	42	62	53	48	17	31	40
52 FigCla	27	37	54	44	41	54	45	49	47	40	40	43	34	45	46	34	13	34	42
53 ClasNS	46	48	62	51	41	56	51	56	39	41	39	46	33	57	56	50	17	33	49
54 NecAOp	41	48	67	50	54	55	58	61	47	37	44	48	40	58	55	54	17	37	42
55 VerbA3	43	34	46	46	41	40	44	45	27	31	27	34	44	43	42	41	11	25	34
56 RmClM3	46	45	50	68	51	45	69	46	35	47	30	48	39	44	44	45	04	35	32

[a] Decimals have been omitted.

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Table C-1. (Continued)

Test	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38
21 BestWC	57																		
22 Omelet	40	50																	
23 PictGN	48	57	45																
24 ConWrd	4!	35	52	42															
25 PerSpd	05	07	11	09	15														
26 LetTri	49	38	29	31	35	08													
27 LetCla	40	40	32	31	30	06	60												
28 PictCM	32	30	11	18	21	13	35	36											
29 Puzzle	47	64	46	47	30	10	48	40	44										
30 Spellg	57	57	55	53	54	10	44	41	30	59									
31 PictEx	55	47	33	42	43	07	40	36	28	42	37								
32 SensOr	60	60	50	55	46	07	54	55	35	62	60	51							
33 FigAna	49	54	35	48	38	18	51	40	36	46	46	52	63						
34 ScramS	33	44	34	40	28	06	09	27	26	36	39	32	48	31					
35 SameOp	45	56	34	44	25	01	25	32	29	50	49	35	54	46	44				
36 FigMat	54	56	34	49	46	06	58	52	37	48	45	51	60	61	33	35			
37 Remote	49	56	44	48	35	07	31	31	24	55	57	42	50	44	36	54	41		
38 NumbEx	49	39	32	28	28	-06	46	41	26	44	40	37	47	43	20	31	47	30	
39 SentOr	48	48	39	40	35	16	48	41	39	64	44	39	60	46	30	37	50	36	54
40 Vocab	56	78	53	61	35	11	45	41	35	71	69	42	63	52	48	60	49	64	43
41 WordRl	50	65	44	42	41	09	54	44	29	60	55	46	59	64	33	49	62	56	52
42 VerbAn	59	67	52	58	36	03	40	41	30	68	62	54	66	59	47	58	55	60	49
43 BestTN	54	62	39	51	32	06	34	42	31	59	48	55	59	47	43	48	52	56	38
44 PictAr	32	38	23	28	25	07	27	22	31	35	22	34	31	39	18	30	45	33	35
45 ArithP	48	54	54	47	42	16	41	40	28	47	54	45	56	48	34	38	51	45	43
46 IdentP	14	22	22	24	20	49	15	19	15	21	17	12	22	19	12	10	13	18	05
47 PicGNS	44	63	38	56	32	11	42	43	38	60	45	48	58	53	44	52	53	50	31
48 NumbCl	49	44	37	37	32	10	51	49	33	53	43	50	65	52	36	38	61	36	49
49 WordEx	49	52	37	38	32	05	48	52	34	50	45	43	54	54	39	40	56	38	59
50 NumbRl	46	55	42	43	41	08	45	42	31	47	54	44	54	57	33	36	53	41	44
51 WordLk	44	58	46	45	31	02	35	35	32	60	49	52	50	47	36	45	47	58	40
52 FigCla	46	44	36	44	33	08	53	51	36	52	47	44	54	57	23	48	60	41	47
53 ClasNS	60	61	47	58	33	14	44	41	34	61	58	42	62	48	38	53	51	55	50
54 NecAOp	53	64	44	56	40	13	43	45	36	57	56	42	66	59	40	50	58	46	46
55 VerbA3	41	49	19	34	25	02	23	29	33	44	36	39	42	39	45	38	38	38	20
56 RmClM3	40	53	33	40	22	06	30	40	40	51	42	44	50	41	34	34	43	43	32

Test	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55
40 Vocab	61																
41 WordRl	52	62															
42 VerbAn	56	73	62														
43 BestTN	43	64	57	66													
44 PictAr	34	38	47	41	41												
45 ArithP	48	56	50	61	45	28											
46 IdentP	18	23	18	14	18	09	34										
47 PicGNS	49	67	53	59	55	31	50	20									
48 NumbCl	49	44	53	54	42	28	48	23	55								
49 WordEx	48	51	55	58	45	29	50	08	53	63							
50 NumbRl	44	53	56	55	48	34	62	23	43	53	53						
51 WordLk	53	63	57	68	55	38	58	16	54	45	48	51					
52 FigCla	50	49	56	57	44	39	46	20	48	56	54	45	44				
53 ClasNS	54	67	53	68	50	32	59	24	59	54	56	56	56	68			
54 NecAOp	55	68	58	67	56	34	71	24	57	51	54	64	54	57	70		
55 VerbA3	26	46	39	50	55	21	45	18	47	38	36	33	45	36	43	47	
56 RmClM3	45	56	40	58	56	32	49	17	41	37	39	45	44	41	49	51	44

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Table C-2. Intercorrelations of Tests: Girls[a]

Test	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1 PictMn																			
2 VerbCl	48																		
3 NumbSe	45	44																	
4 RemClM	52	44	45																
5 NumClE	43	36	46	39															
6 WordGp	48	42	64	44	45														
7 RmClM2	56	44	47	86	39	46													
8 Disvow	50	46	56	48	42	51	47												
9 LetGrp	27	29	49	36	30	54	39	45											
10 CirRea	41	41	37	30	39	45	35	39	39										
11 FigExc	24	34	42	32	25	44	34	33	37	26									
12 SeeTnd	45	33	56	41	44	46	46	50	45	37	32								
13 PictCl	43	44	46	38	39	51	38	27	37	30	39	35							
14 ParaCp	72	52	50	52	47	55	56	51	43	49	37	55	46						
15 RemClN	39	41	42	39	26	43	43	38	34	35	29	34	37	48					
16 WdGpNm	56	50	47	50	39	46	46	48	34	42	34	39	38	54	45				
17 Gestal	24	23	27	26	26	27	28	27	22	19	18	11	24	14	23	26			
18 CardRt	45	36	45	41	34	50	45	36	36	33	36	33	53	53	45	39	21		
19 SpatRl	40	37	45	41	35	46	43	48	46	29	46	41	36	47	32	38	28	48	
20 VerbEx	46	54	47	46	38	45	48	43	39	38	32	45	42	57	48	48	27	45	40
21 BestWC	68	57	47	49	47	51	56	60	40	48	32	50	42	68	52	57	31	42	50
22 Omelet	45	33	39	42	31	42	42	56	29	32	11	38	23	43	34	38	23	23	24
23 PictGN	53	50	44	51	38	43	49	45	38	44	38	38	33	54	45	72	21	35	41
24 ConWrd	35	34	41	37	36	38	40	41	23	25	16	34	31	32	27	30	34	28	33
25 PerSpd	26	28	30	37	21	38	30	34	22	23	26	25	24	25	18	25	-03	26	24
26 LetTri	32	27	46	26	37	47	36	38	42	42	28	46	31	47	23	32	16	30	35
27 LetCla	34	38	52	39	45	60	39	48	44	43	32	49	46	52	41	42	19	40	43
28 PictCM	29	26	31	45	26	40	46	32	33	17	16	30	34	32	30	24	20	33	27
29 Puzzle	53	45	55	46	37	56	49	51	42	36	36	48	37	64	46	53	25	47	42
30 Spellg	58	44	44	34	34	48	42	56	28	40	20	47	26	57	37	54	12	30	32
31 PictEx	45	47	48	38	41	50	39	37	32	27	40	36	56	51	37	42	25	45	51
32 SensOr	54	55	57	44	38	62	48	55	44	48	35	55	50	62	52	54	25	52	49
33 FigAna	39	52	65	39	45	60	42	50	46	46	46	50	45	52	44	48	21	48	53
34 ScramS	37	32	38	32	38	41	34	36	36	40	19	45	38	41	37	37	15	31	34
35 SameOp	60	53	59	52	41	55	56	56	44	43	31	51	40	61	51	47	23	46	46
36 FigMat	45	49	56	43	47	58	45	50	46	46	42	53	47	59	40	51	20	51	47
37 Remote	61	49	52	44	40	44	47	53	39	34	26	48	45	57	40	54	18	34	34
38 NumbEx	16	24	30	25	34	42	28	22	35	31	35	35	26	36	25	31	09	32	37
39 SentOr	34	47	45	41	32	45	32	40	34	38	22	33	33	49	51	46	18	45	35
40 Vocab	74	56	57	46	46	56	52	60	38	45	28	56	41	69	46	57	24	52	43
41 WordRl	48	46	62	45	48	58	51	63	47	47	40	61	39	57	43	53	22	44	47
42 VerbAn	67	54	53	54	49	54	55	52	45	48	32	55	45	68	42	60	24	55	50
43 BestTN	55	44	47	46	43	55	47	50	36	45	32	54	42	59	38	50	21	47	41
44 PictAr	50	39	28	34	24	34	34	37	21	23	17	22	33	40	27	47	30	36	32
45 ArithP	48	40	54	48	55	60	47	54	39	38	38	43	41	56	40	47	29	43	43
46 IdentP	22	13	28	28	20	29	32	22	13	08	21	14	17	16	19	20	07	28	30
47 PicGNS	62	54	53	50	47	54	54	49	35	45	39	46	52	66	52	54	28	57	56
48 NumbCl	28	35	38	25	33	46	30	33	38	42	39	45	38	47	36	30	14	42	30
49 WordEx	32	30	39	34	29	51	37	41	47	39	40	39	45	47	32	36	12	38	39
50 NumbRl	43	37	45	39	48	46	38	44	37	30	37	45	44	52	28	42	15	39	39
51 WordLk	64	41	48	47	49	48	53	51	47	43	33	52	49	64	33	44	22	44	50
52 FigCla	40	39	50	37	34	48	43	39	38	37	38	46	47	52	38	44	18	46	46
53 ClasNS	51	46	40	32	37	44	40	40	36	39	28	46	39	56	47	39	15	34	42
54 NecAOp	53	45	52	42	53	54	46	46	44	42	33	52	47	63	40	46	19	44	41
55 VerbA3	51	35	34	34	35	38	33	42	20	32	28	37	34	45	23	41	19	35	42
56 RmClM3	49	35	42	65	37	34	67	36	32	33	25	43	37	50	34	41	22	37	29

[a] Decimals have been omitted.

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Table C-2. (Continued)

Test	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38
21 BestWC	58																		
22 Omelet	36	44																	
23 PictGN	45	55	31																
24 ConWrd	31	44	47	29															
25 PerSpd	26	27	32	22	19														
26 LetTri	42	45	34	35	33	16													
27 LetCla	44	54	36	37	30	27	50												
28 PictCM	24	40	20	26	24	23	27	36											
29 Puzzle	49	62	40	54	40	19	49	52	37										
30 Spellg	40	64	58	46	49	29	40	46	27	56									
31 PictEx	46	46	25	41	37	18	36	46	30	52	34								
32 SensOr	60	66	40	55	42	25	46	60	39	66	52	58							
33 FigAna	54	53	34	48	37	36	49	57	31	59	44	57	64						
34 ScramS	42	48	33	39	30	15	30	44	29	42	36	33	55	42					
35 SameOp	55	72	39	49	39	30	44	60	43	60	57	48	71	57	46				
36 FigMat	46	54	34	47	37	24	53	60	34	62	43	47	63	61	45	54			
37 Remote	49	62	48	44	36	36	32	42	34	48	52	37	52	47	48	56	47		
38 NumbEx	31	31	11	35	17	26	36	50	24	34	24	26	37	40	22	35	45	20	
39 SentOr	46	49	38	43	32	19	39	59	27	50	43	43	59	45	36	55	50	37	41
40 Vocab	52	76	47	55	42	26	47	53	36	64	67	52	70	56	47	70	61	63	33
41 WordRl	50	58	50	51	43	28	60	57	26	62	57	45	62	63	42	61	66	53	42
42 VerbAn	59	66	49	55	38	31	44	54	35	59	57	50	65	62	49	65	61	63	42
43 BestTN	43	56	36	48	37	22	41	51	38	60	49	48	63	50	47	52	59	54	29
44 PictAr	38	44	27	31	29	11	18	26	26	39	34	43	38	31	20	38	32	36	18
45 ArithP	42	52	45	46	49	33	48	49	25	54	54	46	48	54	38	53	55	45	40
46 IdentP	14	20	27	18	25	44	14	27	24	26	20	23	23	36	20	19	24	22	16
47 PicGNS	55	69	34	55	35	20	37	50	34	60	52	56	67	56	42	63	55	55	36
48 NumbCl	38	41	23	26	24	21	41	57	33	42	38	36	46	48	36	45	55	37	52
49 WordEx	31	38	27	40	31	26	48	51	26	50	38	42	50	51	29	40	58	33	49
50 NumbRl	40	44	41	42	34	18	43	49	19	53	41	42	49	42	40	44	52	34	29
51 WordLk	48	60	40	48	32	31	49	44	42	47	44	42	52	46	39	50	53	58	24
52 FigCla	42	45	28	39	29	27	39	47	26	52	38	44	52	54	40	47	50	41	44
53 ClasNS	46	61	38	44	36	21	39	50	31	50	54	44	64	52	47	54	48	41	36
54 NecAOp	53	54	45	45	37	30	48	53	32	57	51	44	59	52	48	59	59	47	44
55 VerbA3	34	46	25	37	24	16	34	35	15	40	36	45	44	38	24	44	43	38	26
56 RmClM3	40	47	34	38	31	26	31	34	39	44	39	36	42	35	33	46	46	44	18

Test	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55
40 Vocab	58																
41 WordRl	54	65															
42 VerbAn	53	57	70														
43 BestTN	48	62	64	62													
44 PictAr	33	45	39	50	36												
45 ArithP	42	54	64	54	43	40											
46 IdentP	11	27	25	22	29	06	27										
47 PicGNS	56	72	56	64	58	38	52	30									
48 NumbCl	54	46	53	53	44	22	40	15	47								
49 WordEx	46	48	61	46	47	18	48	18	49	57							
50 NumbRl	40	40	53	52	44	30	58	13	46	38	45						
51 WordLk	36	61	55	62	59	32	46	26	58	34	44	48					
52 FigCla	48	48	54	56	53	23	39	23	55	51	49	45	52				
53 ClasNS	51	60	51	63	50	26	44	18	64	54	48	46	56	57			
54 NecAOp	49	59	61	64	55	25	55	18	56	51	53	61	58	60	68		
55 VerbA3	34	49	41	46	47	33	39	11	49	28	36	34	54	38	38	43	
56 RmClM3	30	45	46	52	45	30	40	24	45	26	28	36	47	40	38	42	32

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Appendix D
Factor Results for Each Solution

Table D-1
Alpha Derived Orthogonal Common Factors[a]
$\underline{N}$ = 172 Boys

Test		1	2	3	4	5	6	7	8	9
1	PictMn	56				31				
2	VerbCl	39			30					
3	NumbSe	42	50		39					
4	RemClM	41		71						
5	NumClE		36			32				32
6	WordGp	44	55							
7	RmClM2	35	30	73						
8	Disvow	41	52		34					
9	LetGrp		58							
10	CirRea		36	35						
11	FigExc		51			34				
12	SeeTnd		49							43
13	PictCl					55				
14	ParaCp	57	39							33
15	RemClN	53	39							
16	WdGpNm	52			42	32				
17	Gestal							73		
18	CardRt		48							
19	SpatRl		36			37		35		
20	VerbEx	42	45		30					
21	BestWC	67								
22	Omelet	42			56					
23	PictGN	57			38					
24	ConWrd				53					
25	PerSpd						77			
26	LetTri		70							
27	LetCla		66							
28	PictCM		34	39						
29	Puzzle	64	43							
30	Spellg	51	34		50					
31	PictEx		38			49				
32	SensOr	51	53							
33	FigAna	36	49							
34	ScramS	49								
35	SameOp	62								
36	FigMat		57							
37	Remote	62								
38	NumbEx		58							
39	SentOr	41	53							
40	Vocab	76								
41	WordRl	43	51						31	
42	VerbAn	69	38							
43	BestTN	56		35		30				
44	PictAr								44	
45	ArithP	39	36		38					
46	IdentP						58			
47	PicGNS	65	36							
48	NumbCl	34	66							
49	WordEx	35	63							
50	NumbRl	30	45		36					
51	WordLk	59								

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Table D-1. (Continued)

Test	1	2	3	4	Factors 5	6	7	8	9
52 FigCla	37	60							
53 ClasNS	61	44							
54 NecAOp	52	45							
55 VerbA3	49				32				
56 RmClM3	37		56						

[a] Includes coefficients greater than .300 (absolute).
Decimals have been omitted.

Table D-2
Harris R-S^2 Derived Orthogonal Common Factors[a]
$\underline{N}$ = 172 Boys

Test	1	2	3	4	5	6	Factors 7	8	9	10	11	12	13
1 PictMn	64												
2 VerbCl	38												
3 NumbSe	39	35		32									
4 RemClM	39	.	76										
5 NumClE		41			43								
6 WordGp	39	43											
7 RmClM2	31		76										
8 Disvow	41	35		31									
9 LetGrp		58											
10 CirRea													
11 FigExc													
12 SeeTnd		35				40							
13 PictCl			.						63				
14 ParaCp	60												
15 RemClN	42						46						
16 WdGpNm	51												46
17 Gestal										71			
18 CardRt		36											
19 SpatRl										34			
20 VerbEx	40												
21 BestWC	68												
22 Omelet	42			49									
23 PictGN	50												46
24 ConWrd				68									
25 PerSpd								69					
26 LetTri		63											
27 LetCla		73											
28 PictCM													
29 Puzzle	60						37						
30 Spellg	53			50									
31 PictEx									45				
32 SensOr	42	38											
33 FigAna	32												
34 ScramS	36												
35 SameOp	58												

Table D-2. (Continued)

Test	1	2	3	4	5	6	Factors 7	8	9	10	11	12	13
36 FigMat		39											
37 Remote	71												
38 NumbEx						58							
39 SentOr	33						57						
40 Vocab	76												
41 WordR1	49	34										32	
42 VerbAn	62												
43 BestTN	54		39										
44 PictAr												58	
45 ArithP	35				59								
46 IdentP								67					
47 PicGNS	57												
48 NumbCl		44											
49 WordEx	31	37				50							
50 NumbR1	32				44								
51 WordLk	60												
52 FigCla		40									56		
53 ClasNS	53										46		
54 NecAOp	44				47								
55 VerbA3	38												
56 RmClM3	32		59										

[a] Includes coefficients greater than .300 (absolute). Decimals have been omitted.

The 12 specific factors are for tests numbered: 2, 6, 10, 11, 18, 19, 20, 28, 33, 34, 48, and 55.

Table D-3
UMLFA Derived Orthogonal Common Factors[a]
$\underline{N} = 172$ Boys

Test	1	2	3	4	5	Factors 6	7	8	9	10	11
1 PictMn			70								
2 VerbCl	32		45								
3 NumbSe	50		43			35					
4 RemClM		79	40								
5 NumClE	41						55				
6 WordGp	57		42								
7 RmClM2	21	77	36								
8 Disvow	52		42			31					
9 LetGrp	58										
10 CirRea	38										
11 FigExc	47										
12 SeeTnd	49						31			31	
13 PictCl			36								
14 ParaCp	40		54							34	
15 RemClN	40		49								
16 WdGpNm			62								
17 Gestal				56							

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Table D-3. (Continued)

Test	Factors										
	1	2	3	4	5	6	7	8	9	10	11
18 CardRt	49										
19 SpatRl	34			49							
20 VerbEx	43		43			31					
21 BestWC			71								
22 Omelet			40			53					
23 PictGN			64								
24 ConWrd				32		64					
25 PerSpd					72						
26 LetTri	75								-31		
27 LetCla	68										
28 PictCM	37	34									
29 Puzzle	44		58							33	
30 Spellg	32		53			52					
31 PictEx	39		35	38							
32 SensOr	55		47								
33 FigAna	51		38								31
34 ScramS			46						42		
35 SameOp			58								
36 FigMat	60		32	32							
37 Remote			62								
38 NumbEx	51										
39 SentOr	50		36							33	
40 Vocab			79								
41 WordRl	52		43								45
42 VerbAn	36		64								
43 BestTN	31	34	58								
44 PictAr											44
45 ArithP	32		34				43	36			
46 IdentP					55						
47 PicGNS	42		64								
48 NumbCl	67										
49 WordEx	58										
50 NumbRl	42		31				36				
51 WordLk			54								
52 FigCla	59		31					34			
53 ClasNS	40		55					47			
54 NecAOp	42		50					38			
55 VerbA3			47								
56 RmClM3		52	41								

[a] Includes coefficients greater than .300 (absolute).
Decimals have been omitted.

Table D-4
Alpha Derived Oblique Factors (A'A Proportional to L Solution)[a]
$\underline{N}$ = 172 Boys

Test	Factors 1	2	3	4	5	6	7	8	9
1 PictMn	37	-37					34		
2 VerbCl									
3 NumbSe						36			
4 RemClM				76					
5 NumClE								39	
6 WordGp		43							
7 RmClM2				.78					
8 Disvow						31			
9 LetGrp		52							
10 CirRea								31	
11 FigExc		36					35		
12 SeeTnd								51	
13 PictCl							57		
14 ParaCp	49							33	
15 RemClN	47								
16 WdGpNm						45	30		
17 Gestal									74
18 CardRt		36							
19 SpatR1							40		
20 VerbEx									
21 BestWC	48								
22 Omelet						66			
23 PictGN	31					43			
24 ConWrd						55			
25 PerSpd			77						
26 LetTrl		55							
27 LetCla		60							
28 PictCM				39					
29 Puzzle	65								
30 Spellg						56			
31 PictEx							52		
32 SensOr		39							
33 FigAna									
34 ScramS	35				-32				
35 SameOp	52								
36 FigMat		30							
37 Remote	45								
38 NumbEx		31			31				
39 SentOr	40								
40 Vocab	60								
41 WordR1									
42 VerbAn	54								
43 BestTN	34			30					
44 PictAr					40				
45 ArithP						36		31	
46 IdentP			53						
47 PicGNS	59								
48 NumbCl		52							
49 WordEx		44							
50 NumbR1						31			
51 WordLk	53								
52 FigCla	31	39							

Test		1	2	3	4	5	6	7	8	9
53 ClasNS		55								
54 NecAOp		34								
55 VerbA3		38								
56 RmClM3					55					

Correlations of factors:										
	2	37								
	3	08	12							
	4	46	30	09						
	5	22	31	02	16					
	6	49	32	12	32	16				
	7	40	30	08	37	18	36			
	8	33	36	06	33	19	26	28		
	9	05	13	16	08	10	12	18	10	.

[a] Includes coefficients greater than .300 (absolute).
  Decimals have been omitted.

Table D-5
Harris R-S ^{2} Derived Oblique Factors (A'A Proportional to L Solution)[a]
$\underline{N} = 172$ Boys

							Factors						
Test	1	2	3	4	5	6	7	8	9	10	11	12	13
1 PictMn	46										35		
2 VerbCl													
3 NumbSe													
4 RemClM				77									
5 NumClE		34							43				
6 WordGp		31											
7 RmClM2				75									
8 Disvow													
9 LetGrp		53											
10 CirRea													
11 FigExc													37
12 SeeTnd													
13 PictCl								64					
14 ParaCp	41												
15 RemClN							52						
16 WdGpNm											59		
17 Gestal					70								
18 CardRt													
19 SpatR1													
20 VerbEx													
21 BestWC	48												
22 Omelet						45							
23 PictGN											57		
24 ConWrd						67							
25 PerSpd			69										
26 LetTri		56											

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Table D-5. (Continued)

Test	1	2	3	4	5	6	Factors 7	8	9	10	11	12	13
27 LetCla		69											
28 PictCM													
29 Puzzle	35						43						
30 Spellg						46							
31 PictEx								43					
32 SensOr													
33 FigAna													
34 ScramS													
35 SameOp	48												
36 FigMat													
37 Remote	63												
38 NumbEx													55
39 SentOr							64						
40 Vocab	47												
41 WordRl	35												
42 VerbAn	33												
43 BestTN	34			32									
44 PictAr												56	
45 ArithP									62				
46 IdentP			64										
47 PicGNS	32												
48 NumbCl		30											
49 WordEx													50
50 NumbRl									45				
51 WordLk	39												
52 FigCla										61			
53 ClasNS										49			
54 NecAOp									48				
55 VerbA3													
56 RmClM3				55									

Correlations
of Factors:

	1	2	3	4	5	6	7	8	9	10	11	12
2	21											
3	02	10										
4	36	27	07									
5	03	13	15	07								
6	29	26	10	16	14							
7	42	33	12	30	05	25						
8	27	22	03	27	14	18	16					
9	36	33	14	33	10	32	33	23				
10	35	32	07	24	08	22	35	15	31			
11	46	20	10	30	11	31	29	28	34	25		
12	25	20	02	23	13	15	21	25	19	19	15	
13	25	37	05	23	08	21	34	17	31	29	12	22

[a] Includes coefficients greater than .300 (absolute). Decimals have been omitted.

Table D-6
UMLFA Derived Oblique Factors (A'A Proportional to L Solution)[a]
$\underline{N}$ = 172 Boys

Test	1	2	3	4	5	6	7	8	9	10	11
1 PictMn	70										
2 VerbCl											
3 NumbSe											
4 RemClM				85							
5 NumClE							59				
6 WordGp		30									
7 RmClM2				80							
8 Disvow											
9 LetGrp								30			
10 CirRea											
11 FigExc										30	
12 SeeTnd							33				37
13 PictCl											
14 ParaCp											44
15 RemClN											
16 WdGpNm	44										
17 Gestal			54								
18 CardRt											
19 SpatR1			42								
20 VerbEx											
21 BestWC	47										
22 Omelet						53					
23 PictGN	43										
24 ConWrd						70					
25 PerSpd					72						
26 LetTri		76									
27 LetCla		51									
28 PictCM				32							
29 Puzzle											45
30 Spellg						47					
31 PictEx			31					33			
32 SensOr								31			
33 FigAna										41	
34 ScramS								51			
35 SameOp									31		
36 FigMat											
37 Remote	37										
38 NumbEx											35
39 SentOr											43
40 Vocab	53										
41 WordR1										51	
42 VerbAn									33		
43 BestTN				30							
44 PictAr										43	
45 ArithP							50		35		
46 IdentP					51						
47 PicGNS	36							36			
48 NumbCl								42			
49 WordEx											
50 NumbR1							40				
51 WordLk											33
52 FigCla									48		

61

Test	1	2	3	4	5	Factors 6	7	8	9	10	11
53 ClasNS									64		
54 NecAOp							33		48		
55 VerbA3								34			
56 RmClM3				50							

Correlations
of factors:

		2	3	4	5	6	7	8	9	10
2	10									
3	02	13								
4	35	26	07							
5	08	11	11	08						
6	33	26	06	21	11					
7	26	30	14	33	12	30				
8	35	33	07	37	07	29	35			
9	36	37	03	33	12	35	31	40		
10	28	37	17	31	03	26	31	3̇6	36	
11	29	32	01	33	03	23	29	34	39	32

[a] Includes coefficients greater than .300 (absolute).
Decimals have been omitted.

Table D-7
Alpha Derived Oblique Factors (Independent Cluster Solution)[a]
$\underline{N}$ = 172 Boys

Test	1	2	3	4	Factors 5	6	7	8	9
1 PictMn	34	-57			44				
2 VerbCl						33			
3 NumbSe						43			
4 RemClM				94					
5 NumClE	-36				33			49	
6 WordGp	48	36							
7 RmClM2				98					
8 Disvow						36			
9 LetGrp		50			38				
10 CirRea								40	
11 FigExc					64				
12 SeeTnd								66	
13 PictCl					96				
14 ParaCp	74							39	
15 RemClN	78								
16 WdGpNm					43	57			
17 Gestal									76
18 CardRt					51				
19 SpatRl					69				
20 VerbEx						31			
21 BestWC	62								
22 Omelet					-32	97			
23 PictGN						52			

Table D-7. (Continued)

Test	1	2	3	4	5	6	7	8	9
24 ConWrd	-41					81			
25 PerSpd			80						
26 LetTri		43					34		
27 LetCla		61							
28 PictCM	37			45		-36			
29 Puzzle	112				-32				
30 Spellg						78			
31 PictEx					89				
32 SensOr	41	34				30			
33 FigAna					46				
34 ScramS	46						-46		
35 SameOp	82								
36 FigMat					37				
37 Remote	58								
38 NumbEx							38		
39 SentOr	71				-38				
40 Vocab	84								
41 WordRl					32		32		
42 VerbAn	77								
43 BestTN	38				38				
44 PictAr		-39			33		45		
45 ArithP						48		37	
46 IdentP			52						
47 PicGNS	98								
48 NumbCl	53	45							
49 WordEx	45	33							
50 NumbRl						40			
51 WordLk	78								
52 FigCla	57								
53 ClasNS	91								
54 NecAOp	44								
55 VerbA3	53				42		-39		
56 RmClM3				62					

Correlations
of factors:
	1	2	3	4	5	6	7	8
2	59							
3	20	22						
4	79	47	19					
5	85	58	22	75				
6	85	52	25	67	79			
7	54	62	12	40	53	46		
8	74	60	17	68	72	65	52	
9	14	21	31	14	28	20	21	19

a Includes coefficients greater than .300 (absolute)
  Decimals have been omitted.

Table D-8
Harris R-S^2 Derived Oblique Factors (Independent Cluster Solution)[a]
$\underline{N}$ = 172 Boys

Test							Factors						
	1	2	3	4	5	6	7	8	9	10	11	12	13
1 PictMn	75						42						
2 VerbCl													
3 NumbSe									31				
4 RemClM				93									
5 NumClE		48							68				
6 WordGp		41											
7 RmClM2				90									
8 Disvow													
9 LetGrp		76											
10 CirRea													
11 FigExc													49
12 SeeTnd													
13 PictCl								80					
14 ParaCp	66												
15 RemClN											78		
16 WoGpNm							84						
17 Gestal					75								
18 CardRt		41											
19 SpatRl													
20 VerbEx													
21 BestWC	77												
22 melet						50							
23 PictGN							82						
24 ConWrd						81							
25 PerSpd			71										
26 LetTri		79											
27 LetCla		101											
28 PictCM													
29 Puzzle	53										58		
30 Spellg	48					51							
31 PictEx								50					
32 SensOr													
33 FigAna													
34 ScramS	31												
35 SameOp	85									31			
36 FigMat													
37 Remote	112												76
38 NumbEx													
39 SentOr											98		
40 Vocab	73												
41 WordRl	58											30	
42 VerbAn	46												
43 BestTN	54												
44 PictAr												72	
45 ArithP									100				
46 IdentP			64										
47 PicGNS	47						31						
48 NumbCl		36											
49 WordEx													71
50 NumbRl									70				
51 WordLk	61								36				
52 FigCla										82			

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Table D-8. (Continued)

Test	1	2	3	4	5	6	7	8	9	10	11	12	13
							Factors						
53 ClasNS										61			
54 NecAOp									74				
55 VerbA3	38												
56 RmClM3				64									

Correlations of factors:		1	2	3	4	5	6	7	8	9	10	11	12
	2	69												
	3	13	21											
	4	72	62	16										
	5	25	36	32	25									
	6	63	60	22	42	35								
	7	83	62	23	65	33	64							
	8	64	57	12	59	36	47	64						
	9	81	76	26	69	34	67	76	61					
	10	73	72	17	56	28	54	62	47	71				
	11	82	75	23	65	26	59	69	52	77	74			
	12	64	58	10	57	35	45	53	61	59	54	59		
	13	67	76	01	56	27	53	51	50	71	68	73	58	

[a] Includes coefficients greater than .300 (absolute). Decimals have been omitted.

Table D-9
UMLFA Derived Oblique Factors (Independent Cluster Solution)[a]
$\underline{N}$ = 172 Boys

Test	1	2	3	4	5	6	7	8	9	10	11
					Factors						
1 PictMn	86										
2 VerbCl											
3 NumbSe			36								
4 RemClM				103							
5 NumClE							83		-31		
6 WordGp								51			
7 RmClM2				95							
8 Disvow											
9 LetGrp								65			
10 CirRea			33								30
11 FigExc			43					33			
12 SeeTnd							41				48
13 PictCl			30					58			
14 ParaCp											61
15 RemClN											43
16 WdGpNm	50							41			
17 Gestal										56	
18 CardRt								43			
19 SpatRl									52	35	-32
20 VerbEx									32		
21 BestWC	48										
22 Omelet						64					

65

Test	1	2	3	4	5	Factors 6	7 ·	8	9	10	11
23 PictGN	48		34					32	38		
24 ConWrd						91					
25 PerSpd					75						
26 LetTri		94									
27 LetCla		52						54			
28 PictCM				35							
29 Puzzle											67
30 Spellg						53					
31 PictEx								71			
32 SensOr								61			
33 FigAna			56								-39
34 ScramS		-41						101			
35 SameOp								45	36	-31	
36 FigMat			33								
37 Remote	35										
38 NumbEx	-44		37						37		38
39 SentOr											61
40 Vocab	54										41
41 WordR1			84								
42 VerbAn									43		
43 BestTN								47			
44 PictAr			81								
45 ArithP							69		56		
46 IdentP					49						
47 PicGNS	34							74			
48 NumbC1	-39							89			
49 WordEx	-30							48			
50 NumbR1							53				
51 WordLk											42
52 FigCla									76		
53 ClasNS									107		
54 NecAOp							41		74		
55 VerbA3								69			
56 RmClM3				52			30				

Correlations
of factors:

	1	2	3	4	5	6	7	8	9	10
2	31									
3	61	72								
4	62	52	68							
5	19	26	17	19						
6	62	56	65	51	25					
7	57	63	75	67	28	66				
8	69	71	85	75	24	71	80			
9	67	70	81	68	27	73	74	87		
10	16	04	01	08	16	08	02	08	13	
11	63	62	75	69	16	61	69	81	80	22

a Includes coefficients greater than .300 (absolute).
Decimals have been omitted.

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Table D-10
Alpha Derived Orthogonal Common Factors[a]
$\underline{N}$ = 210 Girls

Test	Factors 1	2	3	4	5	6	7	8	9
1 PictMn	55		57						
2 VerbCl	55								
3 NumbSe		33						39	
4 RemClM	31						54		31
5 NumClE		30	32						
6 WordGp		46							
7b									
8 Disvow	37			47					
9 LetGrp		40						48	
10 CirRea	36	35							
11 FigExc		37							
12 SeeTnd		37	33					37	
13 PictCl		34	31		37				
14 ParaCp	51	-38	45						
15 RemClN	54								
16 WdGpNm	57								37
17 Gestal					50				
18 CardRt	32	37			35				
19 SpatRl		31			39				
20 VerbEx	50								
21 BestWC	63			32					
22 Omelet				64					
23 PictGN	53								34
24 ConWrd				53	34				
25 PerSpd						63			
26 LetTri		48		32					
27 LetCla		60							
28 PictCM							50		
29 Puzzle	43	40							
30 Spellg	50			56					
31 PictEx	33	32	31		50				
32 SensOr	60	42							
33 FigAna	38	46				32		34	
34 ScramS	35								
35 SameOp	56	34							
36 FigMat		55							
37 Remote	50		30						
38 NumbEx		66							
39 SentOr	50	54							
40 Vocab	62		34	34					
41 WordRl	33	51		44					
42 VerbAn	51	39	37						
43 BestTN	39	35	38						
44 PictAr	39				39				
45 ArithP		41		48	32				
46 IdentP						64			
47 PicGNS	57	36	35						
48 NumbCl		71							
49 WordEx		66							
50 NumbRl		43	36	:					
51 WordLk			60						
52 FigCla		52	30						
53 ClasNS	47	47							

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Table D-10. (Continued)

Test					Factors				
	1	2	3	4	5	6	7	8	9
54 NecAOp		54	38						
55 VerbA3			48						
56 RmClM3			30				48		

[a] Includes coefficients greater than .300 (absolute). Decimals have been omitted.

[b] Variable No. 7 was omitted from this analysis.

Table D-11
Harris R-S^2 Derived Orthogonal Common Factors[a]
$\underline{N}$ = 210 Girls

Test							Factors						
	1	2	3	4	5	6	7	8	9	10	11	12	13
1 PictMn	76												
2 VerbCl	38												
3 NumbSe									55				
4 RemClM				60									
5 NumClE											57		
6 WordGp		37											
7b													
8 Disvow	35		46										
9 LetGrp		33						36					
10 CirRea		31											
11 FigExc		34						39					
12 SeeTnd	34	32							33				
13 PictCl						65							
14 ParaCp	61												
15 RemClN													54
16 WdGpNm	37			61									
17 Gestal													
18 CardRt													
19 SpatR1								60					
20 VerbEx	34												
21 BestWC	66												
22 Omelet			67										
23 PictGN	36			62									
24 ConWrd			51										
25 PerSpd							55						
26 LetTri		39											
27 LetCla		54											
28 PictCM													
29 Puzzle	40	32											
30 Spellg	52		54										
31 PictEx						42							
32 SensOr	43	33								34			
33 FigAna		38							34				
34 ScramS										56			
35 SameOp	52	30											
36 FigMat		49											

Table D-11. (Continued)

Test							Factors						
	1	2	3	4	5	6	7	8	9	10	11	12	13
37 Remote	52												30
38 NumbEx		70											
39 SentOr		49											
40 Vocab	72												
41 WordR1	30	47	35										
42 VerbAn	48	37											
43 BestTN	41	30											
44 PictAr	35												
45 ArithP		33	39								40		
46 IdentP							70						
47 PicGNS	58	31											
48 NumbCl		73											
49 WordEx		62											
50 NumbR1			33								35		
51 WordLk	50												
52 FigCla		45										37	
53 ClasNS	45	39										49	
54 NecAOp	35	43										36	
55 VerbA3	43												
56 RmClM3					62								

The 14 specific factors are for tests numbered: 2, 10, 15, 17, 18, 20, 26, 28, 29, 37, 39, 43, 44, and 55.

a Includes coefficients greater than .300 (absolute). Decimals have been omitted.

b Variable No. 7 was omitted from this analysis.

Table D-12
UMLFA Derived Orthogonal Common Factors[a]
$\underline{N}$ = 210 Girls

Test					Factors					
	1	2	3	4	5	6	7	8	9	10
1 PictMn					76					
2 VerbCl						42				
3 NumbSe		34	32						31	
4 RemClM	85									
5 NumClE		32	30							
6 WordGp			44							
7b										
8 Disvow		47								
9 LetGrp			39						45	
10 CirRea			36							
11 FigExc			39					35		
12 SeeTnd			37							40
13 PictCl										
14 ParaCp			37		56					
15 RemClN						49				
16 WdGpNm					31		62			
17 Gestal									38	

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Table D-12. (Continued)

Test				Factors						
	1	2	3	4	5	6	7	8	9	10
18 CardRt			36		31				33	
19 SpatRl			30						61	
20 VerbEx						40				
21 BestWC					52	47				
22 Omelet		64								
23 PictGN							68			
24 ConWrd		53								
25 PerSpd								64		
26 LetTri			49							31
27 LetCla			56			36				
28 PictCM	33									
29 Puzzle		32	38		31	31				
30 Spellg		55			41	32				
31 PictEx									47	
32 SensOr			35			53				
33 FigAna			43			31			34	
34 ScramS						33				
35 SameOp			32		36	51				
36 FigMat			56							
37 Remote					45	32				30
38 NumbEx			69							
39 SentOr			49			47				
40 Vocab		31	31		61	44				
41 WordRl		45	53							
42 VerbAn			38		43					
43 BestTN			35		40					
44 PictAr					,35				32	
45 ArithP		55	42							
46 IdentP								66		
47 PicGNS			34		46	39			33	
48 NumbCl			70							
49 WordEx			66							
50 NumbRl		41	39							
51 WordLk					57					38
52 FigCla			48							
53 ClasNS			37	67	31	37				
54 NecAOp		34	48	33	31					
55 VerbA3					46					
56 RmClM3	49									

The 3 specific factors are for tests numbered: 13, 42, and 43.

[a] Includes coefficients greater than .300 (absolute). Decimals have been omitted.

[b] Variable No. 7 was omitted from this analysis.

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Table D-13
Alpha Derived Oblique Factors (A'A Proportional to L Solution)[a]
$\underline{N}$ = 210 Girls

Test	Factors								
	1	2	3	4	5	6	7	8	9
1 PictMn	62								
2 VerbCl							33		
3 NumbSe									41
4 RemClM								58	
5 NumClE									
6 WordGp									
7b									
8 Disvow				40					
9 LetGrp									55
10 CirRea									
11 FigExc					34				
12 SeeTnd	35								40
13 PictCl					39				
14 ParaCp	46								
15 RemClN						46			
16 WdGpNm							55		
17 Gestal					39				
18 CardRt					37				
19 SpatRl					43				
20 VerbEx									
21 BestWC						39			
22 Omelet				61					
23 PictGN							52		
24 ConWrd				58					
25 PerSpd			63						
26 LetTri		31							32
27 LetCla		43							
28 PictCM								46	
29 Puzzle									
30 Spellg				49					
31 PictEx					56				
32 SensOr						52			
33 FigAna									32
34 ScramS						34			
35 SameOp						41			
36 FigMat		35							
37 Remote	33								
38 NumbEx		65							
39 SentOr		49				39			
40 Vocab	34					39			
41 WordRl		31		35					
42 VerbAn	35								
43 BestTN	37								
44 PictAr					31				
45 ArithP				47					
46 IdentP			61						
47 PicGNS					31	33			
48 NumbCl		64							
49 WordEx		56							
50 NumbRl	30								
51 WordLk	63								
52 FigCla		35							

Table D-13. (Continued)

Test		Factors 1	2	3	4	5	6	7	8	9
53 ClasNS		33	31				39			
54 NecAOp		38	39							
55 VerbA3		46								
56 RmClM3									45	

Correlations of factors:		1	2	3	4	5	6	7	8
	2	35							
	3	15	16						
	4	40	27	17					
	5	33	33	15	24				
	6	44	37	13	36	32			
	7	38	25	12	32	30	37		
	8	32	17	18	25	27	28	26	
	9	34	43	21	32	32	30	25	24

[a] Includes coefficients greater than .300 (absolute). Decimals have been omitted.

[b] Variable No. 7 was omitted from this analysis.

Table D-14
Harris R-S^2 Derived Oblique Factors (A'A Proportional to L Solution)[a]
$\underline{N}$ = 210 Girls

Test	1	2	3	4	5	6	Factors 7	8	9	10	11	12	13
1 PictMn	67												
2 VerbCl													
3 NumbSe													61
4 RemClM						59							
5 NumClE											57		
6 WordGp													
7b													
8 Disvow				38									
9 LetGrp							32						
10 CirRea													
11 FigExc							34						
12 SeeTnd													33
13 PictCl									65				
14 ParaCp	44												
15 RemClN												54	
16 WdGpNm					62								
17 Gestal													
18 CardRt													
19 SpatR1							62						
20 VerbEx													
21 BestWC	52												
22 Omelet				65									
23 PictGN					64								

Table D-14. (Continued)

Test	1	2	3	4	5	6	7	8	9	10	11	12	13
							Factorsᵇ						
24 ConWrd				48									
25 PerSpd			50										
26 LetTri													
27 LetCla		41											
28 PictCM													
29 Puzzle													
30 Spellg	36			47									
31 PictEx									38				
32 SensOr													36
33 FigAna								55					
34 ScramS													
35 SameOp	38												
36 FigMat		37											
37 Remote	40												
38 NumbEx		66											
39 SentOr		38											
40 Vocab	64												
41 WordR1		31											
42 VerbAn													
43 BestTN													
44 PictAr													
45 ArithP											38		
46 IdentP			68										
47 PicGNS	41												
48 NumbC1		65											
49 WordEx		54											
50 NumbR1											31		
51 WordLk	33												
52 FigCla										44			
53 ClasNS										60			
54 NecAOp										43			
55 VerbA3	35												
56 RmClM3						62							

Correlations
of factors:

	1	2	3	4	5	6	7	8	9	10	11	12
2	25											
3	10	11										
4	36	21	15									
5	40	25	09	25								
6	34	17	17	24	31							
7	28	31	17	15	28	23						
8	32	25	05	24	22	20	17					
9	27	27	14	10	21	23	30	19				
10	40	39	08	25	25	24	28	34	30			
11	26	27	09	29	22	26	25	21	25	25		
12	30	28	08	19	29	19	19	25	22	24	07	
13	33	40	20	33	28	26	39	34	30	25	28	26

ᵃ Includes coefficients greater than .300 (absolute). Decimals have been omitted.
ᵇ Variable No. 7 was omitted from this analysis.

Table D-15
UMLFA Derived Oblique Factors (A'A Proportional to L Solution)[a]
$\underline{N}$ = 210 Girls

Test	Factors										
	1	2	3	4	5	6	7	8	9	10	11
1 PictMn	73										
2 VerbCl											
3 NumbSe											
4 RemClM							89				
5 NumClE											
6 WordGp											
7b											
8 Disvow				36							
9 LetGrp									44		
10 CirRea											
11 FigExc											30
12 SeeTnd									42		
13 PictCl						71					
14 ParaCp	46										
15 RemClN					38						
16 WdGpNm								64			
17 Gestal											
18 CardRt						34					
19 SpatR1											66
20 VerbEx					30						
21 BestWC	40				36						
22 Omelet				56							
23 PictGN								71			
24 ConWrd				53							
25 PerSpd			62								
26 LetTri									33		
27 LetCla		39									
28 PictCM											
29 Puzzle											
30 Spellg	33			42							
31 PictEx						38					
32 SensOr					40						
33 FigAna											
34 ScramS											
35 SameOp					45						
36 FigMat		37									
37 Remote	36										
38 NumbEx		66									
39 SentOr		42			33						
40 Vocab	55										
41 WordR1		33		37							
42 VerbAn											
43 BestTN											
44 PictAr	33										
45 ArithP				56							
46 IdentP			63								
47 PicGNS	33										
48 NumbCl		63									
49 WordEx		53									
50 NumbR1				41							
51 WordLk	43								40		
52 FigCla											

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	Factors										
Test	1	2	3	4	5	6	7	8	9	10	11
53 ClasNS										79	
54 NecAOp										37	
55 VerbA3	40										
56 RmClM3							47				

Correlations of factors:		1	2	3	4	5	6	7	8	9	10
	2	22									
	3	11	13								
	4	37	30	17							
	5	37	30	13	34						
	6	30	33	12	24	28					
	7	32	17	18	27	26	27				
	8	38	28	09	31	34	26	28			
	9	30	35	16	34	25	25	23	24		
	10	36	35	09	27	32	27	19	25	28	
	11	25	29	14	24	24	36	21	27	22	18

[a] Includes coefficients greater than .300 (absolute). Decimals have been omitted.
[b] Variable No. 7 was omitted from this analysis.

Table D-16
Alpha Derived Oblique Factors (Independent Cluster Solution)[a]
$\underline{N}$ = 210 Girls

	Factors								
Test	1	2	3	4	5	6	7	8	9
1 PictMn		-32			99				-36
2 VerbC						38	40		
3 NumbSe									57
4 RemClM								63	
5 NumClE					45	-31			
6 WordGp	30								35
7b									
8 Disvow				33					35
9 LetGrp									85
10 CirRea									32
11 FigExc				-42			40		33
12 SeeTnd					49				58
13 PictCl	34			-36	40				
14 ParaCp					66				
15 RemClM					-49	70			
16 WdGpNm							75		
17 Gestal	83				-31				
18 CardRt	31			30					
19 SpatR1	40								
20 VerbEx						41			
21 BestWC						51			
22 Omclet				69					
23 PictGN							72		

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Table D-16. (Continued)

					Factors				
Test	1	2	3	4	5	6	7	8	9
24 ConWrd	70			44					
25 PerSpd			70						
26 LetTri									44
27 LetCla		54							
28 PictCM						40	-38	46	
29 Puzzle									
30 Spellg				62					
31 PictEx	62				38				
32 SensOr						75			
33 FigAna									40
34 ScramS						50			36
35 SameOp						54			
36 FigMat		37							
37 Remote		-34			35	38			
38 NumbEx		94							
39 SentOr		78			-43	43			-32
40 Vocab					40	46			
41 WordR1									
42 VerbAn					44				
43 BestTN					55				
44 PictAr	54								-39
45 ArithP	49	34				-55			
46 IdentP			72						
47 PicGNS					42	46			
48 NumbC1		91							
49 WordEx		72							
50 NumbR1					55	-41			
51 WordLk					110				
52 FigCla		39			42				
53 ClasNS		35			42	49			
54 NecAOp		43			59				
55 VerbA3					87				
56 RmClM3								48	

		1	2	3	4	5	6	7	8
Correlations	2	72							
of factors	3	51	47						
	4	55	51	36					
	5	80	79	50	65				
	6	77	76	46	62	85			
	7	75	67	44	58	80	78		
	8	54	40	42	43	58	56	53	
	9	74	81	54	55	79	72	67	48

a Includes coefficients greater than .300 (absolute). Decimals have been omitted.

b Variable No. 7 was omitted from this analysis.

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Table D-17
Harris R-S^2 Derived Oblique Factors (Independent Cluster Solution)[a]
$\underline{N}$ = 210 Girls

Test	1	2	3	4	5	6	7	8	9	10	11	12	13
1 PictMn	105												
2 VerbCl													
3 NumbSe													105
4 RemClM						76							
5 NumClE												77	
6 WordGp													43
7b													
8 Disvow				46			38						
9 LetGrp	-31						47						30
10 CirRea													
11 FigExc							47						
12 SeeTnd													46
13 PictCl									87				
14 ParaCp	63												
15 RemClN								73					
16 WdGpNm					81								
17 Gestal													
18 CardRt													
19 SpatRl							98						
20 VerbEx													
21 BestWC	77												
22 Omelet				91									
23 PictGN					83								
24 ConWrd				69									
25 PerSpd			49										
26 LetTri		39											
27 LetCla		58											
28 PictCM													
29 Puzzle													
30 Spellg	48			58									
31 PictEx										47			
32 SensOr											34		
33 FigAna													55
34 ScramS											79		
35 SameOp	56												30
36 FigMat		54											
37 Remote	61												
38 NumbEx		102											
39 SentOr		53						35					
40 Vocab	103												
41 WordRl		40											32
42 VerbAn													
43 BestTN	32												
44 PictAr	42												
45 ArithP				31								48	
46 IdentP			70										
47 PicGNS	58												
48 NumbCl		98											
49 WordEx		82											
50 NumbRl	-41			34								33	
51 WordLk	41									36			
52 FigCla										64			
53 ClasNS										88			
54 NecAOp										60			
55 VerbA3	52												
56 RmClM3						82							

Table D-17. (Continued)

Correlations of factors:	1	2	3	4	5	6	7	8	9	10	11	12	13
2	71												
3	24	26											
4	76	63	31										
5	77	64	22	63									
6	73	58	32	63	67								
7	74	76	34	60	69	64							
8	71	68	21	57	66	56	62						
9	66	67	28	48	57	60	72	59					
10	79	79	20	65	63	62	71	64	68				
11	74	68	17	64	60	58	61	64	58	73			
12	68	67	23	67	59	54	66	45	62	64	60		
13	77	81	36	73	68	66	81	67	70	70	74	69	

[a] Includes coefficients greater than .300 (absolute). Decimals have been omitted.

[b] Variable No. 7 was omitted from this analysis.

Table D-18
UMLFA Derived Oblique Factors (Independent Cluster Solution)[a]
$\underline{N}$ = 210 Girls

Test	Factors										
	1	2	3	4	5	6	7	8	9	10	11
1 PictMn					97						
2 VerbCl	51										
3 NumbSe	35										
4 RemClM							98				
5 NumClE				39							
6 WordGp											
7b											
8 Disvow	37			43		-33					
9 LetGrp					-35				68		
10 CirRea									33		
11 FigExc											34
12 SeeTnd									68		
13 PictCl						100					
14 ParaCp					54						
15 RemClN	69										
16 WdGpNm								80			
17 Gestal				36							30
18 CardRt		34			32	40					
19 SpatRl											86
20 VerbEx	54										
21 BestWC	67				35						
22 Omelet				83							
23 PictGN								92			
24 ConWrd				85							
25 PerSpd			65								
26 LetTri									50		
27 LetCla	47	43									
28 PictCM	50			-31							

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Table D-18. (Continued)

Test	Factors										
	1	2	3	4	5	6	7	8	9	10	11
29 Puzzle											
30 Spellg				56	32	-31					
31 PictEx						45			-32		
32 SensOr	72										
33 FigAna	38				-32						
34 ScramS	41								36		
35 SameOp	85										
36 FigMat		42									
37 Remote	42				32				43		
38 NumbEx		95									
39 SentOr	57	56							-38		
40 Vocab	52				64						
41 WordR1		34		48							
42 VerbAn											
43 BestTN											
44 PictAr				32	41				-43		
45 ArithP				89							
46 IdentP			67								
47 PicGNS					37						
48 NumbCl		84									
49 WordEx	-30	71									
50 NumbR1	-52			68		31					
51 WordLk	-33				50				70		
52 FigCla											
53 ClasNS										92	
54 NecAOp										35	
55 VerbA3					53						
56 RmClM3							48				

Correlations
of factors:

	1	2	3	4	5	6	7	8	9	10
2	75									
3	37	32								
4	83	72	39							
5	80	58	29	75						
6	74	71	33	67	65					
7	59	42	36	56	57	54				
8	76	63	27	70	72	62	54			
9	79	77	39	81	72	69	55	66		
10	68	65	22	61	64	57	37	54	64	
11	67	66	34	65	69	72	47	61	64	46

[a] Includes coefficients greater than .300 (absolute). Decimals have been omitted.

[b] Variable No. 7 was omitted from this analysis.

PICTURE MEANING (1)

This is a picture vocabulary test. The subject is given pictures of four things, e.g., a chair, a dog, a boat, and a bird, and is told to "find the dog." It is used in the Primary Mental Abilities (PMA) Thurstone, 4-6 test battery (1962) as a test to measure verbal meaning. Permission was received from the publisher, Science Research Associates, Inc., to reproduce this test for our research purposes.

Example:
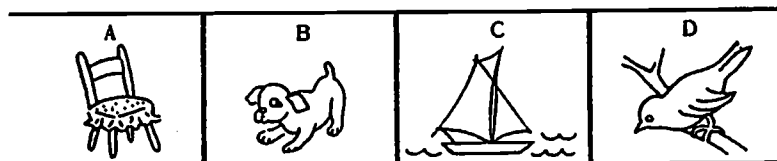
VERBAL CLASSIFICATION (2)

This test is our adaptation of Guilford's Verbal Classification test (which was adapted from Thurstone). We simplified the format for use with fifth graders and made it machine scorable. The subject is given four exemplars which belong to the same class. He is to infer the class and then choose, from three choices, another exemplar of that class.

Example: steak   A. egg
           milk   B. knife
           orange   C. dish
           onion

NUMBER SERIES (3)

This is a typical number series test in which exemplars forming a series are given and the subject must infer a quantitative rule and choose the number which would come next in the series from five choices which are given. The rule is based on addition, subtraction, multiplication, division, powers, roots, etc. It may be noted here that we experimented with the type where any one number in the series may be incorrect and the task is to find this one incorrect number. It was found that this type of number series item was too difficult for fifth graders.

Example: 7 8 9 10 ___   A. 7
                               B. 8
                               C. 10
                               D. 11
                               E. 12

REMEMBERING CLASSES: MEMBERS (4)

This test was suggested by Guilford's Remembering Classes test. His test calls for inferring and remembering class names. (Our test of this type is called Remembering Classes: Names.) For this test the subject studies 10 sets of three words. Immediately following the study period, he is asked to respond whether or not each of 20 sets of two words belongs to a class that was studied. Each set of two words contains one word from a studied set of three words. This was an attempt to make the task more a memory for classes than a memory for specific things studied. It was felt that this type of test may be a "remembering classes" test more than one which calls for inferring and then remembering a class name; the latter type may be more dependent on being able to name the class.

Example: chair
         desk
         bed

         A. chair   B. chair
             sofa   door

NUMBER CLASS EXTENSION (5)

This test was constructed to fill the "classification of things using number-semantic content" cell of the Cognition of Concepts schema. The test calls for inferring a class from four given numbers and selecting another exemplar of that class from three given choices.

Example: 3   A. 2
           9   B. 6
          12   C. 13
          21

WORD GROUPS (6)

This test is our adaptation of Guilford's Word Groups. We changed the format to make it machine scorable. The subject is given four words, using words as collections of letters or forms, and is asked to add an exemplar to that class from three given choices.

Example: ran   A. fat
         man   B. fan
         can   C. cat
         tan

REMEMBERING CLASSES: MEMBERS II (7)

This test is identical to Test 4, Remembering Classes: Members. It was administered at the end of the testing session which included Tests 4 through 7 without any further study of the material given. Thus, it is a second administration of Test 4 with two tests intervening.

DISEMVOWELLED WORDS (8)

This test is our adaptation of Guilford's Disemvoweled Words test. Words with blanks where vowels normally appear in the spelling of the word are given. The subject is asked to give the vowel which belongs in the blank.

Example: Y__S T__R D__Y
            1   2   3

82   GPO 826—617—4

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LETTER GROUPING (9)

This test is our adaptation of Guilford's Letter Grouping test. The test was originated by L. L. Thurstone. The subject is given four groups of three or four letters each. He is to infer a class and then choose the group which is different (does not belong to the class). This is an exclusion technique, selecting the nonexemplar, as opposed to a classification one of adding another exemplar.

Example: 1. AAA   2. BBB   3. CCC   4. ABC

CIRCLE REASONING (10)

This test is our adaptation of Guilford's Circle Reasoning test to make it appropriate for fifth graders. The subject is to infer a position rule for a darkened circle from four exemplars (rows of dashes and circles with one darkened circle) and to add another exemplar (darken the correct circle in a fifth row according to the rule). Guilford used 15 circles and dashes in each row of his test; we used seven.

```
Example:   ● - - - 0 0 0
           - ● - 0 0 0 -
           0 0 0 0 0 - ●
           - 0 0 - ● - -
           0 0 - 0 - 0 0
           1 2 3 4 5 6 7
```

FIGURE EXCLUSION (11)

Figure Exclusion is used by Guilford as a measure of CFC and in the PMA 4-6 test battery as a measure of Reasoning (Induction). Permission was received from the publisher, Science Research Associates, Inc., to reproduce the test. It is called Figure Grouping in the PMA battery. From four given figures, the subject infers a class and then chooses the one figure which is different (does not belong to that class).

Example:

| A | B | C | D |
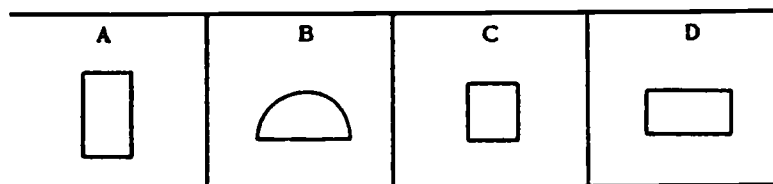
SEEING TRENDS (12)

This test is our adaptation of Guilford's Seeing Trends II test. The content of the test is word-form; words are used as collections of letters. Four exemplars are given. The subject infers a rule based on number of letters, alphabetic position of letters, etc., and places another exemplar in its proper serial position.

Example: six _____ five _____ fifty _____ one   (nine)
                   A   B   C

PICTURE CLASSIFICATION (13)

This test was constructed to parallel the Verbal Classification test using picture-semantic content instead of verbal-semantic; the purpose was to study the relationships of getting meaning

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from pictures and from words. Many of the items use the same exemplars as those used in the Picture Exclusion test to study the relationships between classification and exclusion type tasks without the confounding effects of specific content (exemplars). Pictures of three things which belong to a class are given. The subject is to infer the class and choose a fourth exemplar of that class.

Example:
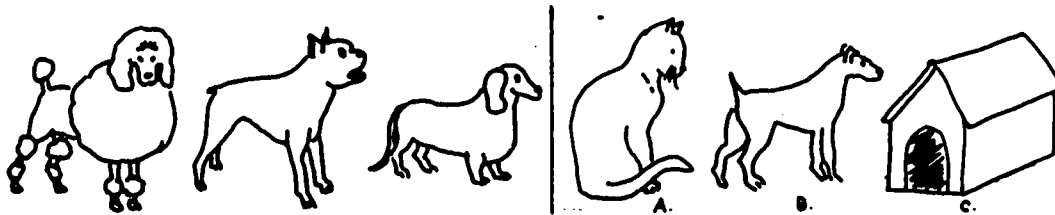
PARAGRAPH COMPREHENSION (14)

This test consists of selected passages and questions taken from the Grade 5 Reading Comprehension test of the Iowa Tests of Basic Skills (1964). Permission was received from the publisher, Houghton Mifflin Co., to reproduce this test.

REMEMBERING CLASSES: NAMES (15)

This test is our adaptation of Guilford's Remembering Classes test. The subject infers a class name for 10 sets of four words each and is to remember these class names. He is tested by being asked to recognize the 10 class names from among 10 other class names.

Example: dog
cat
horse
rabbit

1. animals

2. plants

WORD GROUP NAMING (16)

This test is our adaptation of Guilford's Word-Group Naming test. Four exemplars of a class are given and the subject must supply a name for the class. This is a free response type test and requires hand scoring or coding. It should be pointed out here that the exemplars given for many of the items of this test are the same ones as those given for many of the items of three other tests-- Picture Group Naming (23), Picture Group Name Selection (47), and Class Name Selection (53). The purpose of this was to study the relationships among producing and selecting a class name when the exemplars are given in verbal-semantic and picture-semantic content; the exemplars were held constant so knowledge of specific things would be held to a minimum as a confounding influence.

Example: poodle
terrier   are all _____
hound
collie

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GESTALT COMPLETION (17)

This is our adaptation of the Thurstone-Street Gestalt Completion test, which has also been used by Guilford. Portions of our test were taken from the Gestalt Completion Test--C-1 in the ETS Kit of Reference Tests for Cognitive Factors (1962). The test involves naming an object from a partially obliterated picture of it. This test must be hand scored or coded as the subject produces the answer.

Example:

CARD ROTATIONS (18)

This is the Card Rotations Test--S-1, Part I in the ETS Kit of Reference Tests for Cognitive Factors (1962). It involves determining whether figures representing the same card as a given one but with a different orientation are merely rotated or are mirror images of the card (have been turned over). The subject responds directly on the test page and the test must be hand coded or scored.

Example:
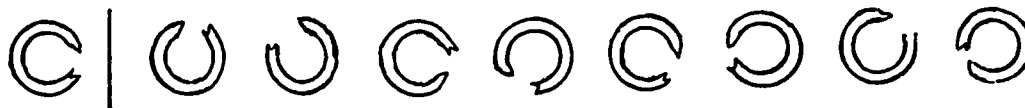
SPATIAL RELATIONS (19)

This is the Spatial Relations test from the PMA 4-6 test battery. It was reproduced for use by the CAA Project with permission of the publisher, Science Research Associates, Inc. From four choices the subject chooses the figure that would complete a given figure to form a square.

Example:
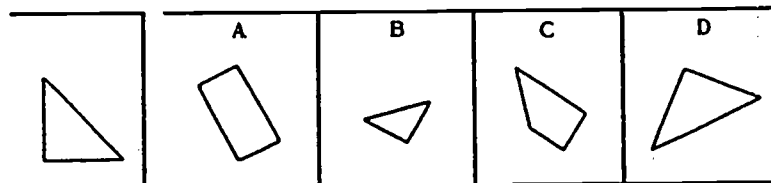
VERBAL EXCLUSION (20)

This is our adaptation of Guilford's Word Classification test. From four given words, three of which are exemplars of a class and one nonexemplar, the subject infers a class and picks out

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the nonexemplar.

Example: A. Sunday   R. Thursday   C. Yesterday   D. Wednesday

BEST WORD CLASS (21)

This is our adaptation of Guilford's Best Word Class test. One word is given and the subject is to give the best class name.

Example: OAK is a kind of   A. plant
                             B. bird
                             C. food
                             D. tree

OMELET (22)

This is our adaptation of Guilford's Omelet test. It is an anagrams test. Familiar words are given with the letters in a scrambled order and the subject is to write the word spelled correctly. This test requires hand coding or scoring.

Example: orf _____

PICTURE GROUP NAMING (23)

This is our adaptation of Guilford's Picture-Group Naming test. Four exemplars of a class are given in the form of pictures. The subject is to infer the class and supply a name for it. This is a free response type test and requires hand scoring or coding. As was pointed out before, the exemplars given for many of the items are the same ones as those used for three other tests.
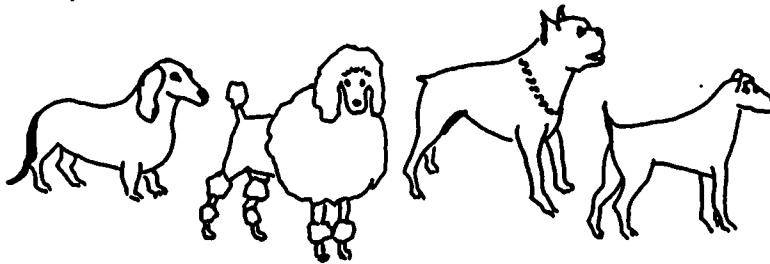
Example: are all:

_____

CONCEALED WORDS (24)

This is our adaptation of Thurstone's Mutilated Words test. Portions of our test were taken from the Concealed Words Test--Cs-2 in the ETS Kit of Reference Tests for Cognitive Factors (1962). The test involves the recognition and writing down of a partially obliterated word. The words used are all very familiar ones. This test requires hand scoring or coding.

Example: n⅃ꞮꞓꞮꞓꞇꞓ _____

PERCEPTUAL SPEED (25)

This is the Perceptual Speed test from the PMA 4-6 test battery (1962). It was reproduced for use in this study with the permission of the publisher, Science Research Associates, Inc. The test involves the circling of the two identical figures from four given figures. It was administered under speeded conditions; three minutes were allowed to complete 40 items.

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Example:

| A	B	C	D
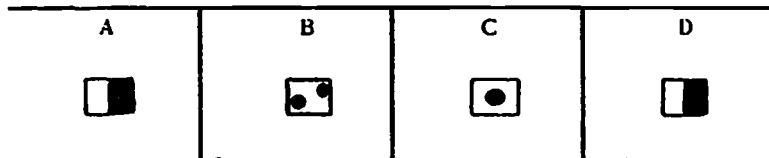
LETTER TRIANGLE (26)

This is our adaptation of Guilford's Letter Triangle test. Letters as members of the alphabet with ordinal position are presented in the form of a triangle with a blank appearing where one of the letters belongs. The subject is to find a spatial rule for the ordering of the letters and select, from three choices, the letter that belongs in the blank. Guilford used 15 letters and blanks in a five-row triangle in his test; we used five letters and one blank in a three-row triangle.

Example:

```
      _
   P  L            1.  O
                   2.  N
   F  H  J         3.  M
```

LETTER CLASSIFICATION (27)

This test was constructed to measure the ability represented by the "classification of things with letter-symbolic content" cell in the Cognition of Concepts schema. It was patterned after the Letter Grouping (9) test which is an exclusion type task for things with letter-symbolic content. The subject is to infer a class from three given exemplars and add, from three choices, a fourth exemplar to that class.

```
Example:   AAA        1.  ABC
           CCC        2.  DDD
           BBB        3.  AAB
```
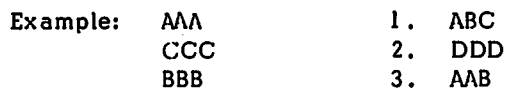
PICTURE CLASS MEMORY (28)

This is our adaptation of Guilford's Picture Class Memory test. The subject studies ten sets of three pictures each. The three pictures in each set are exemplars of a class. The subject infers the class, remembers it, and then judges whether or not 20 sets of two pictures each belong to a class that was studied. Each of the sets of two pictures to which the subject responds contains one picture from one of the sets which was studied. This was an attempt to make the test measure remembering of a class more than remembering specific exemplars of a class, which we felt might be more like remembering units (to use Guilford's terms).

Example:
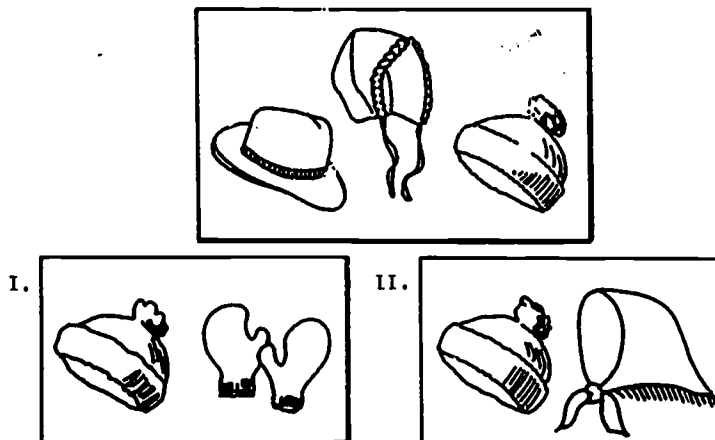
PUZZLES (29)

This is a syllogistic reasoning test and consists of selected items from the "Test of Logical Ability" (Hill, 1960).

Example: If Ann is at school then she is the leader today.
Ann is not the leader today.

Is Ann at school?

SPELLING (30)

This test consists of 30 selected items taken from the Grade 5 Spelling test of the Iowa Tests of Basic Skills (1964). These items were reproduced for use in this study with the permission of the publisher, Houghton Mifflin Co. The entire Grade 5 test consists of 43 items; we did not use the first six and the last seven of these. The subject is to select the misspelled word if there is one, or to select "no mistakes" if each of four words is spelled correctly.

Example: A. good
B. skool
C. book
D. jump
E. (no mistakes)

PICTURE EXCLUSION (31)

This test was constructed to parallel the Verbal Exclusion test using picture-semantic content instead of verbal-semantic content to study the relationships between getting meaning from pictures and getting meaning from words. As was discussed earlier, many of the items of this test use the same exemplars as those used in the Picture Classification test in order to study the relationships between the two tasks of classification and exclusion. Pictures of four things are given. Three of these belong to a class. The subject is to infer the class and choose the pictured object which does not belong to that class.

Example:

a   b   c   d
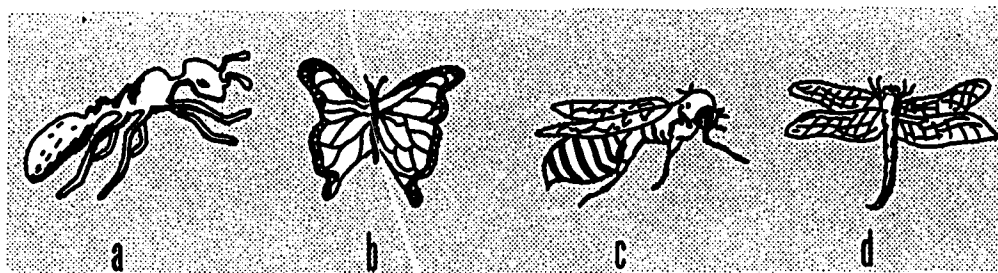
SENSITIVITY TO ORDER (32)

This is our adaptation of Guilford's Sensitivity to Order test. Four exemplars are given in their correct order with a fifth that is to be fit into this order in one of five places according to its proper serial position. Guilford gave five exemplars and asked that the order be rearranged if it was incorrect.

Example:

_____ Monday _____ Wednesday _____ Thursday _____ Friday _____ (Tuesday)
A   B   C   D   E

FIGURE ANALOGIES (33)

This is an analogies type test using figures rather than words. The test consists of 22 selected items from the 33 items of the Non-Verbal Test No. 3 of the Lorge-Thorndike Intelligence Tests (1964). These items were reproduced with the permission of the publisher, Houghton Mifflin Co. Items which contained pictures of things instead of figures and items which were of a series type, such as an increase in size of each succeeding figure, were not used.

Example:
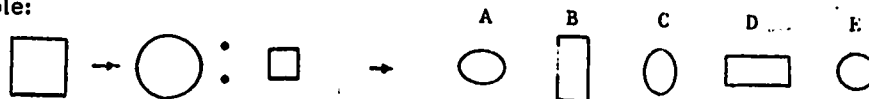
SCRAMBLED SENTENCES (34)

This test consists of short simple sentences (4 to 11 words) that are presented in a scrambled order. The subject is to rearrange the words to form a sentence and then decide whether the statement of the rearranged sentence is true or false. To make it more of a school learning achievement type of test, the content of the sentences was taken from the four subject matter fields being studied by the CAA Project: language arts, mathematics, science, and social studies.

Example: above grow ground flowers

> (When these words are correctly rearranged, do they make a true or a false statement?)

SAME-OPPOSITE (35)

Two words are given for each item. The subject is to decide whether the two words are the same or about the same in meaning or are opposite or about opposite in meaning.

Example: big. . . large

FIGURE MATRIX (36)

This test consists of 20 selected items from Guilford's Figure Matrix test. Permission was received from Sheridan Psychological Services, Inc. to reproduce the test. We did not use Guilford's Items 11; 12, 19, and 24. Three or more cells of a three-row and three-column matrix contain figures. The subject is to infer two spatial relations (across and down), combine them, and select from five choices the figure that belongs in the cell in the bottom right hand corner (the figure that fits the spatial relation conditions).

Example:

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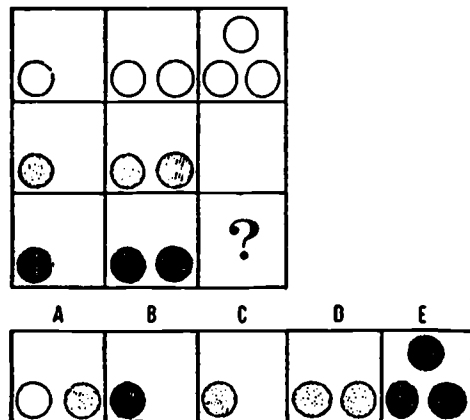
REMOTE CLASS COMPLETION (37)

This test consists of selected items from the "WADDLE" test (Warren & Davis, 1970). They were used with the permission of the developers. Three words are given and the subject is to produce a fourth word that goes with all three of the given words. The words all belong together in some way, but the class is a remote one. This test requires hand coding or scoring.

Example: right   fist   shake   _____

NUMBER EXCLUSION (38)

This test was constructed to parallel the Number Classification test but to require the task of exclusion instead of classification--it belongs in the "exclusion of things with number-symbolic content" cell in the Cognition of Concepts schema. Four exemplars, using numbers as symbols, are given. The subject is to infer a class and select the one exemplar that is incorrect for that class.

Example: A. 22   B. 55   C. 26   D. 33

SENTENCE ORDER (39)

This is our adaptation of Guilford's Sentence Order test. Three short and simple sentences which are in a random temporal order are given. The subject is to infer the proper order of events, arrange the three sentences in this order, and tell which sentence should come first and which sentence should come last.

Example: 1. Which sentence below should come first?

            2. Which sentence below should come last?

                A.   I bought some apples.
                B.   Mother sent me to the store.
                C.   I ate an apple on the way home.

VOCABULARY (40)

This test consists of 30 selected items taken from the Grade 5 Vocabulary test of the Iowa Tests of Basic Skills (1964). These items were reproduced for use by the CAA Project with the permission of the publisher, Houghton Mifflin Co. The entire Grade 5 test consists of 43 items; we did not use the first six and the last seven of these. The subject is to select a synonym for the underlined word in a phrase.

Example: a <u>tall</u> building

                A.   high
                B.   wide
                C.   low
                D.   new

WORD RELATIONS (41)

This is our adaptation of Guilford's Word Relations test. It is a multiple-choice analogies test with two pairs of words presented to determine the relationship instead of only one. The subject is to infer the rule and complete a third pair by choosing the answer from five possible choices.

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Example:	top – pot	A.	pet
		B.	tat
	tip – pit	C.	part
		D.	put
	tap – ___	E.	pat

VERBAL ANALOGIES (42)

This test consists of 24 items adapted from Analogy Questions (Gouber, 1967) with the permission of the publisher, Arco Publishing Company, Inc. Questions for 14 different types of relationships are included in the book; we used two items for each of 12 different types of relationships in the test. The types of relationships used were: action to object, association, antonym, cause and effect, characteristic, degree, object to action, part–part, part–whole, place, purpose, and sequence. We did not use grammatical and synonym types.

Example: HAND is to MAN as PAW is to   A. boy
                                               B. dog
                                               C. foot
                                               D. bird

BEST TREND NAME (43)

Permission was received from Sheridan Psychological Services, Inc. to reproduce Guilford's Best Trend Name test. We made a few minor changes in the test to make it more appropriate for use with fifth graders. We replaced Items 10, 14, 16, 18, and 20 with new items and we used easier words for two trend names—importance instead of prestige and usefulness instead of utility. The subject is to infer a trend and select the name of that trend.

Example: horse – push cart – bicycle – car   A. speed
                                                             B. time
                                                             C. size

PICTURE ARRANGEMENT (44)

This test is Guilford's adaptation of Dorothy C. Adkins' test which was adapted from the comic strip "Louie." Sets of four pictures from a comic strip are given in a scrambled order. The subject is to infer the sequence of events and arrange the pictures in the proper order. This test requires hand scoring or coding.
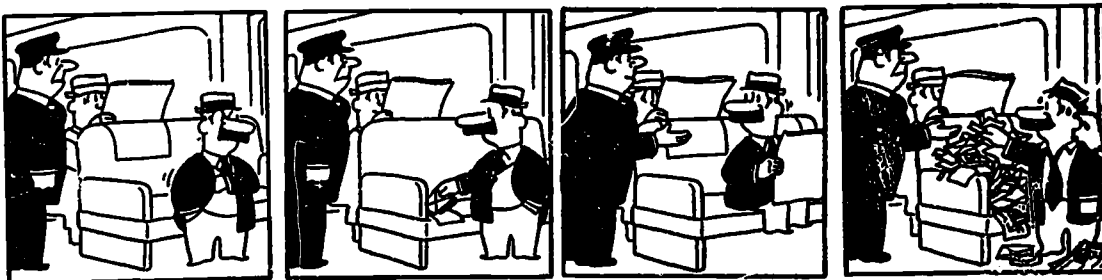
Example:

ARITHMETIC PROBLEMS (45)

This test consists of working arithmetic problems of the following types: addition and sub-

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traction of fractions and decimals, division, and multiplication. The test requires hand scoring or coding.

Examples:
$$\frac{4}{5} - \frac{3}{5}$$
2.7 + 1.1
$$7\overline{)21}$$
$$\begin{array}{r} 117 \\ \times\ 3 \\ \hline \end{array}$$

IDENTICAL PICTURES (46)

This is the Identical Pictures Test--P-3, Part II from the ETS Kit of Reference Tests for Cognitive Factors (1962). It is a highly speeded test which involves selecting a figure from five possibilities which is identical to a given one. This test requires hand scoring or coding.

Example:

PICTURE GROUP NAME SELECTION (47)

This test was constructed to complete the picture versus word and naming versus name selection group of tests in order to study these relationships. As previously mentioned, the other three tests are Word Group Naming (16), Picture Group Naming (23), and Class Name Selection (53). Three pictured exemplars of a class are given. The subject is to infer the class and select the best name for the class.

Example:
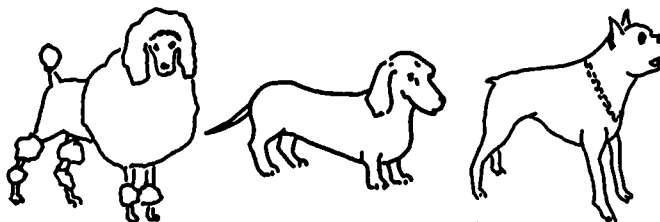
are all:

A. animals
B. brown animals
C. dogs

NUMBER CLASSIFICATION (48)

This is our adaptation of Guilford's Number Classification test. Numbers are used as symbols. The subject is to infer a class, according to the form or structure of the numbers, from three exemplars and select another exemplar of that class. We used the same format as Guilford, short matching sets, with the modification of only three items and five choices in a set instead of four items and five choices.

Example:

I.	21	24	27	A.	39
II.	79	89	19	B.	44
				C.	12
III.	22	33	55	D.	92
				E.	23

WORD EXCLUSION (49)

This test was constructed to measure the ability implied by the "exclusion of things of word-

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form content" cell in the Cognition of Concepts schema. From four words as collections of letters the subject is to infer a class rule and select the nonexemplar of the class.

Example: A. thought   B. tot   C. that   D. twirl

NUMBER RELATIONS (50)

This is our adaptation of Guilford's Number Relations test. Four exemplars which are pairs of numbers are given. The subject is to infer a quantitative rule for the relationship of the number pairs and select the exemplar which does not follow this rule.

Example: A.   3, 4
            B.   1, 2
            C.   4, 6
            D.   2, 3

WORD LINKAGE (51)

This is our adaptation of Guilford's Word Linkage test. Word pairs, with both words having a common double meaning are given. The subject is to select the common double meaning, i.e., a word that is related to both of the given words.

Example: airplane--insect   A.   fly
                                B.   passenger
                                C.   bug

FIGURE CLASSIFICATION (52)

This is a classification type test using figures. The test consists of 20 selected items from the Non-Verbal Test No. 1 of the Lorge-Thorndike Intelligence Tests (1964). These items were reproduced with the permission of the publisher, Houghton Mifflin Co. All 16 of the items from Levels B and C that were not serial in type, e.g., the exemplars increase in size, were used. To obtain 20 items we used the last two items from the preceding level and the first two items from the succeeding level. Three exemplars are given and the subject is to infer a class and select another exemplar of that class.

Example:

CLASS NAME SELECTION (53)

This is our adaptation of Guilford's Class Name Selection test. As discussed earlier, it is one of the four included in a group to study the relationships between getting meaning from words versus getting meaning from pictures and providing a class name versus selecting a class name. Four exemplars of a class are given and the subject is to infer the class and select the best class name.

Example: poodle   A.   animals
            terrier   are all   B.   dogs
            hound   C.   brown animals
            collie

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NECESSARY ARITHMETIC OPERATIONS (54)

This arithmetic reasoning type of test was originally used by Thurstone. It is the Arithmetic Reasoning test from the NLSMA Reports (1968) which was suggested by the Necessary Arithmetic Operations Test--R-4 from the ETS Kit of Reference Tests for Cognitive Factors (1962). A problem is given but the subject does not have to solve it; he is asked only to select the operations required for solving the problem.

Example: Jane's father was 26 years old when she was born. Jane is now 8 years old. How old is her father now?

     A. subtract
     B. divide
     C. add
     D. multiply

VERBAL ANALOGIES III (55)

This is Guilford's Verbal Analogies III test. Permission was received from Sheridan Psychological Services, Inc. to reproduce it. We changed nine of the distractors, one for each of nine items, to make the test more appropriate. Guilford says it is different from a typical verbal analogies test in that the alternative answers are close together in competition for completion of the analogy, thus making perceiving the right relationship the important feature in correctly answering the item.

Example: TRAFFIC : SIGNAL as RIVER : _____   A. bank
                                                       B. dam
                                                       C. canal
                                                       D. sand bags

REMEMBERING CLASSES: MEMBERS III (56)

This test is identical to Test 4, Remembering Classes: Members. It was administered as the last test in the battery without restudy of the material given. Thus, it is a third administration of Test 4 with three days intervening for boys and seven days for girls.

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